KARACHI METROPOLITAN CORPORATION

MUNICIPAL SERVICES DEPARTMENT

(CONTRACT MANAGEMENT)

TENDER DOCUMENTS

RATE RUNNING CONTRACT OF THE WORK OF REPAIR AND MAINTENANCE OF MECHANICAL SWEEPERS, TRACTOR MF-240 AND TRACTOR MF-385 (MPD) MS, KMC FOR THE YEAR OF 2015-16 (RE-INVITE)

Estimated Cost:-	**Offer Rate**	**Tender Cost:**	**Rs. 3,000/-**
Time Limit:-	**12 Months**	**Penalty**	**Rs. 3000/-**
To be Opened on:-	**07-12-2015**	**Validity of Tender:**	**90 Days**

Chief Engineer (CM)
Municipal Services, KMC

Tender Issued:

No: KMC/MS/CM/15/15-16

Issue to M/s. _____ **P.O / Challan No. _____**

_____ **Dated _____**

_____ **Bank: _____**

Signature & Stamp of Issuing Authority

KARACHI METROPOLITAN CORPORATION

OFFICE OF THE CHIEF ENGINEER (CONTRACT MANAGEMENT)

MUNICIPAL SERVICES DEPARTMENT

Room # 409, 4th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi

No. CE (CM)/MS/KMC/316/15 **Dated:02 -11-2015**

NOTICE INVITING TENDER

Tender in sealed covers are invited for the following work from reputable firms, having experience of similar nature work:

Sr.#	Tender Reference No.	Name of Scheme	Estimated Cost	Bid Security in shape of Pay Order or Bank Guarantee in favour of KMC	Tender Cost In shape of paid Challan in favour of KMC (Non-Refundable)	Eligibility Criteria
1	2	3	4	5	6	7
1.	KMC/MS/CM/ 13/15-16	Providing and Fixing Tires & Tubes for Fire Vehicles and Allied Vehicles for Fire Brigade Department, MS, KMC.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
2.	KMC/MS/CM/ 14/15-16	Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant supply.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
3.	KMC/MS/CM/ 15/15-16	Rate Running Contract of the work of Repair and Maintenance of Mechanical Sweepers, Tractor MF-240 and Tractor MF-385 (MPD) MS, KMC for the year of 2015-16. (Re-invite).	Offer Rate	Rs.8,00,000/-	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
4.	KMC/MS/CM/ 16/15-16	Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II).	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
5.	KMC/MS/CM/ 17/15-16	Remote Controlled Trailer Mounted Lighting Towers 04 Nos. for disasters & Fire Fighting Purpose for Fire Brigade Department.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
6.	KMC/MS/CM/ 18/15-16	Modification of Grab Crane increase of Boom with Hydraulically operated etc.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
7.	KMC/MS/CM/ 19/15-16	Refurbishment of Wheel Loader Model Lie Gong-856.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**

8.	KMC/MS/CM/ 20/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**
9.	KMC/MS/CM/ 21/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

TERMS & CONDITIONS

1. Tender schedule shall be as follows:

SCHEDULE	DATE & TIME	VENUE
1. Receiving of Application & Issuance of Tender	**From 12-11-2015** To **04-12-2015** During Office Hours	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
		Office of Director (Planning), F&A Department, 6th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
		Office of Deputy Director (Accounts), Administrator Secretariat, Karachi 1st Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
2. Dropping of Tender	**07-12-2015** at **2:00 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
3. Opening of Tender	**07-12-2015** at **2:30 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.

2. The tender documents will be issued to the firms on submission of application in their original letter head alongwith original paid challan in the prescribed account of KMC for tender cost as mentioned above. This challan can be obtained from the office of tender sale as mentioned in this NIT.

3. The tender in sealed cover superscripted with the name of work should be dropped in the tender box kept in the committee room of the office of Sr. Director (Municipal Services) KMC.

4. In case the date of opening declared as a public holiday by the Government, or Non working day due to force Majeure the next official working day shall be deemed to be the date for submission and opening of tenders at the same time.

5. **Substantially Responsive Bid:-**

   Only those bids, which comply with the each eligibility & minimum qualification criteria attached with the tender documents shall be declared substantially responsive bids and will be eligible for further evaluation, otherwise the same will be declared as non responsive / rejected.

6. Bid Security of bid amount in the form of a pay order or bank guarantee from any schedule bank should be enclosed with the tender which will be retained till finalization of the case.

7. Canvassing in connection with tenders is strictly prohibited and tenders submitted by the contractors who report canvassing will liable for rejection.

8. KMC may reject all or any bids or proposals at any time prior to the acceptance of a bid or proposals, subject to the relevant provisions of SPP Rules 2010.

Sd/=
Chief Engineer (CM)MS, KMC

BIDDING DATA

A	Name of Procuring Agency:	Karachi Metropolitan Corporation (KMC)
B	Brief Description of Work:	**RATE RUNNING CONTRACT OF THE WORK OF REPAIR AND MAINTENANCE OF MECHANICAL SWEEPERS, TRACTOR MF-240 AND TRACTOR MF-385 (MPD) MS, KMC for the YEAR 2015-16 (RE-INVITE)**
C	Procuring Agency Address:	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
D	Estimated Cost:	Offer Rate
E	Amount of Bid Security:	Rs.8,00,000/-
F	Period of Bid validity (Days):	90 Days
G	Security Deposit (i/c Bid Security):	(10 % of Quoted Amount)
H	Percentage, if any, to be deducted from bills:	(5% to be deducted from Running Bills)
I	Deadline for submission of bid along with time:	04-12-2015 (During Office Hours)
J	Venue, Time and date of Bid Opening:	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
K	Liquidity Damages:	
I	Deposit Receipt No. Date & Amount:	

KARACHI METROPOLITAN CORPORATION

Bank Deposit Challan

MUNCIPAL SERVICES DEAPRTMENT, KMC

The Manger,
Habib Bank Ltd,
KMC Branch

BANK CODE	0	1

BANK ACCOUNT NO.	2	6	0	4	-	5	7		

DATE

BRANCH CODE	0	0	1	5

BANK ACCOUNT CODE	5	7

BANK BRANCH Please receive the amount as noted below for credit to the account of KMC mentioned above and as specified here below:-

Depositor's Name & Address	Particulars (To be filled up by Department)	☐ Cheque / Pay Order / Demand Draft			Amount
		Name of Bank	No.	Date	Rs.
M/s	Deposit of tender Cost Fee for the work of RATE RUNNING CONTRACT OF THE WORK OF REPAIR AND MAINTENANCE OF MECHANICAL SWEEPERS, TRACTOR MF-240 AND TRACTOR MF-385 (MPD) MS, KMC For The Year 2015-16 (Re-Invite) Tender Enquiry # **KMC/MS/CM/15 /15-16** To be opened on 07-10-2015				3,000/-
		☐ **Cash Rs.**			
				Total	**3,000/-**

Rupees in Words **: -** **Three Thousand Only**

Note: It is valid if to be deposited on or before the last date of sale of tender as mentioned in the NIT or its corrigendum, if any. If the same are furnished on the given date of sale in the office of the tender issuing authority, the tender will be issued.

Bank Stamp

Signature Bank Cashier

Signature of Depositor

Signature with stamp
Accountant/Assistant Accounts Officer
Drawing & Disbursing Officer

Signature Bank Officer

CHALLAN NO.

PRICE SCHEDULES

SUBJECT: RATE RUNNING CONTRACT OF THE WORK OF REPAIR AND MAINTENANCE OF MECHANICAL SWEEPERS, TRACTOR MF-240 AND TRACTOR MF-385 (MPD) MS, KMC FOR THE YEAR 2015-16 (RE-INVITE)

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
A	**MECHANICAL SWEEPER.**				
1	P/F Brush right and left.(Round).	Each			
2	P/F Gutter Broom Rare.(Brush).	Each			
3	P/F Rear Mud Flap.	Each			
4	P/F Half Round Rubber Back side.	Each			
5	P/F Center Rubber Separator.	Each			
6	P/F Sprayer with Nozzle (as per sample.).	Each			
7	P/F Servicing & Maintenance of Brush/Motors.	Each			
8	P/F Coil in the Brushes for Motors.	Each			
9	P/F Hydraulic set seals in motors.	Each			
10	P/F Hydraulic pipes (as per sample) Big.	Each			
11	P/F Hydraulic pipes (as per sample) Short.	Each			
12	P/F Hydraulic pipes (as per sample) Medium.	Each			
13	P/F shocker set as required.	Each			
14	P/F Hydraulic Pump as per sample.	Each			
15	P/F Hydraulic Motor as per sample.	Each			
16	P/F Hydraulic filter as required.	Each			
17	P/F Control Pannel complete as per sample.	Each			
18	P/F Back motor coupling as required.	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
19	P/F of Excel as per sample.	Each			
20	P/F of Axcel bearing as required size.	Each			
21	P/F Hub as per sample.	Each			
22	P/F Tire 600-9	Each			
23	P/F Water Pump is same as old as required.	Each			
24	P/F Brush Drum(Rear).	Each			
25	P/F Brush Drum(Front).	Each			
26	P/F of Drum bearing as per old size & instruction of Engineer Incharge.	Each			
27	P/F of Drum sporting plate as per instruction of Engineer Incharge.	Each			
28	P/F of Hydraulic Centre Valve replace the old one as per instruction of Engineer Incharge.	Each			
29	P/F Emergency light as required.	Each			
30	P/F Emergency Siren complete in all aspect as per instruction of Engineer Incharge.	Each			
31	Providing and re-fixing the Indicator lights as req.	Each			
32	Repair/Maintenance Brush Drum(Rear).	Each			
33	Repair/Maintenance Brush Drum(Front).	Each			
34	Repair/Maintenance of Dust Bin as required.	Each			
35	Repair/Maintenance of Machine Frame as required.	Each			
36	Repair/Maintenance of P.T.O Pump replacement of P.T.O Pump Kit as required.	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
37	Repair/Maintenance of Machine front support jack as required.	Each			
38	Repair/Maintenance of Big Jack change of damages parts and refixing the same as required.	Each			
39	Repair/Maintenance of Small Jack change of damages parts and refixing the same as required.	Each			
40	Repair/Maintenance of Hydraulic tank after repair and refixing the same condition as required.	Each			
41	Repair/Maintenance of Water tank after repair and refixing the same condition as required.	Each			
42	Complete denting and painting body of the Mechnical sweepers & as per instruction of Site Engineer Incharge.	Each			
B	**TRACTOR MF 240**				
1	P/F Clutch plate as per sample.	Each			
2	P/F Pressure plate as per sample.	Each			
3	P/F Finger kit as required.	Each			
4	P/F Finger bolt as required size.	Each			
5	P/F Control valve as per sample.	Each			
6	P/F safety valve as per sample.	Each			
7	P/F Threads bearing as required size.	Each			
8	P/F Diesel filter.	Each			
9	P/F Oil filter.	Each			
10	P/F Air filter.	Each			
11	P/F Tapa spring as per required size.	Each			
12	P/F Ignition switch as required.	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
13	P/F Meter cable as per sample.	Each			
14	P/F Excilator cable as required.	Each			
15	P/F Pilot bearing as per size required.	Each			
16	P/F Water body fan as per sample.	Each			
17	P/F of Assembly complete.	Each			
18	P/F Tire 600-16	Each			
19	P/F Tire 12-4-11-28	Each			
20	P/F Battery 108 Amps.	Each			
21	P/F and testing hydraulic pump Assy. 3 way out let genuine.	Each			
22	P/F complete Engine block, Tracker MF 240 as required.	Each			
23	P/F Piston set as required size.	Each			
24	P/F Ring set as required size.	Each			
25	P/F Sleave set as required size.	Each			
26	P/F Gas kit Major as per sample.	Each			
27	P/F Valve set as per sample.	Each			
28	P/F Valve Guide set as required.	Each			
29	P/F Crank shaft as per sample.	Each			
30	P/F Cane shaft set as per sample.	Each			
31	P/F Cane shaft bush set as required.	Each			
32	P/F Connecting rod as per sample.	Each			
33	P/F Connecting rod bush as required.	Each			
34	P/F Oil pump as per sample.	Each			
35	P/F Fuel injector pump.	Each			
36	P/F Automizer as required.	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
37	P/F Automizer pipe as per sample.	Each			
38	P/F Fuel pump as per sample.	Each			
39	P/F Radiator top and bottom complete.	Each			
40	P/F Water body as per sample.	Each			
41	P/F Timing belt as per sample.	Each			
42	P/F Tuning gear as required.	Each			
43	P/F Gear box complete.	Each			
44	P/F Staring box complete.	Each			
45	P/F Front Suport as required.	Each			
46	P/F Tie rod end as per sample.	Each			
47	P/F Spendal front as per sample.	Each			
48	P/F Crown penin as per sample.	Each			
49	P/F Fly wheel as required.	Each			
50	P/F Oil Chamber as old size as required.	Each			
51	P/F Selancer complete.	Each			
52	P/F P.T.O pump as required.	Each			
53	P/F Hydraulic pump as required.	Each			
54	P/F P.T.O pump shaf as per sample.	Each			
55	P/F Four wheel gear as required.	Each			
56	P/F Hydraulic Control valve as required.	Each			
57	P/F Hydraulic pump kit as required.	Each			
58	P/F P.T.O Seal as required.	Each			
59	P/F Chilum seal as required.	Each			
60	P/F Axel Seal as required.	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
61	P/F Generator 12 Volts D.C. as required.	Each			
62	P/F Self complete as required.	Each			
63	P/F Lefty Pump as required.	Each			
64	P/F Stearing Jack seal as required.	Each			
65	P/F Stearing Pump complete as required.	Each			
66	Repair and Maintenance of Excel seal as required & as per instruction of Engineer Incharge.	Each			
67	Repair and Maintenance of Chillum seal as required & as per instruction of Engineer Incharge	Each			
68	Repair and Maintenance of P.T.O seal as required and as per instruction of Engineer Incharge.	Each			
69	Repair & Maintenance of Hydraulic pump kit as required & as per instruction of Engineer Incharge	Each			
70	Reapir & Maintenance of Hydraulic control valve as required & as per instruction of Engineer Incharge	Each			
71	Repair & Maintenance of Generator replacement of parts as required and complete in all aspect.	Each			
72	Repair & Maintenance of Lefty pump replacement of parts as required and complete in all aspect.	Each			
73	Repair & Maintenance of Four wheel Gear replacement of parts as required.	Each			
74	Repair & Maintenance of Break booster complete in all respect as required as per site Incharge.	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
75	Repair & Maintenance of Shawls Jack replacement Parts as required and complete in all respect.	Each			
76	Repair/Maintenance Jack seal kits and hydraulic pipe as required complete in all respect as required.	Each			
77	Repair & Maintenance of Stearing jack seal as per instruction of Engineer Incharge.	Each			
78	Repair & Maintenance of Stearing pump as required as per instruction of Engineer Incharge.	Each			
79	Replacement of existing sprocket chainsby new one as required as per sample.	Each			
80	Steering clutch box repair i/c P/F leather both side of plate and disc plate phasing left right.	Each			
81	Self repair and servicing, self starter assy. 12 volts heavy duty replacement of worn out carbon brushes field coil commentator etc complete.	Each			
82	Complete Engine overhauling by providing fixing of worn-out parts and machine works only labours.	Each			
83	Fuel injection pump servicing repairing and calibration with change of injector nozzle complete	Each			
84	Complete denting and painting body of the Tractor and as per instruction of Site Engineer Incharge.	Each			
C	**TRACTOR MF 385**				
1	P/F Clutch plate as per sample.	Each			
2	P/F Pressure plate as per sample.	Each			
3	P/F Finger kit as required.	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
4	P/F Finger bolt as required size.	Each			
5	P/F Control valve as per sample.	Each			
6	P/F safety valve as per sample.	Each			
7	P/F Threads bearing as required size.	Each			
8	P/F Diesel filter.	Each			
9	P/F Oil filter.	Each			
10	P/F Air filter.	Each			
11	P/F Tapa spring as per required size.	Each			
12	P/F Ignition switch as required.	Each			
13	P/F Meter cable as per sample.	Each			
14	P/F Excilator cable as required.	Each			
15	P/F Pilot bearing as per size required.	Each			
16	P/F Water body fan as per sample.	Each			
17	P/F of Assembly complete.	Each			
18-A	P/F Tire 600-16	Each			
18-B	P/F Tire 1000-20	Each			
19	P/F Tire 18-4-15-30	Each			
20	P/F Battery 108 Amps.	Each			
21	P/F and testing hydraulic pump Assy. 3 way out let genuine.	Each			
22	P/F complete Engine block, Tracker MF 240 as required.	Each			
23	P/F Piston set as required size.	Each			
24	P/F Ring set as required size.	Each			
25	P/F Sleave set as required size.	Each			
26	P/F Gas kit Major as per sample.	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
27	P/F Valve set as per sample.	Each			
28	P/F Valve Guide set as required.	Each			
29	P/F Crank shaft as per sample.	Each			
30	P/F Cane shaft set as per sample.	Each			
31	P/F Cane shaft bush set as required.	Each			
32	P/F Connecting rod as per sample.	Each			
33	P/F Connecting rod bush as required.	Each			
34	P/F Oil pump as per sample.	Each			
35	P/F Fuel injector pump.	Each			
36	P/F Automizer as required.	Each			
37	P/F Automizer pipe as per sample.	Each			
38	P/F Lefty pump as per sample.	Each			
39	P/F Radiator top and bottom complete.	Each			
40	P/F Water body as per sample.	Each			
41	P/F Timing belt as per sample.	Each			
42	P/F Tuning gear as required.	Each			
43	P/F Gear box complete.	Each			
44	P/F Staring box complete.	Each			
45	P/F Front Suport as required.	Each			
46	P/F Tie rod end as per sample.	Each			
47	P/F Spendal front as per sample.	Each			
48	P/F Crown penin as per sample.	Each			
49	P/F Fly wheel as required.	Each			
50	P/F Oil Chamber as old size as required.	Each			
51	P/F Selancer complete.	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
52	P/F P.T.O pump as required.	Each			
53	P/F Hydraulic pump as required.	Each			
54	P/F P.T.O pump shaft as per sample.	Each			
55	P/F Four wheel gear as required.	Each			
56	P/F Hydraulic Control valve as required.	Each			
57	P/F Hydraulic pump kit as required.	Each			
58	P/F P.T.O Seal as required.	Each			
59	P/F Chilum seal as required.	Each			
60	P/F Axel Seal as required.	Each			
61	P/F Generator 12 Volts D.C. as required.	Each			
62	P/F Self complete as required.	Each			
63	P/F Brake Booster as required.	Each			
64	P/F Finger Four wheel seal as required.	Each			
65	P/F Shawal Jack as required.	Each			
66	P/F Stearing Jack seal as required.	Each			
67	P/F Stearing Pump complete as required.	Each			
68	Repair and Maintenance of Excel seal as required & as per instruction of Engineer Incharge.	Each			
69	Repair and Maintenance of Chillum seal as required & as per instruction of Engineer Incharge	Each			
70	Repair and Maintenance of P.T.O seal as required and as per instruction of Engineer Incharge.	Each			
71	Repair & Maintenance of Hydraulic pump kit as required &	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
	as per instruction of Engineer Incharge				
72	Reapir & Maintenance of Hydraulic control valve as required & as per instruction of Engineer Incharge	Each			
73	Repair & Maintenance of Generator replacement of parts as required and complete in all aspect.	Each			
74	Repair & Maintenance of Lefty pump replacement of parts as required and complete in all aspect.	Each			
75	Repair & Maintenance of Four wheel Gear replacement of parts as required.	Each			
76	Repair & Maintenance of Break booster complete in all respect as required as per site Incharge.	Each			
77	Repair & Maintenance of Finger Four wheel seal as per instruction of Engineer Incharge.	Each			
78	Repair & Maintenance of Shawls Jack replacement Parts as required and complete in all respect.	Each			
79	Repair/Maintenance Jack seal kits and hydraulic pipe as required complete in all respect as required.	Each			
80	Repair & Maintenance of Stearing jack seal as per instruction of Engineer Incharge.	Each			
81	Repair & Maintenance of Stearing pump as required as per instruction of Engineer Incharge.	Each			
82	Replacement of existing sprocket chains by new one as required as per sample.	Each			
83	Steering clutch box repair i/c P/F leather both side of plate and disc	Each			

Sr.#	Description	Unit	Rate in Figure	Rate In Word	Amount
1	2	3	4	5	6
	plate phasing left right.				
84	Self repair and servicing, self starter assy. 12 volts heavy duty replacement of worn out carbon brushes field coil commentator etc complete.	Each			
85	Complete Engine overhauling by providing fixing of worn-out parts and machine works only labours.	Each			
86	Fuel injection pump servicing repairing and calibration with change of injector nozzle complete	Each			
87	Complete denting and painting body of the Tractor and as per instruction of Site Engineer Incharge.	Each			
Total Amount Quoted					

Checked & Verified by:

I/We quoted the price schedule and bound ourselves to comply all terms and conditions of this contract with all existing rules and regulations of KMC and I have attached an Earnest Money in shape of Pay Order / Bank Guarantee _____ No. _____

(Pay Order / Bank Guarantee)

Dated_____ issued from _____

Amounting Rs.8,00,000/- in favour of Karachi Metropolitan Corporation (KMC).

We / I read the standard Bidding Documents (Volume-I) available in SPPRA / KMC WEB site and agreed to abide all of them and also provide all these documents with our signature as & when directed

Signature of Bidder with Stamp

RATE RUNNING CONTRACT OF THE WORK OF REPAIR AND MAINTENANCE OF MECHANICAL SWEEPERS, TRACTOR MF-240 AND TRACTOR MF-385 (MPD) MS, KMC FOR THE YEAR 2015-16 (RE-INVITE).

SPECIAL CONDITION OF CONTRACT IN ADDITION TO GENERAL TERMS & CONDITION AS PER EXISTING CONTRACT / RULES

GENERAL

a) All existing terms & condition of KMC along with NIT will be applicable.

b) The tender is base on Annual Rate Running Contract. The lowest bidder will be those who will be lowest on maximum items (Value wise) and agreed to execute the remaining item on the other lowest quoted bid. Otherwise KMC will have the right to accept the bidder quoted bid wise, if technically possible.

c) The rate quoted & accepted by the successful bidder shall be valid for 12 months.

d) A letter of Acceptance will be issued to the lowest bidder. The work order will be issued on work to work basis after execution of agreement for this specific job with the approval / sanction and budgetary position during 12 months period. The bidder will enter into an principal agreement for their all selected items for their acceptance to execute the agreement & work as and when asked by KMC.

e) The bidder shall assure to execute work within the specified period as mentioned in the work orders issued time to time.

f) The bidder shall ensure that the work if of high class standard / certified and upto the satisfaction of the Engineer Incharge, Karachi Metropolitan Corporation.

g) Alternate bid / proposal is not acceptable.

h) Bid security will as per NIT and shall be attached along with the bid in the shape of pay order / Bank Guarantee from any scheduled Bank of Pakistan.

i) Time limit: 12 Months (Items wise as & when needed)

j) Penalty Rs.10,000/- per day on delay as per time limit given in each work order issued.

k) The quantity or item can be deleted / reduced / increased as per requirement during execution of work.

PERFORMANCE SECURITY: -

i. The contractor will furnish a pay order / bank guarantee of Rs.8,00,000/- at the time of issuing of Acceptance letter as mentioned above as part of the Performance Security which will be released after 12 months of receiving the letter of acceptance.

ii. An amount equal to 10% will be deducted for each bill 5% of this deduction which will be called retention money will be released after expiration of defect liability period / warranty period as mentioned in work order which will be issued time to time whereas the remaining 5% will be refunded along with the performance gurantee submitted with the acceptance letter.

Signature of Bidder with Stamp

Eligibility Criteria

The evidence / documents for the following minimum qualification / eligibility will be checked during opening process of tender & if anyone is missing then the tender will be summarily rejected at the moment by the tender opening committee.

PART-A: Eligibility Criteria

- Having Experienced in relevant field.
- NTN Certificate.
- Valid Professional Tax.

PART-B:
Minimum Qualification Criteria

i). Bid Security, as mentioned in the NIT & Bidding Documents, is furnished.

ii). All rates quoted including the total amount of the bid shall be in figures & words (both).

iii). All corrections / overwriting shall be clearly re-written with initials & duly stamped by the bidder.

iv). The bid shall be properly signed, named & stamped by the authorized person of the firm and authorization letter for signatory shall be enclosed with the tender by the authorized person, if other than the signatory of the firm.

v). Evidence of workshop facilities either on ownership basis or rental with proof of ownership of at least 04 types of workshop machinery (meant for maintenance of the machinery as mentioned in the tender)

vi). The minimum turn over / work experience of similar nature works with satisfactory completion report in last 02 years and their aggregate cost should be equal to the work cost in which bidder interested to participate. The bidder may include, but not more than 40% of the required limit of turn over, in hand works of similar nature works.

Those bids which will meet all Eligibility & Minimum Qualification Criteria shall be declared as "Substantial Responsive Bidder" and their bids will be allowed for its technical evaluation as per bid documents. Those bids which will be substantially responsive & will meet the minimum technical specification will be declared as "Responsive Bid".

Signature of Bidder with Stamp

KARACHI METROPOLITAN CORPORATION

MUNICIPAL SERVICES DEPARTMENT

(CONTRACT MANAGEMENT)

TENDER DOCUMENTS

DEVELOPMENTS OF ENGINEERED SANITARY LANDFILL SITE FOR MUNICIPAL SOLID WASTE FOR GONDPASS LANDFILL SITE

Estimated Cost:-	**Offer Rate**	**Tender Cost:**	**Rs. 3,000/-**
Time Limit:-	**12 Months**	**Penalty**	**Rs. 3000/-**
To be Opened on:-	**07-12-2015**	**Validity of Tender:**	**90 Days**

Chief Engineer (CM)
Municipal Services, KMC

Tender Issued:

No: KMC/MS/CM/21/15-16

Issue to M/s. _____

_____

_____

P.O / Challan No. _____

Dated _____

Bank: _____

Signature & Stamp of Issuing Authority

Section –I introduction

Location

Karachi is located at latitude 24° 48 N and longitude 66° 59 E. The urban sprawl starts from the westernmost mouth of the River Indus and goes up to the mountains and hills that form the southernmost edges of the Kirthar Mountain Range. The Arabian Sea is the southern boundary of the city.

Geography

Karachi is mostly made up of flat or rolling plains with hills on the western and northern boundaries of the urban sprawl. Two rivers pass through the city the Malir River (north cast to center) and the Lyari River (north to south). Many other smaller rivers pass through the city as well with general drainage being from the western and northern areas towards the south. The Karachi harbour is a protected bay to the south west of the city. The harbour is protected from storms by Keemari Island. Manora Island and Oyster Rocks, which together block the greater part of the harbour entrance in the vest. The southern limit of the city is the Arabian Sea and forms a chain of beautiful sandy beaches.

Government

Karachi as a city is governed by the Karachi Metropolitan Corporation (KMC). The KMC has an elected city council that looks after the working of the KMC.

The city district of Karachi is divided into 06 District. These District names are as follow:

1. District Central
2. District West
3. 3. District East
4. District South
5. District Malir
6. District Korangi

Demographics

Karachi's current population is estimated to be about 20 million. A much larger figure than it was in 1947 (400,000). The city's population has grown at a very enormous rate. So much so that no it is one of the largest cities in the world. The 16th Largest.

The breakup of Karachi's population is as under. Men form 53.7% of Karachities. 37.6% of us are under the age of 15. 4.4% of us are older than 50. 70.1% of us arc literate. 22.1% of us are migrants from other places.

Area:

Karachi is spread over a vast area of about 450 sq. km.

1.2 Municipal Waste Management Situation in Karachi

The population of Karachi produces around 12000 tons of municipal garbage / day out of which about 40% is disposed off to landfill Sites by the present set-up of Solid Waste Management Department of EX-TMA.

At present, there are a large number of scavengers operating in Karachi which collect about 100 kg/each of recyclable materials like paper, glass, ferrous waste, plastic bottles etc..

In most parts of Karachi there is Communal Collection of Waste. Large containers ranging from 5 cubic yards to 30 cubic yards are placed at any available spot. Mostly these containers are full and overloading. The picking is mainly done at these spots.
Karachi's households may be divided as follows:

- High Income Group: With low population density. From 500 sq. yards plots to 2000 sq. yards plots.

- Middle Income Group: With medium population density. From 200 sq. yards plots to 500 sq. yards plots and high rise buildings.
- Low Income Group: 80 yards plots to 100 yards plots.
- Peri-urban. or informal housing areas.
- Old City Areas with narrow streets and heavy traffic congestion
- Commercial Areas with high rise buildings, shops and offices.

At present, there is a fraction of door to door collection in small societies/areas where certain groups are operating with small carts and collecting Rs. 50-100 per household depending on the area served. Mostly NGOs are trying to perform this service. At present there is no organized commercial company providing such services except in Clifton Cantonment Board and Defense Housing Society. The DHA has given a contract to a private company.

Waste Recycling is a major un-organized industry in 'Karachi. Materials like paper, card boards, packing materials, glass bottles, plastics. Ferrous items, bones are collected either from the producers or from the communal garbage dumps. The yard waste and kitchen waste is usually thrown on the street sides to rot and produce bad smell, attract vermin and cause unhealthy and ugly esthetics.

1.3 Existing Facility

Landfill site Gond Pass = 500 Acres

ACTION PLANT

The department is carrying out the "SEMI AEROBIC, Fukuka Method of Japan" Land Filling selecting 40 Acres out of 500 of landfill site for 01 year.
The department carrying out Gas ventilating pipe on the One going Land Fill Site.

SECTION-II- INSTRUCTION TO CONTRACTORS

2.1 Purpose for Contracting out SWM

The purpose of this document is to invite reputed and experienced Waste Management Firms to submit their bids for Providing of Services for Construction & Operation of Landfill according to Scope of Work as mentioned in Section-IV (A&B) for a period of I year. The scope of work is according to modem technology of "Fukuka Semi Aerobic Method" of Japan for Land filling Site.

2.2 Communication Regarding Tender

All intended Contractors interested in participating in the project may reach the following officer either in person or through written correspondence:

Director (Solid Waste Management)

Old KBCA Building KBCA officer club civic center Karachi
PH # 992301341-2

2.3 Evaluation Criteria

The successful bidder should have full fill the following criteria:

a) Experience in operation and maintenance of landfill site.
b) 2% Earnest Money of quoted rate on the basis on 1500 ton / day.
c) The contractor should quote the rate as follows:

   i) Per Ton tipping fee up to 1000 Tons per Day.
   ii) Per Ton tipping fee from 1001 Tons per Day and More.

The rate of the contractor will be considered for the average rate / per ton of the above & (ii)

2.4 Validity of Bids

Contractors should state in writing and confirm that all furnished information, including unit cost and prices will remain valid for a period of 120 days from the date of opening of the bids.

2.5 Supporting Documents

All supporting documents submitted by the contract will become the property of the government and none of the documents will be returned to successful or unsuccessful bidders. The document is to be submitted along with bid with stamp and signature of the bidder on each page.

2.6 References

The Contractor shall include any reference of their previous work carried out in the similar field.

SECTION — III — Additional Terni's & Conditions

3.0 Address for Notices

Concessionaire shall indicate in the space provided, their fill and proper address at which notice may be legally served on them and to which all correspondence in connection with this tender and contract to be sent.

3.1 No Alteration / Addition in Bill of Quantities / Schedule of Item of works and Terms of the Contract.

No alteration or addition shall be made by the Contractor in schedule of quantities/item of works and terms of the contract. The rates must be filled in ink or typed out, both in figures and words clearly. All corrections must be initialed by the Bidders. Any tender which does not comply with the condition will be liable to summarily rejected and will not be considered.

3.2 Increase or Decrease in Cost

Concessionaire attention is drawn to the fact that there is no provision in the contract for variation in contract price in respect of any rise or fall in the cost of labour. material or on tools, equipments, machinery if required or any other matter effecting the cost of works due to national or provincial ordinance or Law or any other Regulation or Bylaws of arty local or other duly constituted authority or otherwise, except as mentioned in clause 6.4.

3.3 Organization Chart of Concessionaire

The Concessionaire shall submit an organization chart of the supervisory staff and workers which he proposes to employ for the execution of work.

3.4 Labour Cost

Concessionaire must estimate and determine for themselves what wage rate they will have to pay to secure the workers and supervisory staff they will require for the performance of the contract, there is no provision in the contract for escalation in contract price due to fluctuation of labour wage rates as a result of Government statutes ordinance and decree or otherwise.

Concessionaire are also advised to study the Labour Laws of Pakistan and Pak P.W.D. Contractors Labour Regulations.

The Contractor shall be responsible for compliance of provision of payment of wages Act and Rules made by the Government and for payment of compensation, which may became payable under worker-men's compensation act of under any other Law prevailing in the country.

3.5 Period of Contract

The contractual period shall be Twelve (12) months starting from the date of hand over the site or the date of start mentioned in the work order extendable to further period with mutual consent without prejudice to the terms and conditions of the contract.

3.6 Work during Holidays in Emergency

The contractor shall made special arrangement for performing works under the contract on all gazetted holidays and in emergency on written directives of CDGK.

3.7 Contractor's failure To Start To Work

If the Contractor fail to start the work from the date specified in the work order, the earnest money will forfeited and the work will be treated as cancelled.

3.8 Decision of Authority and Dispute

Notwithstanding anything to the contrary contained herein, all dispute, controversies or deficiencies which may arise between the Incharge Officer. KMC and the Contractor or in relation to or in connection with this contract except to any matter the decision of which is specially provided for herein, the matter in dispute shall be referred to Mayor / City Nazim KMC has decision shall be final and binding on both the parties.

3.9 Work Schedule / Programme

Maximum operation of Solid Waste Management Activities will be performed at night.

3.10 Arrangement of Water

The Contractor should make his own arrangement of water if required for execution of work and as well as for drinking purposes.

3.11 Taxation

The rate and prices in the tender submitted by the Contractor shall include all business taxes income taxes and other taxes that may be levied according to the Laws and Regulations is being prior to the closing date for submission of tenders on the equipment. Machinery required for the purpose of the contract and on the services performed tinder the contract. Nothing in the contract shall relieve the Contractor from his responsibilities to pay any taxes that may be levied on the profit made to him in respect of contract.

3.12 Tender Validity

Tender shall remain valid and open for acceptance for a period of one hundred and twenty (120) calendar days after opening offender

3.13 13 Earnest Money & Security Deposit

The total amount of security deposit shall be 10% (Ten Percent) of contract price approved by the Employer, including 2% earnest money. The tender must be accompanied with an earnest money equal to 2% of contract prices in Pakistani

Rupees in the following shape of Bank draft / Pay Order / Bank Guarantee drawn on any approved scheduled bank in Karachi payable to CDGK

The 8% retention money will be deducted from each running bills submitted by the successful Contractor during the period of contract.

3.14. Refund of Security Deposit

The security deposit shall be refundable after three months of the completion of work contract to the satisfaction of authority and after issuance of completion certificate by the authorized Incharge Officer of the Contract.

3.15 Tender to be non responsive without 2% Earnest Money

Any tender which is not accompanied with required Earnest Money of (2% Bid Price) in the shape described above will be rejected as non-responsive.

3.16 Income Tax clearance Certificate

The Contractor shall have to produce income tax clearance certificate before entering into contract and prior to execution of agreement.

3.17 Professional Tax Clearance Certificate

The Contractor shall be required to produce professional Tax Clearance Certificate before entering into contract agreement.

3.18 Termination of Contract

The City Dist. Government Karachi shall have the option for terminating the contract without giving any reason at any time by serving written Notices of
30 days. However in case of termination of contract by KMC wherein Contractor is not at fault the security deposit shall be refunded to Contractor after three months from the date of such termination. No claim of Contractor shall be entertained by KMC in this regard.

3.20 Concessionaire to Carefully Examine Documents

The Concessionaire is expected to examine carefully all instruction, terms and conditions in the tender documents. Failure to comply with the requirements of the tender submission will be at the Contractor's own risk. Tenders, which are not substantially responsive to the requirements of Tender Documents, will be rejected.

3.21 Award Criteria

Employer may award the contract to the tender whose tender has been determines to be substantially responsive to the tender documents and who has offered the lowest evaluated tender price, provided further that the Concessionaire has the capability and resources to carry out the contract effectively.

3.22 Disorderly Conduct (etc.)

The Contractor shall at all times take all reasonable precautions to prevent any Lawful Riotous or disorderly conduct by or amongst his employees and for the preservation of peace and protection of persons and property in neighborhood of the work.

3.23 Employment of Persons in Services of others

The Contractor shall not recruit or attempt to recruit his staff and labour from amongst persons in service of Employer.

3.24 Tender Amount to Be Quoted In Figures As Well As IN Words

The Concessionaire should quote the tender amount in figures as well as in words in English Language clearly.

3.25 Each Page of Tender Document should be signed by the Concessionaire

The Concessionaire should sign each page of the tender Documents as Well as corrections and over writing in the form. Schedules of quantities etc., before submitting his tender.

3.27 Employer's Right to accept any Tender and to reject any or all Tenders

The Employer's reserves the right to accept any tender, or reject any/all tenders an any time prior to award of contract without notice thereby without incurring liability to the effected tenders or Concessionaire or any obligations to inform the effected tenders or tender of ground for Employer's action.

3.28 Rates to included of all incidental charges

The Tender rate shall be inclusive of all incidental charges in connection with the work.

3.29 Shift Pattern of Contractor's Staff! Workers and Time allowed to carry out the Work

Shift pattern of Contractor Staff! Workers and Time allowed to carry out the work and detail program of work shall be submitted by the Contractor for approval of Employees. Timing of work and shift pattern is the essence of the contract. The maximum activities regarding SWM should be performed in Night Time.

3.30 Expiry of the Contract and Employers Directives

Unless otherwise directed, the Contractor shall continue to work at the same rates and on same terms and conditions of contract till such time arrangements are made by the Employer for fresh contract and award of further work even after expiry of present contract.

3.31 Contractor Not to Leave the Work before stipulated period of Contract

In the event Contractor leaves the work before stipulated period of contract, the security deposit shall be for forfeited in favour of CDGK.

3.32 Contractor's General Responsibilities

The Contractor shall at all time responsible with due care and diligence to execute the operation of land fill area under contract as defined in the scope of work and for making all necessary arrangements for the fulfillment of the work to the entire satisfaction of the Employer, the Contractor shall be fully responsible for payment of wages, allowances, right(s). Facility, liability or benefit to its employees deployed at this contract as per applicable rates, KMC shall not in any way accept the liabilities of the Contractor.

3.33 Contract Agreement

The Contractor shall if called upon so to do, enter into contract and execute the contract agreement to be prepared and completed at the cost of Contractor, including cost of Stamp Paper Duties etc. as per rule, will be paid by Contractor.

3.34 Contractor's Superintendence

The Contractor shall provide all necessary superintendence during execution of work and as long thereafter as the Officer Incharge may consider necessary for the proper fulfilling of Contractor's obligations under the contract. The Contractor or his competent authorized representative approved by the City District Government Karachi (which approval may at any time be withdrawn) shall give his whole time to the superintendence of the work such authorized representative shall receive on behalf of the Contractor, instructions from the Incharge Office.

3.35 KMC to Object

The KMC shall be at liberty to object to and require the Contractor to remove forthwith from the works any person provided by the Contractor, who in the opinion of KMC misconducts himself, or is incompetent or negligent in proper performance of his duties or whose presence on site of work is otherwise considered by KMC to be undesirable, and such person shall not again allowed upon the works without the consent of KMC. Any persons removed from the work shall be replaced as soon as possible.

3.36 Identification of workers of the Contractor.

For the purpose of identification, and security Contractor, shall issue proper identity cards, jackets, caps etc. to all of its employees who may be detailed to work within the area under contract, if any employee of the Contractor is found without identity card, jacket, cap etc. a penalty Rs. 25/- per person per day will be imposed and deducted from monthly bill of the Contractor.

3.37 Contact on the basis of Tonnage

The contractor should quote the rate as follows:

i) Per ton tipping fee up to 1000 Tons per day.

ii) Per ton tipping fee from 1001 Ton per day and more.

The rate of the contractor will be considered for the average Rate! Ton of the above i , ii& iiiper day.

3.38 Emergency and Contractor Recourses at the Contract

In case of emergency Contractor resources, (sanitary works equipment and machinery detailed at the contract) may be utilized on the directives of KMC to some other areas beyond the contract limits, and the same may be adjusted without any additional cost and the Contractor shall be bound to do so.

3.40 Bill to be submitted by Contractor on Fortnightly Basis

The Contractor shall be required to submit its bill on Fortnightly basis, which shall be checked, scrutinized for the fulfillments of Contractor obligation under contractor and shall be paid after verification of Incharge Officer and approval of authority.

SCOPE OF WORK

Landfill Method

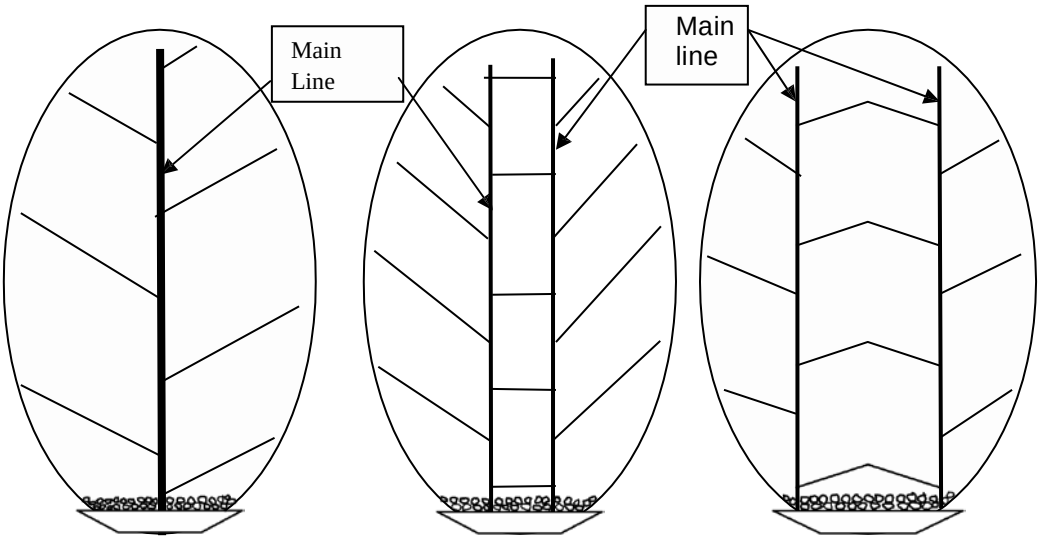
Area Method

The area method is used when the terrain is unsuitable for the excavation of trenches. Earth dike with a height of one lift (2-3m) is first constructed to get the support for compaction. The wastes are unloaded at the toe of the earth dike and spread and compacted on the slope of the dike in a series of layers that vary in depth from 30 - 60 cm. The recommended slope of these layers is 1 to 3. The width of the working face should be as narrow as possible to confine the waste to the smallest possible area but at the same time it should be wide enough to give necessary maneuverability to bulldozers. At the end of every week operation, a 15cm to 30 cm layer of cover soil is placed over that weeks completed fill. This one day's completed fill including the cover soil is called a cell. However, in the case of large landfills with the amount of solid waste more than 1200 ton per day, two or more cells should be constructed each day to avoid the decrease of structural stability caused by large cells. The wastes should be unloaded at the top of the last cell and spread and compacted using the slope of the cell as the support for compaction. When all the area is converted by one layer of cells it is called a lift. One more lift can be constructed on the top of the preceding lift whenever it does not surpass the final topography set by the design.

Considerations for ensuring cross section of leachate collection discharge pipe

(1) Requirements

Leachate collection discharge pipes are set in the bottom of the land fill area and maintenance control after starting the landfill is difficult. As an obstacle for air inflow cross section of the leachate collection discharge pipe, retention of leachate inside the leachate collection discharge pipe covering a large portion of the cross section or collecting of filthy water in the bottom of the leachate collection discharge pipe and blocking the cross section can occur. These types of things are difficult to estimate beforehand during the design stage. Therefore, from experience, it is desirable to use a pipe diameter of at least 600 mm for the leachate collection discharge pipe when using the "Fukuoka Method". However, when using pipe materials that can be obtained in developing countries, the larger the pipe the more there is anxiety regarding the strength of the pipe. In this case, uses a pipe diameter of 450 mm for the main leachate collection discharge pipe and use a design with several of these placed as in Fig.2-1



Placement pattern for leachate collection discharge pipes

Considerations for ensuring height of leachate collection discharge pipe and covering material

(1) Requirements

In the “Fukuoka Method”, fresh air must be introduced into the landfill through the leachate collection discharge pipes. However, in the examples so far, the leachate collection discharge pipe are laid deep in trenches that have been dug and there are cases where in the event that

leachate is retained in the landfill area, the cross section for air flow is completely blocked off.

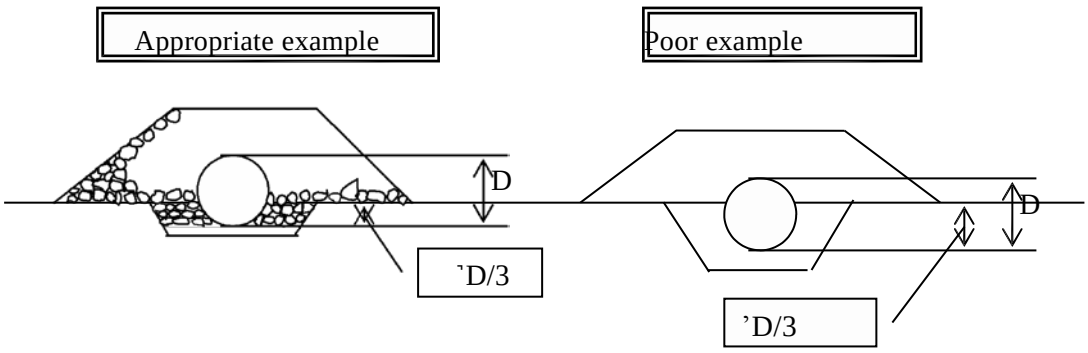


Fig. 2.2 Placement examples of leachate collection discharge pipes

(1) It is easy for the leachate collection discharge pipe to become submerged if water is retained in the landfill
(2) Infiltration of sludge becomes easier

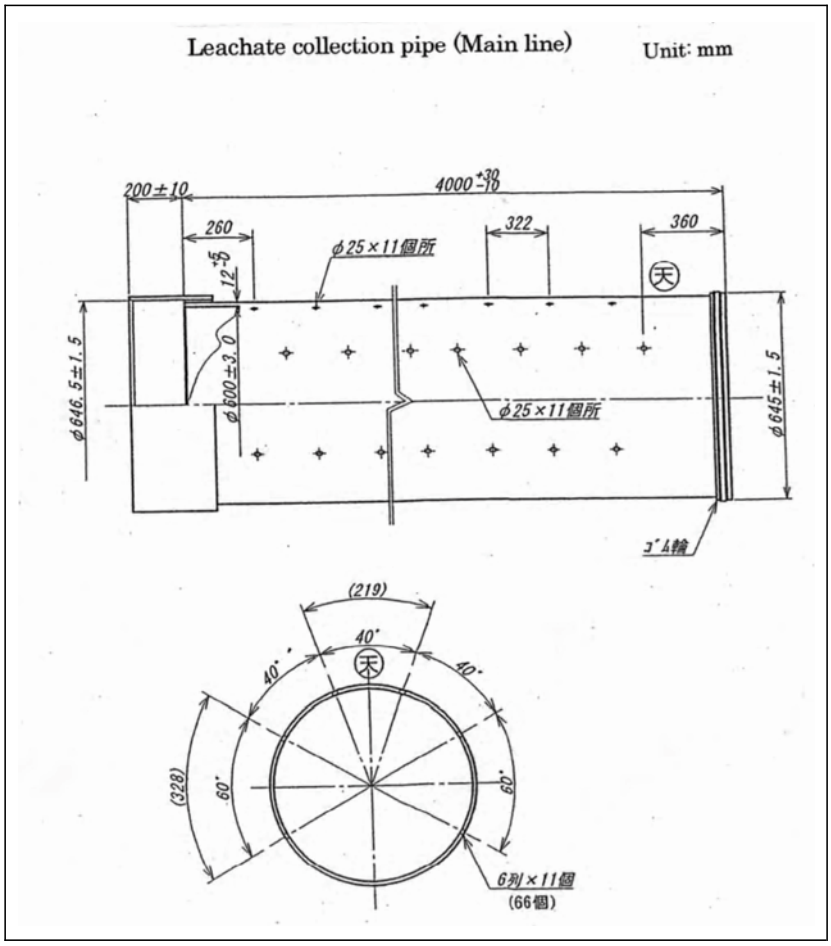
Picture2-3 Good example of leachate collection facilities

Picture 2-4 Good example of main leachate collection pipe

Considerations for ensuring perforated areas in the leachate collection discharge pipe

(1) Requirements

In the “Fukuoka Method”, fresh air must be introduced into the landfill through the leachate collection discharge pipes. Supply of air to the landfill layer through the leachate collection discharge pipe is provided through holes in the leachate collection discharge pipes. Therefore, measures must be taken so that the perforations of the leachate collection discharge pipe exhibit their function.



Example of perforations in leachate collection discharge pipes

(2) Application Example

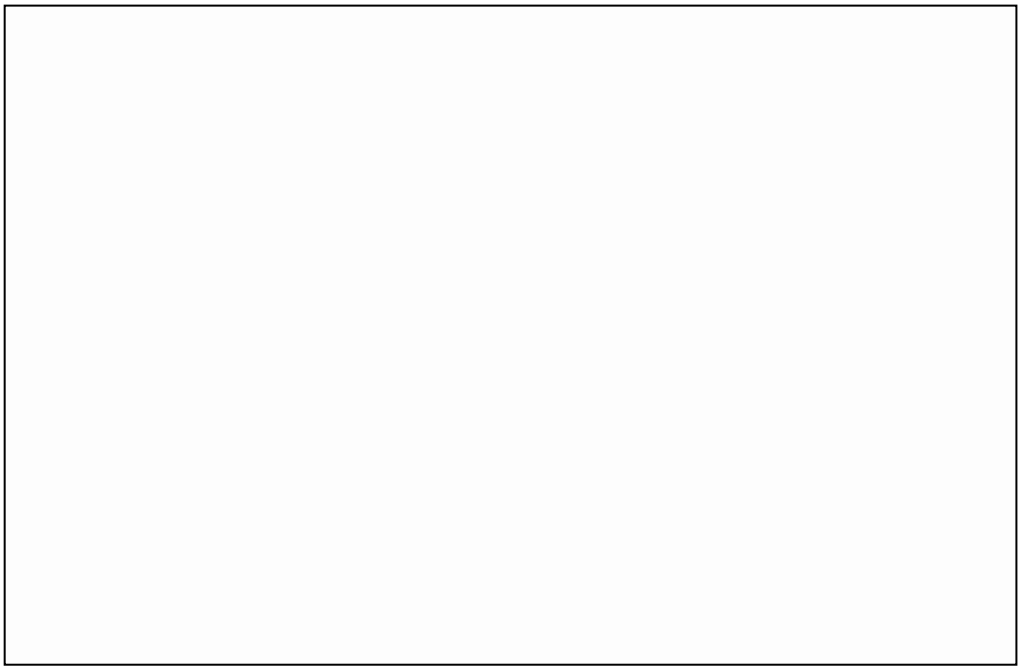
The good example or counter example configuration shown in chapter 2-6 must be used to achieve ensuring that the holes in the leachate collection discharge pipes stay open. Comparing these, the countermeasure example of Fig. 2-8 has less chance of the perforations being blocked by sludge etc.

Picture 2-5 Suitable placement example for ensuring perforation areas stay open

2-6 Considerations for reliable protection of leachate collection discharge pipes

(1) Requirements

In the “Fukuoka Method”, installing leachate collection discharge pipes suitably in the bottom of the landfill area rapidly discharges leachate in the landfill area and in addition causes fresh air to flow into the landfill through natural convection and thus supplying of air promotes aerobic decomposition in the landfill layer. Therefore, as the leachate collection discharge pipes are key equipment in the “Fukuoka Method”, they must be suitably protected so that they are not damaged through operation of the landfill or pressure caused by landfill waste.



(1) Requirements

In the “Fukuoka Method”, it is necessary to enable maintaining of the landfill layer in an aerobic environment. It follows that it is necessary to place gas venting pipes in the landfill area at suitable intervals.

In order to reliably install gas venting pipes, the configuration for raising the gas venting pipes must use materials that can be obtained locally to the landfill site and use a configuration that can be implemented using the control structure at the landfill site.

In cases where there is a lot of organic material that can be decomposed in the landfill waste and the landfill layer is at optimal aerobic decomposition conditions, the oxygen in the landfill layer will be rapidly consumed and may switch to anaerobic. In this case, in order to smoothly introduce fresh air into the landfill layer, air flow pipes must be placed every 10 ~ 15 m of height of the landfill. (See Fig. 2-8)

The roles and purposes of the vertical gas venting pipes are as follows.

(i) Suppress generation of CH4 through expanding aerobic area

(ii) Rapid removal of leachate function

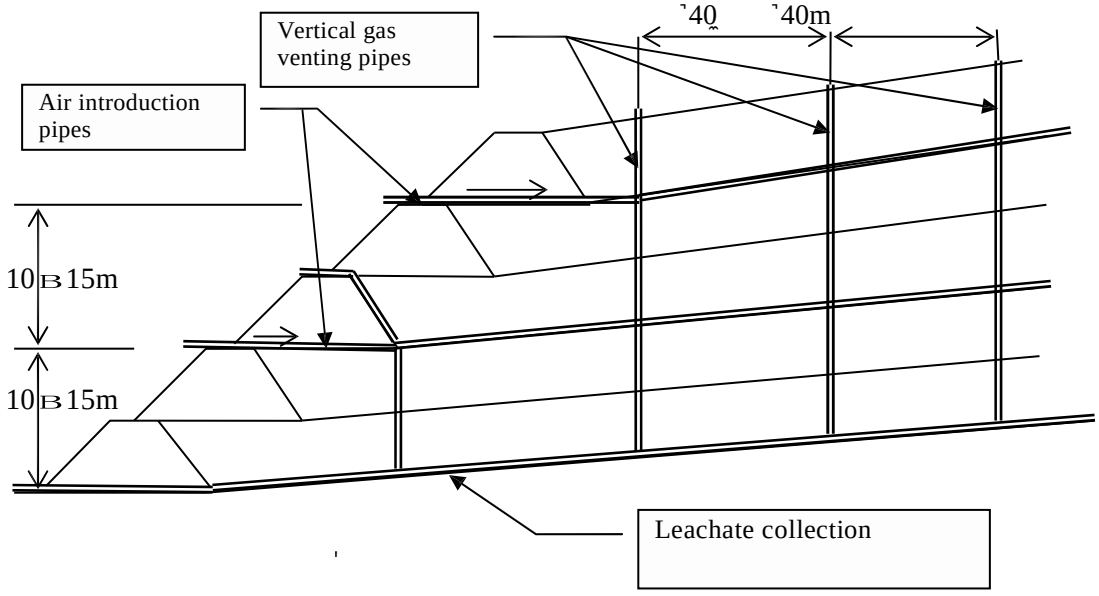
(iii) Circulation of leachate using vertical gas venting pipes

(2) Application Example

In the “Fukuoka Method”, it is recommended that gas venting pipes be installed every 20 to 40 m for flat landfill sites. If the landfill layer thickness is less than 10 m, a 40 m interval is suitable, if the landfill layer thickness is 10 m to 20 m, use a 30 m interval and if more than this, an interval of 20 m is suitable. Using an interval of less than 20 m enables increased aerobic decomposition but as the gas venting pipes would hinder landfill operation, this can not be recommended.

In cases where the amount of material requiring placement in the landfill is high, large number of gas venting pipes impede landfill operation and also become complex to erect. In this case,by taking into account installation of horizontal air flow pipes every 15 m of waste landfill layer, the installation interval can be widened to roughly 40 m.

In order to ensure reliable installation of gas venting pipes, it is necessary to use materials that can be obtained at the site and a configuration that can easily be implemented. The material noted in chapter 2-1 can be used as an example.

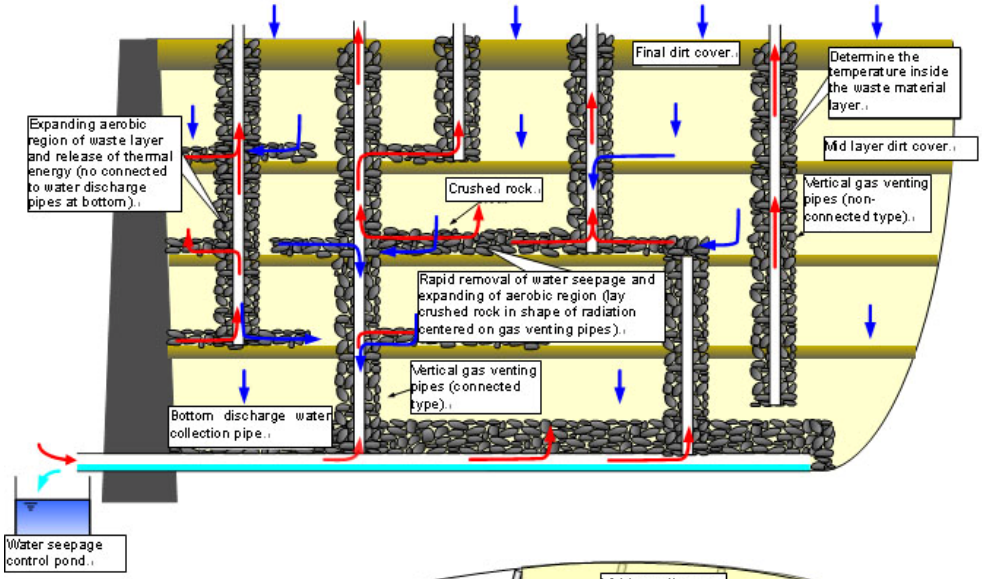


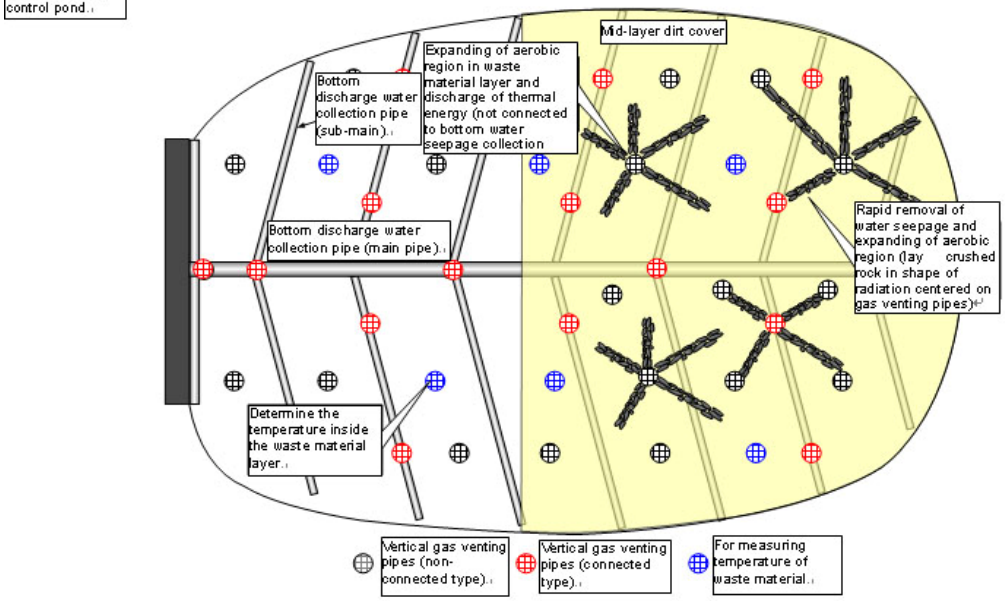
discharge pipes

Fig. 2-9 Illustration of application of air introduction pipes in the case that the landfill height is high

Picture 2-10 Installation example of gas venting pipes

In the case that there is not a slope where gas introduction pipes can be installed, suitably forming of a layer of crushed rock enabling supplying of air from the vertical gas venting pipes into the landfill layer can be considered as a countermeasure. An illustration of this countermeasure is shown in the following diagrams.


Final dirt cover
Determine the temperature inside the waste material layer.
Expanding aerobic region of waste layer and release of thermal energy (no connected to water discharge pipes at bottom).
Mid layer dirt cover.
Crushed rock.
Vertical gas venting pipes (non-connected type).
Rapid removal of water seepage and expanding of aerobic region (lay crushed rock in shape of radiation centered on gas venting pipes).
Vertical gas venting pipes (connected type).
Bottom discharge water collection pipe.
Water seepage control pond.


Mid-layer dirt cover
Expanding of aerobic region in waste material layer and discharge of thermal energy (not connected to bottom water seepage collection
Bottom discharge water collection pipe (sub-main).
Bottom discharge water collection pipe (main pipe).
Rapid removal of water seepage and expanding of aerobic region (lay crushed rock in shape of radiation centered on gas venting pipes).
Determine the temperature inside the waste material layer.
Vertical gas venting pipes (non-connected type).
Vertical gas venting pipes (connected type).
For measuring temperature of waste material.

(1) Requirements

The “Fukuoka Method” is a method that promotes decomposition of organic material inside the landfill layer through introduction of fresh air into the landfill layer and this can not be achieved by simply installing leachate collection discharge pipes. This is that discharging of gas in the landfill layer warmed by heat generated through decomposition of organic material through gas venting pipes to the top of the landfill pulls fresh air through leachate discharge pipe openings based on convection.

In general, the functions of gas venting pipes are not understood in developing countries and they are installed in an inappropriate manner, leading to cases where the function of the “Fukuoka Method” is lost. It follows that protection of the gas venting pipes must be clearly shown in the drawings during the design stage and the installation procedure must be specified.

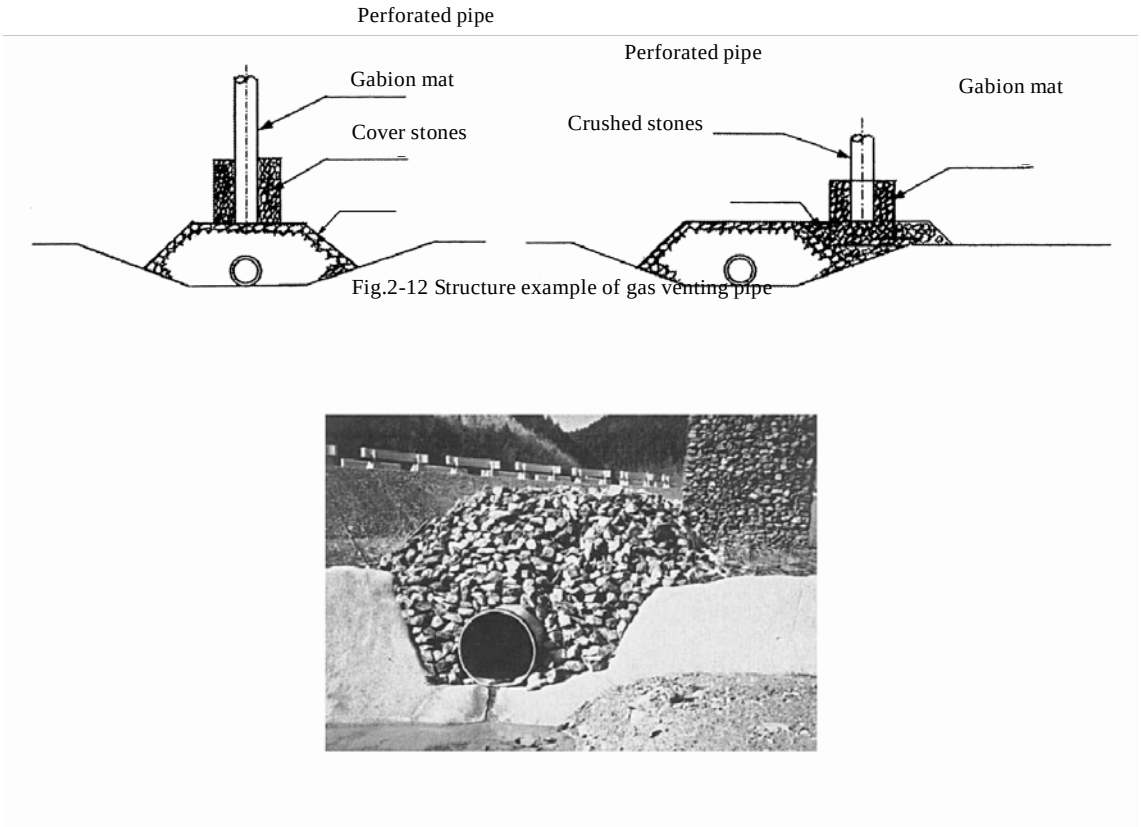


Fig.2-12 Structure example of gas venting pipe

Picture2-13 Example of bottom leachate collection pipe and gas venting pipe

(2) Application Example

In the “Fukuoka Method”, for protection of the gas venting pipes, it is desirable that the dimensions shown in Fig. 2-14 below are used as a basis and that structure is determined based on actual conditions for developing countries and each landfill site.

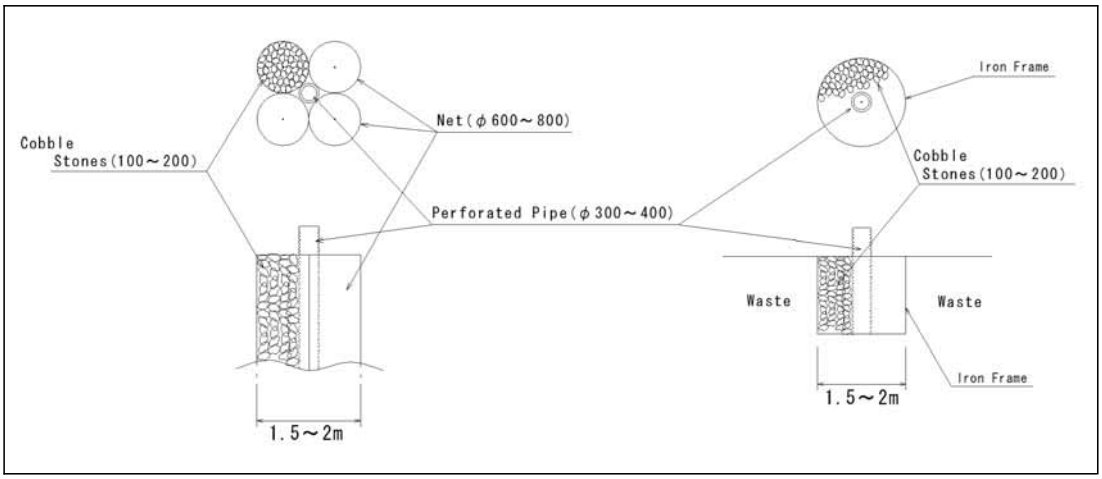


Fig. 2-14 Gas venting pipe production standard dimensions

(1) Requirements

As the “Fukuoka Method” is called a semi-aerobic landfill, there are also areas that are anaerobic in addition to the aerobic areas and while decomposition of biological pollution material proceeds in the aerobic areas, the combination of both aerobic and anaerobic areas has the function of nitrogen removal treatment. As the nitrogen is removed from the leachate, the nitrogen in the leachate has to go through the process of being oxidized and reduced but through saturating the landfill layer with leachate that has been discharged again, this function can be utilized to its utmost.

In the “Fukuoka Method”, circulating leachate by returning leachate discharged from the landfill site back to the landfill site is effective at both purifying the water quality of the leachate and reducing the amount of leachate. Circulation of leachate can be achieved using a simple system. If introduction of leachate treatment equipment is difficult from a financial perspective, use of circulation is desirable. Furthermore, in the case that introduction of leachate treatment equipment is feasible, this reduces the load on the leachate treatment equipment and suppresses treatment costs and use is therefore desirable. However, circulation requires a pump to return leachate to the landfill area.

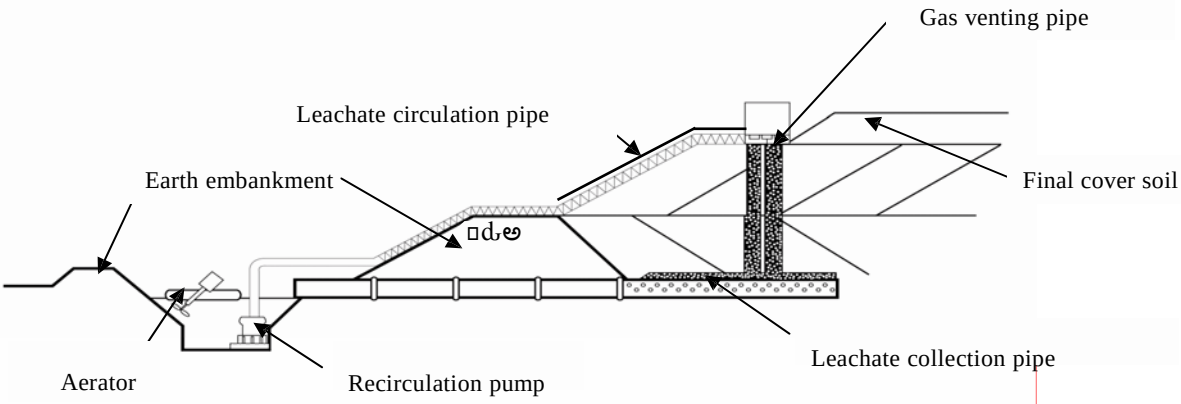


Fig. 2-15 Example of Ampang Jajar landfill site in Malaysia that uses a water seepage circulation system

Picture 2-16 Example of Malaysia Ampang Jajar landfill site

3. Landfill operation

3-1 Considerations for maintaining function of the leachate collection discharge pipes

(1) Requirements

The Fukuoka Method (semi anaerobic structure) has (1) leachate collection discharge pipes installed in the bottom, and (2) gas venting facilities as facility for supplying air (oxygen) to the waste layer. Of these, the leachate collection discharge pipes have the most important role and things that would reduce their function such as breakage or blockage of the pipes must be completely avoided. Therefore, sufficient care must be taken during landfill operation to maintain the functionality of the leachate collection discharge pipes.

(2) Application Example

(i) Consideration for type of waste material disposed of near the leachate collection discharge pipes. (Avoid small particle shaped items that can easily wash away.)

During use of the landfill, there is the possibility that the filter material of the leachate collection discharge pipes that are installed at the bottom of the landfill will become plugged with small particles in the soil covering and waste materials as well as insoluble materials included in the leachate. (See Fig. 3-1)

Especially when the first layer is buried, soil covering material and waste particles that flow with rain water may flow into the filter material at locations where the leachate collection discharge pipes are directly exposed and plug the filter material. Furthermore, the filter material may be plugged by non-soluble materials included in the leachate that is generated through decomposition of waste that is being processed in the landfill.

Picture 3-1 Plugging of leachate collection discharge pipes

The function of the leachate collection discharge pipes must be maintained over the long period of time unit the disposal site is closed. It follows that when land filling close to the leachate collection discharge pipes, that care must be taken to suppress clogging of the filter material.

One method for doing this is to avoid particles that can flow easily as landfill waste in the vicinity of the leachate collection discharge pipes and instead fill with bulky waste materials that have non-uniform shape and are rough and that are not soluble such as rubble from construction materials and pieces of concrete. (See Picture 3-2 ~ 3)

Picture 3-2 Example of landfill of large waste material in the vicinity of leachate collection discharge pipes

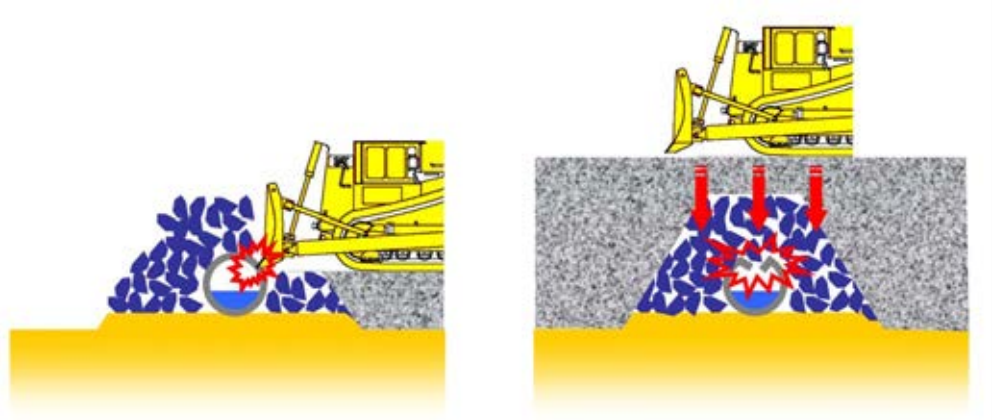
Picture 3-3 Example of landfill of rough waste material in the vicinity of leachate collection discharge pipe

(ii) Landfill method that does not break the leachate collection discharge pipes

The leachate collection discharge pipes installed on the bottom must be designed with the strength to withstand the static weight of waste layers of landfill up to the height planned for the landfill. However, initially when the landfill thickness is less than 3 m, the pipes directly receive the kinetic force of transport vehicles and heavy machinery driving over the surface of the landfill area. Furthermore, as the leachate collection discharge pipes are exposed for the first layer, heavy machinery used for landfill operation may directly contact the leachate collection discharge pipes and cause damage. If the leachate collection discharge pipes are damaged, waste material may get into the pipe directly at the damaged location and hinder flow of leachate and/or supply of air. (See Fig. 3-1)

Therefore, in the early stages of landfill where there is less than 3 m, suitable measures must be taken when driving heavy landfill machinery or transport vehicles over the top of the leachate collection discharge pipes.

One method of preventing damage to leachate collection discharge pipes is to maintain a landfill thickness of crushed rock that is not affected by kinetic load of heavy machinery of at least 1 m and proceed with the landfill for the first layer.



(a) Damage due to contact with heavy machinery (b) Damage due to kinetic load of heavy machinery

Fig. 3-4 Damage phenomenon of leachate collection discharge pipes of the initial layers of landfill

In cases where sufficient landfill thickness can not be maintained or locations where heavy machinery or large vehicles cross frequently, lay a steel plate with a thickness of at least 20 mm with the purpose of distributing the kinetic load of the heavy machinery etc. (see Fig. 3-2) or use a special road with at least 1 m of fill for crossing to prevent damage of leachate collection discharge pipes.

(iii) Control of the leachate level (pipe end open at all times)

The Fukuoka Method mechanism uses decomposition thermal energy to introduce fresh air (oxygen) through the discharge opening of the leachate collection discharge pipes in the bottom and enables supply of oxygen to the waste layer through the leachate collection discharge pipes and gas venting pipes. Therefore, the water level of the leachate control pond must be controlled and the discharge pipe opening of the leachate collection discharge

pipes must be open to the atmosphere at all times.

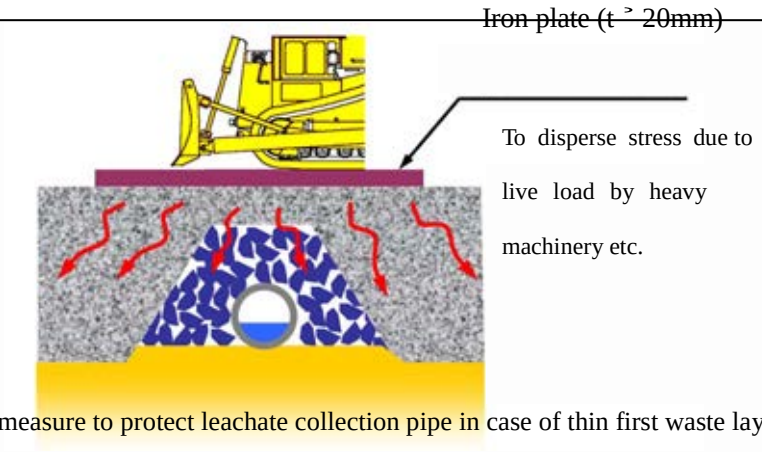


Fig.3-5 Example of measure to protect leachate collection pipe in case of thin first waste layer

(1) Requirements

Gas venting facility is important facility that enables smooth flow of air so that air in the landfill layer is not insufficient in the case that there is a lot of organic material to be decomposed. Therefore, maintaining of the function of the gas venting facility with regards to landfill operation must be sufficient considered.

(2) Support Example

(i)Vertical pipes (gas venting facility) reliable, suitable installation. (Meandering is better)

In the Fukuoka Method (semi-aerobic structure), leachate collection discharge pipe on the bottom and vertical pipes (gas venting facility) are important facilities that have the function of promoting discharge of leachate and supplying air (oxygen).Therefore, it is necessary to install the vertical pipes (gas venting facility) in suitable locations and to reliably connect and raise them in conjunction with proceeding of the waste landfill.

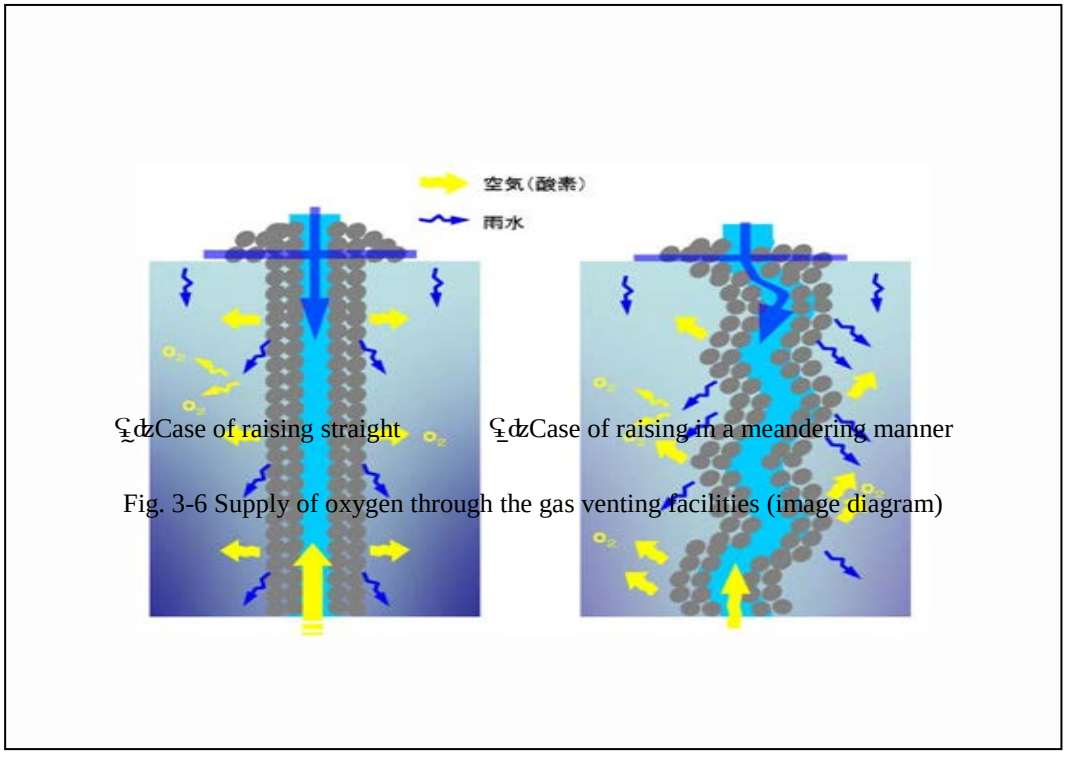


Fig. 3-6 Supply of oxygen through the gas venting facilities (image diagram)

In order to more fully exhibit efficiency in the function of the vertical pipes, it is desirable to link the vertical pipes directly to the leachate collection discharge pipes and install them roughly with a horizontal distance of roughly 20 m. Furthermore, in order to ensure better contact surface and suppress plugging of the vertical pipes at the same time, they should have a diameter of at least 10 cm and in addition be covered with at least 1 m in diameter of filter material that is not soluble.

Furthermore, in the case that the vertical pipes are raised (connected) along with the increasing height of the waste layer, use the same type of filter material and same diameter for raising of the vertical pipes. In this manner, the vertical pipes are not raised in a straight line; it is more desirable for them to meander. This configuration enables sufficient retention time of air and rainwater inside the gas venting facility and promotes supplying of oxygen. (See Fig. 3-4)

As a method for raising the gas venting facility while causing it to meander, connect and raise the system based on the following elements (see Fig. 3-5).

a) Install the gas venting pipe at an inclination as in Fig. 3-5 and fill with crushed rock as the gas venting facility for each waste layer.

b) When connecting and raising the next layer, install the gas venting facility centered on the center of the gas venting pipe that is above the surface and install the gas venting pipe in a direction that is different from the previous layer and fill with crushed rock.

c) Repeating i) and ii) will enable raising the gas venting pipe in a meandering path.

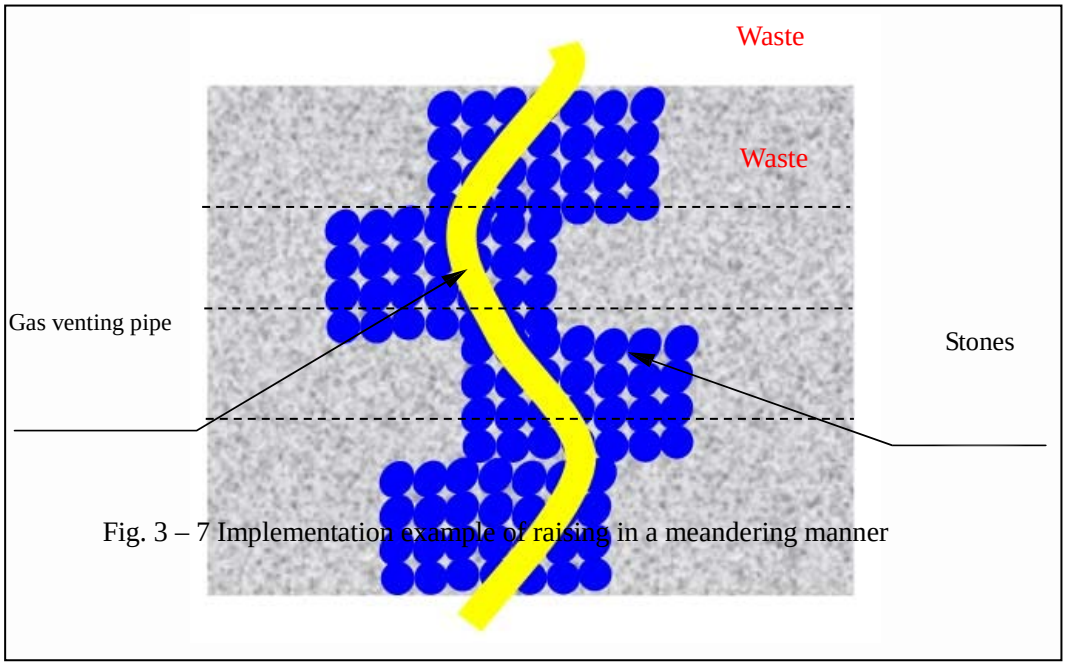


Fig. 3 – 7 Implementation example of raising in a meandering manner

(ii) Landfill method that does not break gas venting facilities

When performing landfill operations, vertical pipes can be knocked down, broken, or collapse due to contact with heavy machinery or load of landfill material; therefore, care is important when performing landfill operations.

For starting of the landfill for each layer, in general the vertical pipes and sloped surfaces for gas venting facilities target that for 1 layer (roughly 3 m). In this condition, if waste pushes from one side or contact is made with heavy machinery the vertical pipe may fall over, become damaged, or collapse. Especially for the first layer, the leachate collection discharge pipe directly connected to the gas venting facility may also be damaged; therefore, contact by heavy machinery must be prevented. Furthermore, if landfill is filled higher than independent gas venting facilities, the gas venting facility may become buried. If this happens this gas venting facility can no longer be added to or raised in the next landfill layer. If this is left as it is, air can no longer be supplied, the aerobic area inside the waste layer is reduced and the Fukuoka Method can not be maintained. (See
Picture 3-4 ~ 5)

Picture 3-8 Waste is higher than Gas venting facility (○) case (bad example)

Picture 3-9 Gas venting facility that is in the process of being plugged and buried (bad example)

• Preceding Independent type case

In the case of independent preceding type where gas venting facilities are raised to a height higher than the height for the landfill prior to implementing landfill operation and then proceed with landfill (see Fig. 3-6, picture 3-6), care is needed to perform landfill operation not from only one direction but in a uniform manner in the surrounding area to prevent falling down, damage, or breaking.

The independent height is higher than the planned height for waste and care must be taken

so that waste or covering soil does not flow into the facilities after landfill operation. In the case that there is a possibility of becoming buried, after landfill around the gas venting facility is complete pile crushed rock beforehand such that the gas venting facilities are at least 50

cm higher than the surrounding waste. (See Fig. 3-8)

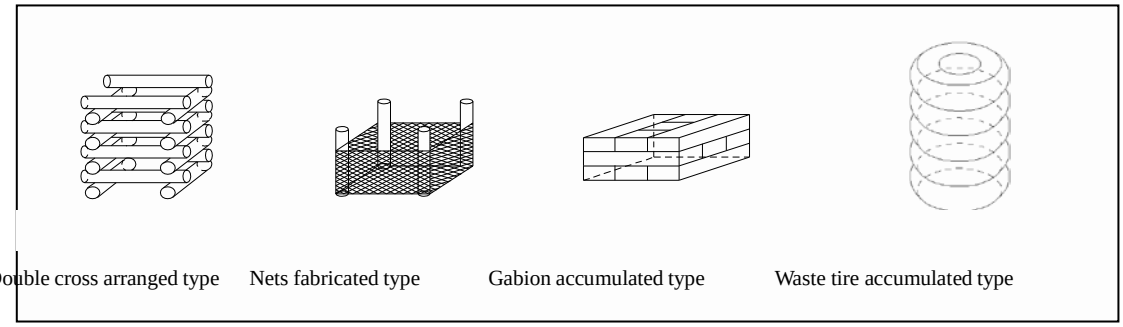


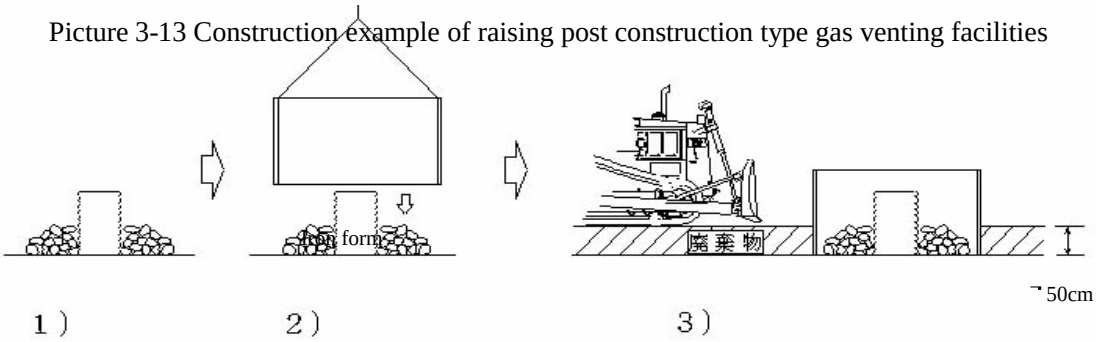
Fig. 3-10 Vertical pipe construction (preceding independent type) construction example

Picture 3-11 Vertical pipe construction (preceding independent type) construction example

Post construction type

A method of temporarily placing a steel frame of the gas venting facility that is scheduled to be raised and after burying the outer circumference of the steel frame, putting crushed rock in the steel frame and proceeding with raising (see Fig. 3-7) enables prevention of being knocked over, being damaged, or collapsing as well as achieving efficient raising operation.

Picture 3-13 Construction example of raising post construction type gas venting facilities



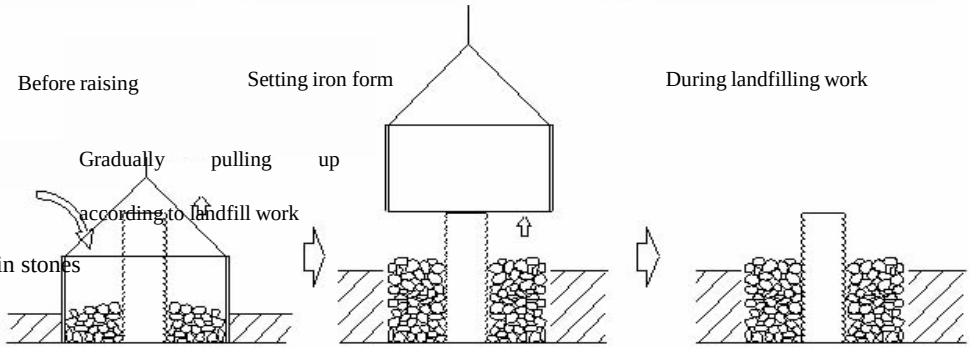
Before raising

Setting iron form

During landfilling work

Gradually pulling up according to landfill work

Throwing in stones



Connecting pipes, throwing in stones and pulling up iron form

Repeat procedure 4) and removing iron form finally

Completion of gas venting pipe raising

1) Install the steel frame using heavy machinery such as a backhoe

2) Perform landfill operation around the steel frame (from the perspective of plugging the pipe, waste material that is in rough pieces is suitable)

3) Connect the pipe and put crushed rock in the steel frame

4) Pull up the steel frame using the heavy machinery such as a backhoe

5) Repeat the above operation to raise the structures

Note 1 when a worker is working inside the steel frame, be sure to measure oxygen concentration before and during operation and take countermeasures for lack of oxygen as well as presence of toxic gases

4. Environmental Monitoring

4.1 Understanding Aerobic and Anaerobic Conditions

(1) Remarks

Decomposition of wastes (organic substances) is divided broadly into two processes of solubilization and gasification. In the solubilization process, soluble organic acids, ammonia, and CO2 etc. are produced, resulting the increase in the BOD load of leachate and the decrease in pH. In the gasification process, as gas is produced from the organic acids, etc. BOD load is reduced and pH increases. These two processes are influenced by the biological conditions of the wastes layer. In an aerobic condition, organic substances are decomposed by aerobic microorganisms; the time span of the first stage solubilization process (hydrolysis of organic substances) is short and transition to the second stage gasification process is rapid. In other words, as aerobic decomposition progresses, BOD load is reduced early on and pH increases. Therefore, monitoring BOD and pH enables understanding of the degree the wastes layer is aerobic.

Also, the final products generated through aerobic decomposition in the gasification process are oxides such as CO_2, nitrate and sulfate ions. On the other hands, in the case of anaerobic decomposition, the final products are reducing substances such as CH_4, H_2S, and ammonia. The products by the decomposition of organic wastes are different based on the biological conditions of wastes layer. The existence of aerobic area in wastes layer can be determined through measuring the quality and quantity of the gases generated from landfill and calculating these gases ratios. As these two processes are separated into 6 phases from the differences in concentration of pollutants and the generation volume of and

composition of gas (see Fig. 4-1, decomposition pattern), this can also be used as an indicator of landfill stabilization.

Furthermore, in the cases that metals are included in the wastes, iron and manganese are reduced in anaerobic conditions and as this makes them more soluble, the concentration of iron and manganese in the leachate increases. Therefore, the degree that the wastes layer is anaerobic can be determined through measuring the concentration of soluble iron and manganese in the leachate.

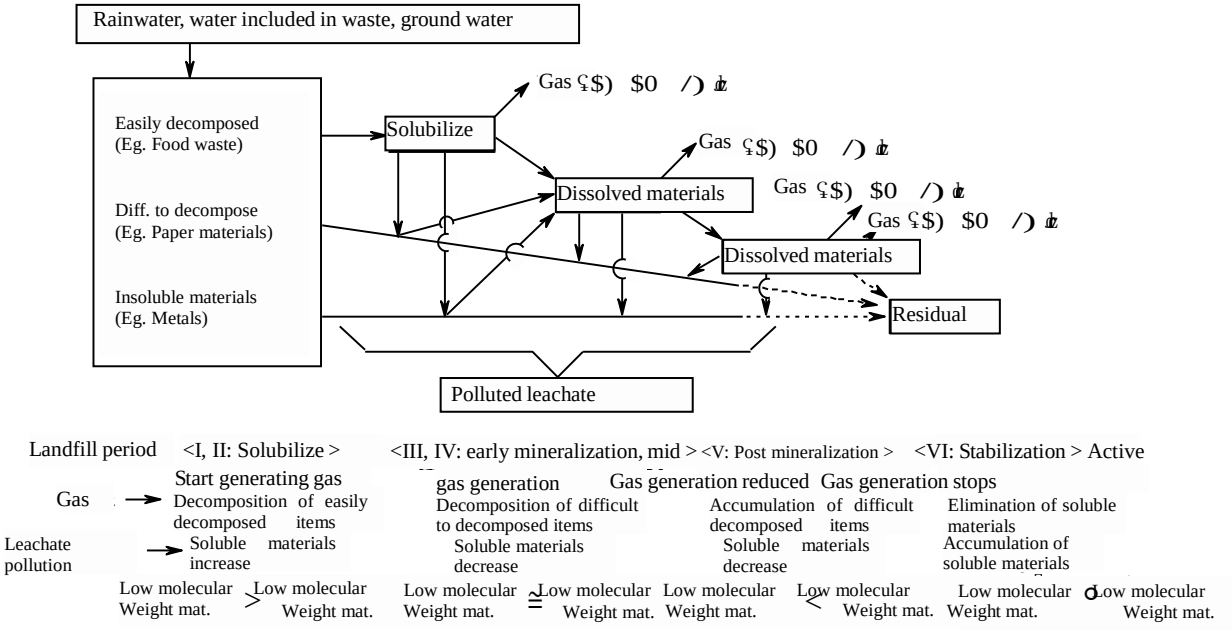


Fig. 4-1 Landfill waste material decomposition patterns

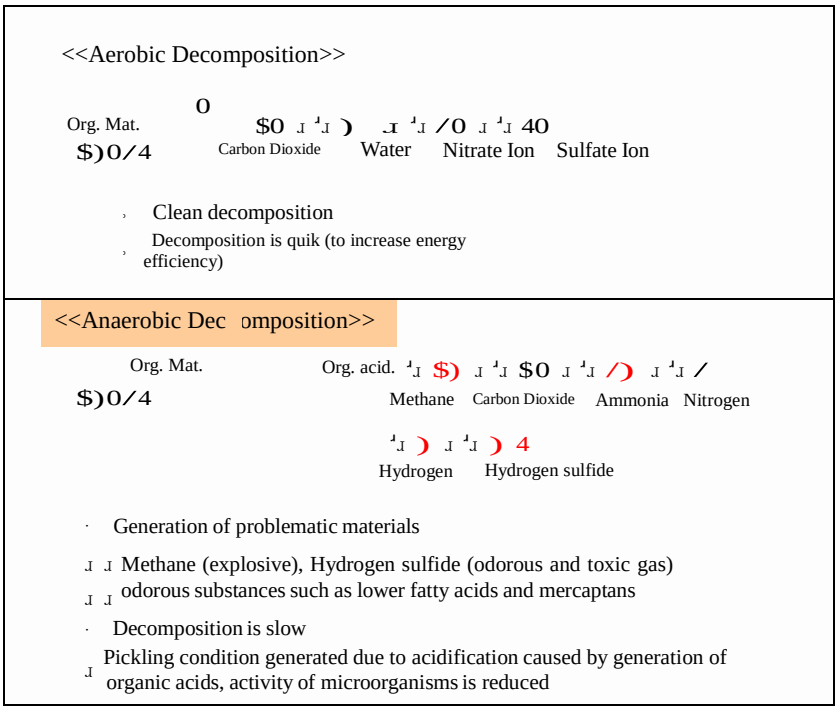


Fig. 4-2 Outline of Aerobic and Anaerobic Decomposition

(2) Measurement example

(i) pH and BOD concentration of leachate

a. pH measurement method and note for a measurement

pH test paper is best suited for measurement of pH on site. There are various types of pH test paper but a universal type of pH test paper is sufficient to gain a rough level of pH such acidic, neutral and alkali. Even if sample contains a lot of suspended matter, or if is colored, the pH can be measured within a error of roughly 0.2 to 0.4. Name of pH test papers and their applicable pH levels are shown in table 4-1.

If the pH test paper is left in leachate for a long period, the chemicals containing the test paper will dissolve into leachate and will be removed from test paper. If the test paper is touched by hand, it will change color due to sweat etc. so use tweezers or something similar for dipping in leachate. If tweezers are not available, pick up the edge of test paper and be careful not to immerse a part of paper that you are touching.

Use pH test paper with specified measuring range or a pH meter for accurate

measurement of pH. There is various type of pH meter with the different accuracy but devices for accurate measurement are not required. As the electrodes of pH meter are made with a thin glass film they are easy to break so be careful when using them. Store with the electrodes immersed in water.

Table 4-1 pH test paper names and applicable pH levels

CR	Cresol Red	0.2 – 2.0
		7.2 – 8.8
tb	Thymol Blue	1.4 – 3.0
		8.0 – 9.6
BPB	Bromophenol Blue	2.8 – 4.4
PB	Phenol Blue	3.2 – 5.6
BCG	Bromocresol Green	4.0 – 5.6
CPR	Chorphenol Red	5.0 – 6.6
MR	Methyl Red	5.4 – 7.0
BCP	Bromcresol Purple	5.6 – 7.2
BTB	Bromothymol Blue	6.2 – 7.8
PR	Phenol Red	0.0 – 1.6
		6.6 – 8.2
AZY	Alizarin Yellow	10.0 – 12.0
ALB	Alkali Blue	11.0 – 13.6

b. BOD measurement method and note for a measurement

The BOD is expressed by the amount of dissolved oxygen in sample that is consumed over a 5 day period at 20 °C. In Japan, the Winkler Azide modified method based on manganese oxidation by dissolved oxygen is used as a standard test method to measure the amount of dissolved oxygen. Also, the miller modified method that is based on the oxidation of iron by dissolved oxygen is used as a simple measurement method. In addition, there is a membrane electrode method that generates a current between metal electrodes based on the amount of dissolved oxygen and uses this value to determine the amount of dissolved oxygen. The Winkler Azide modified method and Miller modified

method are easily affected by reducing materials such as soluble iron and manganese etc. On the other hand, the membrane electrode method is not affected by reducing materials and measurement is easy but stabilization of the measurement value is difficult.

An important point for a measurement using the above 3 methods is that BOD components decompose and reduce while being stored so the test should be performed immediately after collecting the sample. In addition, as the test takes 5 days, if measurement does not go well, it is difficult to redo the measurement. Therefore, dilution ratio must be estimated accurately. These estimates are preformed based on past results and COD value, color, and smell of the sample. Cases where are 1/2, 1/4, 1/8, and 2, 4, 8 times of the base estimated BOD concentration must also be tested at the same time. Make sure that air can not get into the incubation bottles the incubation period (5 days).

c. Measurement example

The first period of solubilization phase (phase I) is a period where organic material hydrolyzes and where soluble pollutants such as organic acids are produced. Therefore, the BOD concentration is high and pH is acidic ranging 4 – 6 during this period. During the latter period of solubilization phase (phase II) and gasification phase (phase III), a portion of the solubilized organic substances is converted to gas so the BOD concentration is reduced and pH rise. In this period, CO_2 dissolves into the leachate and causes the pH to rise. A semi-aerobic type is more on CO_2 generation than an anaerobic type so that pH of Semi-aerobic type reach to as high as 8. During the middle to latter period of gasification phase (phase IV), gasification is the highest in both semi-aerobic and anaerobic type and therefore, the BOD concentration reduces further but the pH maintains a roughly neutral level. The most of decomposable organic substances is decomposed by the solubilization and gasification processes. Therefore, soluble organic subsutances vanishes and the BOD concentration is a low concentration of less then 10 mg/L in the stabilization phase (phase V). In addition, the alkalinity increases and a pH reach to 7 – 8 due to CO_2 produced in gasification phase.

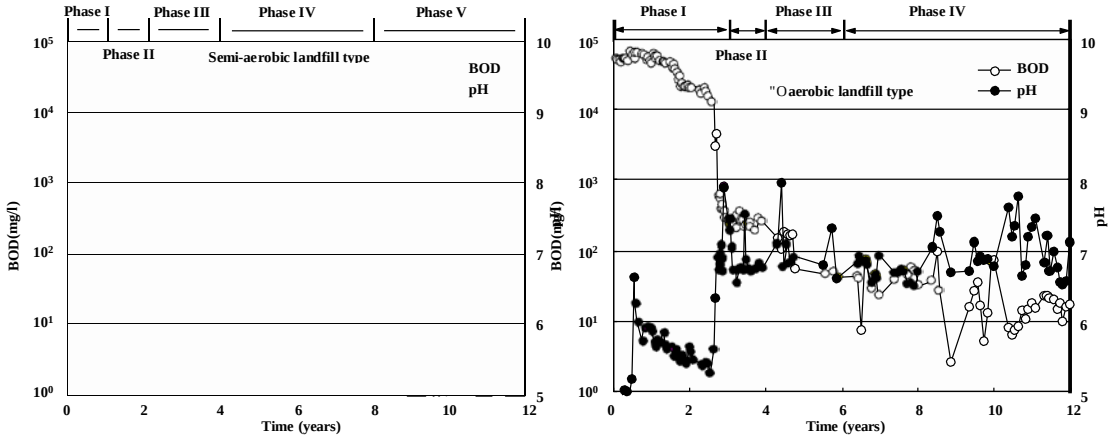


Fig.4-3 pH and BOD concentration variation with time

(ii) Ammonia and nitrate concentrations in leachate a.

Important points for measuring

Nitrogen compounds also biodegrade for storing and change to various type of nitrogen compounds such as ammonia and nitrate etc.. Therefore, measurement should be quickly performed after collecting sample.

b. Measurement example

Ammonia is produced through hydrolysis of organic material. Then, ammonia oxidizes under aerobic conditions and is converted to nitrite and nitrate. As nitrogen oxides are soluble, they dissolve in the leachate. On the other hand, as ammonia does not oxidize in an anaerobic condition and does not change. Ammonia is also soluble and dissolves in the leachate as well. In other words, detection of nitrogen oxides in leachate shows that wastes layer is an aerobic.

In the gasification process where pH increases, part of the ammonia is released as a gas. Therefore ammonia concentration gradually reduces during the gasification process.

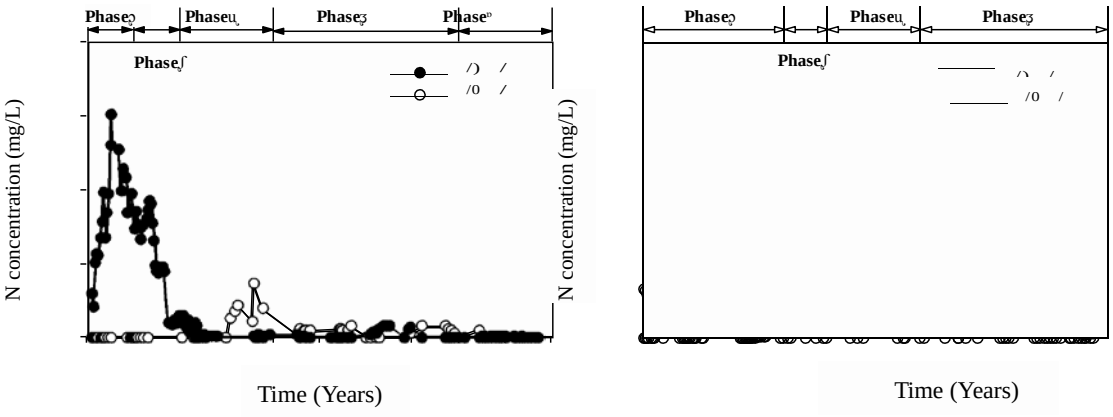


Fig.4-4 NH_4^+-N and NO_3^- N concentration variation with time

(iii) Soluble iron and soluble manganese concentrations in leachate

a. Important points for measuring

Soluble iron and soluble manganese are oxidized by air and become insoluble (precipitates). Therefore, after collecting a sample, quickly filter it and immediately perform acid treatment as pre-treatment for measurement or if this can not be done, add hydrochloric acid and adjust the pH to less than 1 for storage.

b. Measurement example

Heavy metals change from insoluble to soluble based on pH or oxidation/reduction potential. In general, most heavy metals are soluble with acidity. Heavy metals that change based on oxidation/reduction potential are arsenic, iron, and manganese etc. Especially, there is a relatively high amount of iron and manganese in wastes and they dissolve when the oxidation/reduction potential is low, or under anaerobic conditions, and concentrations of these metals increase in the leachate.

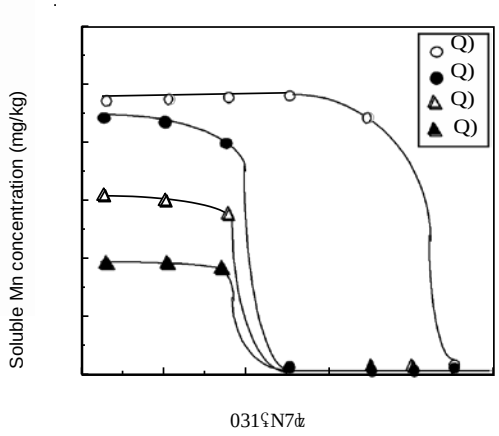


Fig. 4-5 pH ORP affect on solubility of Mn in soil

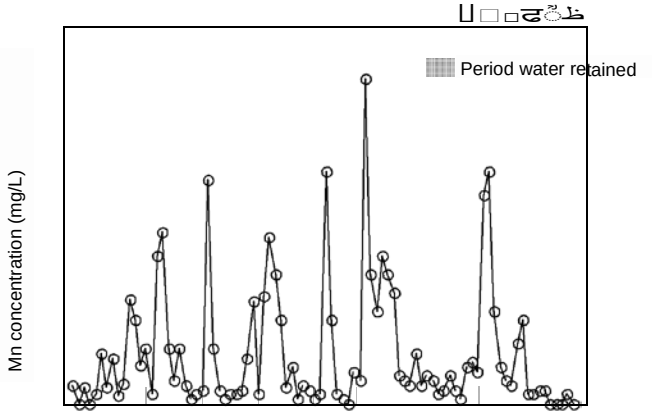


Fig. 4-6 Increase in Mn concentration based on water retention in landfill layer

(iv) $CH_4$and CO_2 concentrations in product gas

a. Measurement method and important points for measuring

Measuring methods for the composition of the landfill gas divided into two types broadly. One method is to analysis using gas chromatography in a lab. Another method is direct measurement at the landfill site. The first method enables analysis of several gas constituents at the same time and has high accuracy but equipment is expensive. Using the second method, one device can only measure one or two types of gas but it is inexpensive and does not require special measurement skills and can be applied to the measurement of CH_4 and CO_2 etc. with accuracy on the order of several %. A flammable gas detection device is used to measure CH_4 and an infrared absorption type or gas detection tube methods are used to detect CO_2. Flammable gas detection devices are developed with the purpose of preventing accidents caused by gas. There are LEL types and the actual concentration measurement type of flammable gas detection devices. The type that measures actual concentration needs to be selected for purchase as well as for measuring. Because the maximum detection range of LEL type is the explosion limit.

b. Measurement example

The gasification process has two path which is aerobic and anaerobic paths. Semi-aerobic type has both aerobic areas and anaerobic areas in the wastes layer. Therefore, the composition of the landfill gas will change based on the ratio of these two areas. As the aerobic area increases, the anaerobic gasification phase (phase IV) shortens and CH_4/CO_2 ratio of phase V and phase VI is reduced. The CH_4/CO_2 ratio based on landfill conditions is shown below.

Aerobic: CH_4 concentration is 0

Semi-aerobic (V, VI periods): $CH_4/CO_2 < 2$

Anaerobic (IV period): $CH_4/CO_2 > 2$

、Theoretically $CH_4/CO_2 = 1$ but CO_2 reacts with positive ions in the waste material where it is fixed and dissolves into leachate or precipitate and therefore its concentration in gas is reduced.

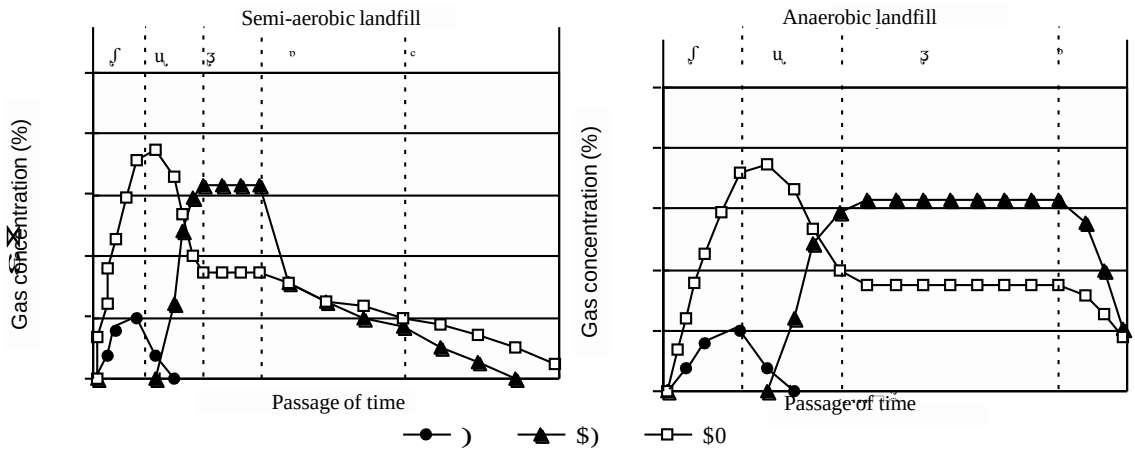


Fig. 4-7 Landfill product gas composition changes

(v)H_2S concentration in landfill gas

a. Measurement method and important points for measuring

Gas chromatography analysis can be used for hydrogen sulfide (H_2S) and for methyl mercaptans (CH_3SH), which are odorous constituents, similar to CH_4 and CO_2 but a induced type gas detection device is easy and inexpensive for measuring of these gases. Also, using this device a prescribed amount (maximum intake amount 100 mL for each time) of gas can be induced into the tip, the amount of intake can be reduced for gas with high concentrations and on the other hand, the number of intake can be increased if the concentration is low. The value noted on the tip is result from one intake so when the volume or number of intakes is changed, some type of calculation such as the dividing the value by the number of intakes is required and therefore care must be taken. There are several types of tips that are classified based on concentration and therefore one with an appropriate concentration range must be selected.

b. Measurement example

When organic sulfur compounds in the wastes are aerobically decomposed by

Microorganisms, they are converted to intermediate products and in the end to sulfuric acid. On the other hand, when anaerobic decomposition occurs, it changes to odorous substances such as hydrogen sulfide (H_2S) and methyl mercaptan (CH_3SH). Of the inorganic sulfur components, sulfur is converted to sulfuric acid by sulfur oxidation bacteria under the aerobic condition. Therefore, if there are sulfur compounds such as CH_3SH or H_2S detected during the initial (solubilization) phase of decomposition of organic substances, it shows that the wastes layer is under the anaerobic condition.

An anaerobic landfill, there has an aerobic area in the surface layer of the landfill. Therefore, a portion of inorganic sulfur in this aerobic area of the surface layer is converted to sulfate and dissolve into leachate. Then sulfate in leachate is changed again to H_2S by sulfate reducing bacteria in the anaerobic area of the middle wastes layer. Therefore, in an anaerobic landfill, H_2S is not only generated in the beginning of land filling but there are also cases where high concentrations are detected from 4 to 5 years after starting of landfill operation. In the semi-aerobic type, as there are aerobic areas in the bottom and around the gas venting pipes, H_2S that is produced in anaerobic areas is again oxidized to sulfate. Therefore the H_2S concentration in the gas is reduced. On the other hand, as the sulfate produced by oxidation of inorganic sulfur is soluble, it is discharged with the leachate. In other words, as the aerobic area increases, in addition to H2S concentration in gas being reduced, the sulfuric acid ion concentration in the leachate increases.

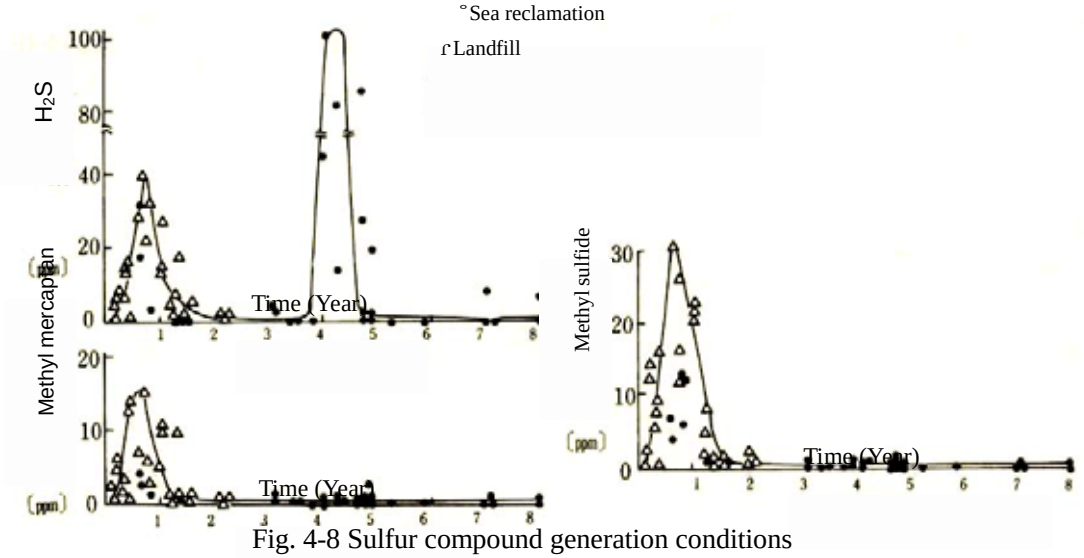


Fig. 4-8 Sulfur compound generation conditions

(1) Remarks

The target of a semi-aerobic landfill is the degradation of organic material by the micro bacteria that exist in the waste layer. Therefore, the effect of stabilization provided by semi-aerobic landfill can be evaluated by reduction in the amount of organic material. If there is any organic material, a portion of the energy generated by microorganisms is converted to thermal energy and biodegradation products dissolved pollutants and biogas. BOD of the dissolved pollutants indicates the amount of organic matter that is easily biodegradable, so the rate of BOD in the total amounts of organic material (COD) is reduced. The biodegradation is slowness when the amount of organic material is reduced, therefore there is a smaller amount of energy is generated, the temperature of waste layer is decreased, and also the amount of gas production is reduced. The leachate passes through most of the waste layer, so it can be considered that characteristics of the leachate reflect the inside of landfill, but the landfill gas can be measured only at a specific area such as the gas ventilation pipe, so it cannot be expected to reflect the whole landfill area. It is possible to measure the amount of gas production on the part of final cover soil but a lot of effort is required to measure the whole surface of a large landfill area.

A simple method for measuring amount of gas generated particularly methane gas is the investigation of vegetation on the soil cover. There are some types of vegetation that can be inhibited by gases such as methane. In other words, to observe the growth of these vegetations can be realized the reduction of methane production.

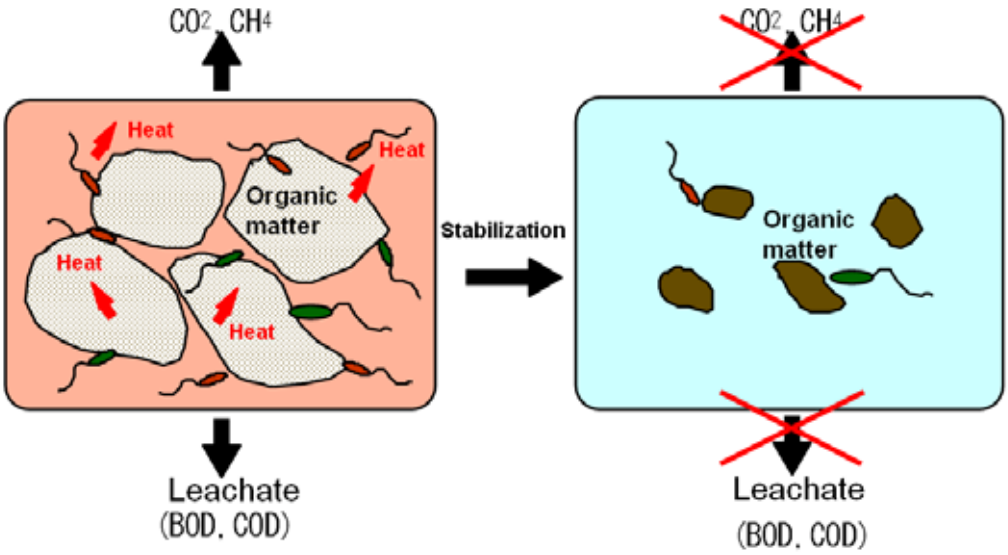


Fig. 4-9 conceptual scheme for stabilization of landfill

(2) Measurement example

(i) Temperature of leachate measurement

a. Advantage and simplicity method of leachate temperature

There is a heat balance in landfill to receive inside and release to outside. (see Fig. 4-10). In this figure, the way to recognize the state of waste degradation based on the temperature: (1) temperature from gas collecting pipes (2) leachate temperature from collecting pipe, and (3) temperature of waste layer, throw (2) is easy and low cost. The temperature of the leachate reflects the condition of inside the landfill because rain water passes through the waste layer and heat transfers to the leachate through heat exchange from the waste in the landfill and with the gases. Furthermore, the diagnosis with leachate temperature can estimate by the energy transfer with leachate and rain water temperature and amount of leachate.

b. Measurement method and note for a measurement

> Leachate temperature:

Temperature measurement of leachate using a thermometer and recorder must be measured at the outlet port of leachate collecting pipe or the collection pit. And the sampling water must be analyzed by thermometer just after taking, and the temperature of rain water is measured periodically by a thermometer.

>Leachate amount:

The leachate volume must be measured from collecting pit every day.

c. Measurement example

Biodegradation Diagnosis using water temperature is performed from (1) temporal change of leachate temperature and amount and (2) amount of thermal energy discharged by

Leachate calculated from the following equation.

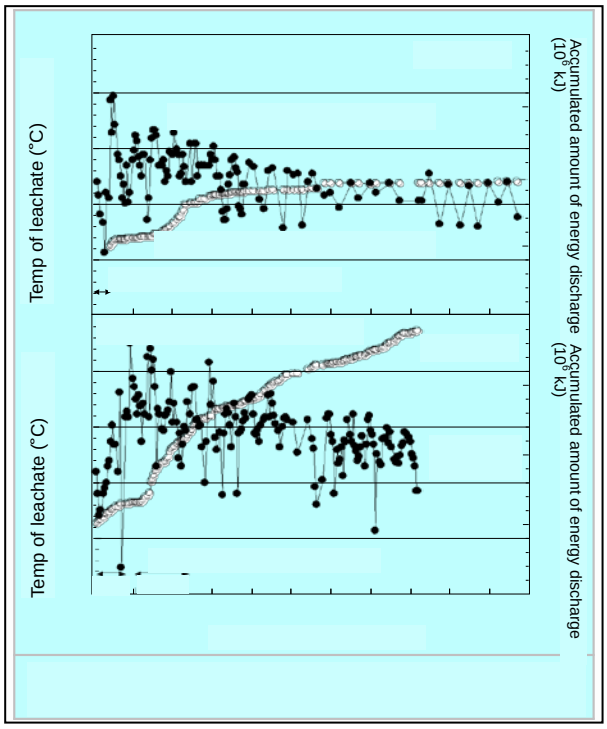
Amount of thermal energy transfer to leachate:

$$Q = V_L \, (_TL - T_W) \, C_P \, [J]$$

T_L: temperature of leachate [°C]; T_W: temperature of rainwater [°C]; V_L: volume of leachate [L]; C_P: specific heat of water = 4.18 [KJ/kg-K]

Temporal change of the leachate temperature and the accumulation of amount of energy

discharged based on the equation in every month show in Fig. 4-11.



From this figure, both of landfills A and B show a leachate temperature of 30 ~ 40 °C in the primary period, but after 15 years A landfill showed around 20 °C, the same temperature as ground water, means getting a stabilizing. It can be judged that it will take a little longer for B landfill to stabilize around 25 °C.

Change in temperature of leachate is easily affected by surroundings temperature such as the summer and winter as well as rain water, so there is a difficult case to judge it. From the results of the amount of thermal energy for each month in landfill A, is shown that the accumulation of energy discharged in the leachate in every month is low and it can be estimated that there is not any heat generation inside the landfill. The degradation of the waste is almost complete and the landfill can be judged to be stabilizing.

On the other hand, there is a lot of thermal energy generated in the B landfill and the accumulated amount of thermal energy shows still increasing. The landfill is generating thermal energy and therefore it can be judged that degradation is currently proceeding and that the landfill has not entered the stable period.

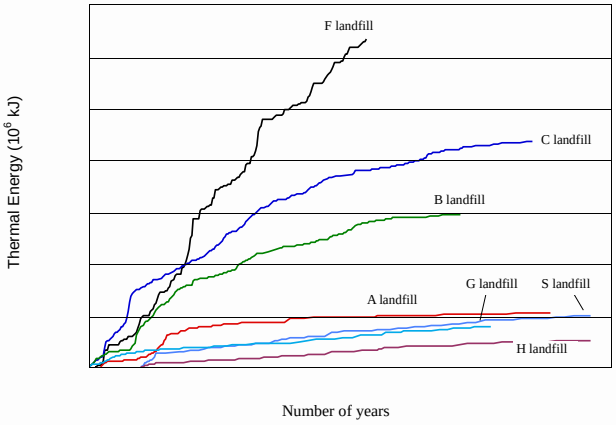


Fig. 4-12 Accumulated thermal energy discharged through seepage water

Examples of accumulated thermal energy amount discharged through leachate of several landfill sites are shown in Fig. 4-12. Based on Fig. 4-12, the amount of increase in accumulated energy discharged by leachate from the landfill sites A, G, H, and S. This result show that the waste in these landfill sites has been decomposed and reaches in a stable condition.

On the other hand, F landfill is in running so accumulated energy discharged to leachate still increases with time showing that decomposition of waste is activity in the landfill site. Landfill operation for B and C landfills is completed and as the increase in amount of accumulated thermal energy discharged is gradually going down, it shows a trend of stabilization of waste.

(ii) BOD/COD of leachate

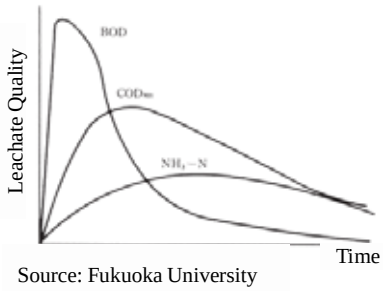
a. Measurement method and note for a measurement

Following 1) of chapter 4-1.

b. Measurement example

The quality and concentration of leachate is depending on the type of land filled waste. In generally, the trend of landfill which filled mainly with organic material is shown the water quality pattern as Fig. 4-13, and they show a trend of BOD > COD. In addition, as nitrogen components in waste material gradually degradable, so TN in leachate shows increasing

after long period. However, in a landfill site filled mainly with organic material, if the landfill is maintained with an aerobic condition, BOD is rapidly decomposed by microorganisms (see Fig. 4-14).



Source: Fukuoka University

Fig. 4-13 General trends of leachate quality

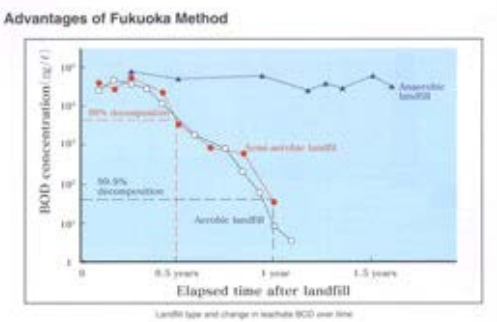


Fig. 4-14 BOD of leachate from landfills mainly filled with organic material

The leachate quality of a semi-aerobic landfill of incombustible waste and incineration residue is shown in Fig. 4-15. In a landfill site that sufficiently maintains the function of a semi-aerobic construction, the BOD (easily biodegradable organic matter) degrades in early stage and the COD (hardly biodegradable organic matter) decrease gradually, so it has a trend of BOD < COD. In addition, TN in leachate shows increasing due to nitrogen components in waste gradually degraded and dissolved into leachate after several years from the starting operation.

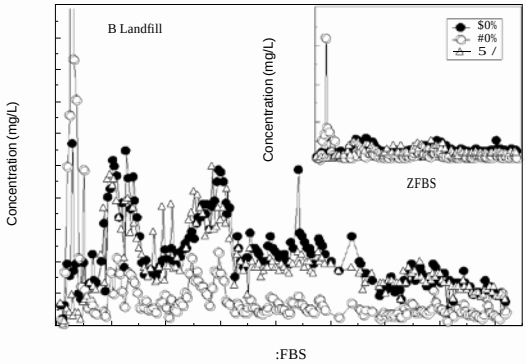


Fig. 4-15 Leachate quality of landfill by mainly incombustible waste with semi aerobic construction

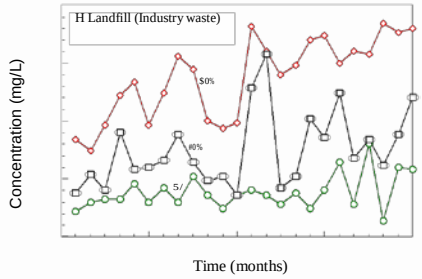


Fig. 4-16 Leachate quality from a landfill of industrial waste

This Fig 4-16 is an example of leachate quality from a landfill site of industrial waste. The H landfill site had a relationship of BOD < COD from just after startup of the landfill and it is the prior stage of TN discharge.

The quality of leachate discharged from the landfill is greatly influenced by differences in the land filled waste and also differences in aerobic/anaerobic environment of the landfill. However, if leachate is remained underwater (anaerobic condition) in the landfill, the quality became pejoration and in the case that leachate is not remained inside (aerobic or semi-aerobic condition) a BOD < COD trend that means the quality will quickly become favorable can observe.

(iii) Amount of gas production (final cover soil)

a. Measurement method and note for a measurement

As a method for measuring the amount of gas production from the final cover soil, a chamber method which set the chamber on the surface and calculating the flux of methane and carbon dioxide concentrations by the temporal change is generally used. In this method, the gas which is inside of the chamber should be sampled without any influence from the gas pressure, therefore a mixing device to maintain a homogeneous in the chamber is necessary. Also, the measurement time limit must be less than the time until each gas concentration reaches to gas saturation period, so the measurement time is less than 20 minutes in general.

In the case to evaluate the methane production by vegetation, these plants must be selected the normal plants that grow on bare land. However, as the vegetation differs with

regions, a type of vegetation that is highly sensitive to methane concentration needs to be confirmed in order to research the relationship between gas concentration and vegetation.

b. Measurement example

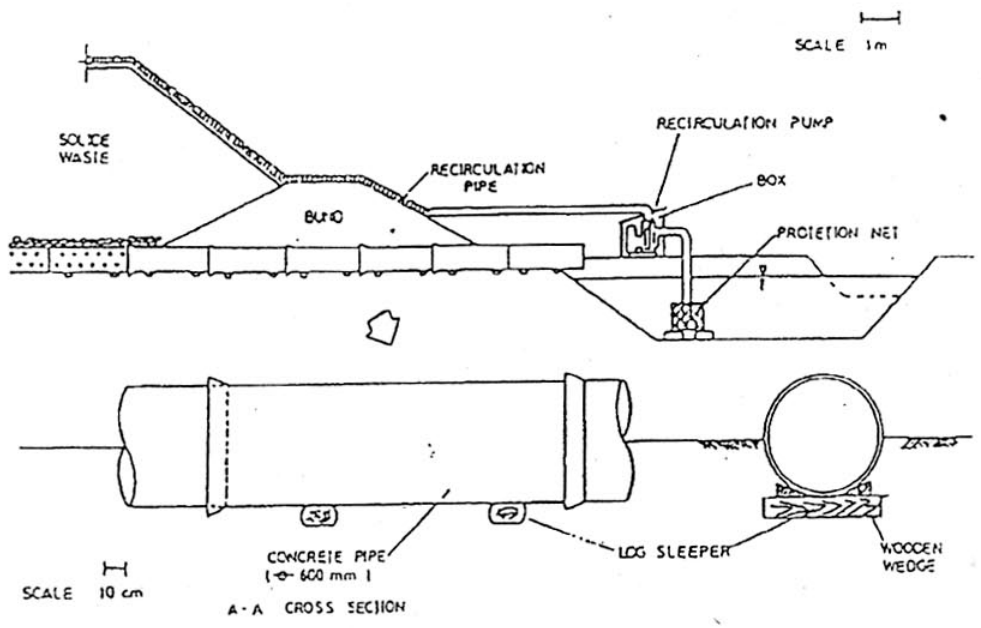
As mentioned before the amount of gas generated from the final disposal site differs with the landfill construction of the landfill. In an aerobic construction, 70% of the organic material in the landfill site is discharged as landfill gas, but in an anaerobic construction there is less gas generation. This is because in an anaerobic construction, the soluble organic components produced are discharged as leachate during degradation of organic material in the acid fermentation period. Also, the stabilization period which means after completely decomposition of organic material and the period where little or nothing generation of gas is prospected to be roughly 10 years for an aerobic construction. A semi-aerobic construction shows a similar gas generation pattern as aerobic construction but as the speed of generation is lower. Due to the period where gas generation is delayed compared to aerobic construction, it is considered that it will approach stabilization within 20 years. On the other hand, splitting the gas generation curve for an

anaerobic construction into two parts at the 5^{th} year, the curve for years 5 ~ 10 is a straight

line and there is no decrease in gas generation seen after the 10^{th} year.

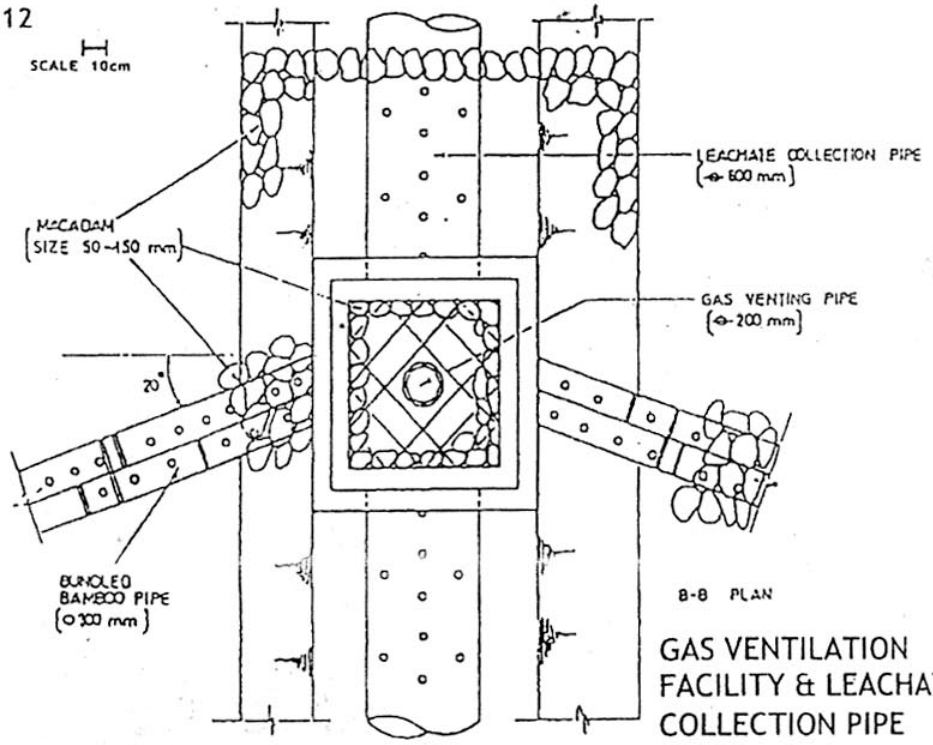
Measuring the amount of gas generated from the huge surface area such as the landfill requires a lot of work. Here, an example of evaluation of stabilization based on amount of gas generated using vegetation as a simple method is introduced. In general, methane affects growing of vegetation, but this effect differs greatly based on the type of vegetation. In the case that monitoring the amount of gas generated is necessary to choose some plants with high sensitivity to methane. Growth range of vegetation with respect to methane concentration is shown in Fig. 4-17. In the vegetation that grows naturally, growth of *arrowroot* and *tall golden rod* is hindered by a methane concentration of 0.02%. Growth of these plants is an indicator of reduction in methane concentration. In other words, if these plants are growing in the final cover soil, there is very little generation of methane which means it can be evaluated as being in stabilization stage.

FIG.11



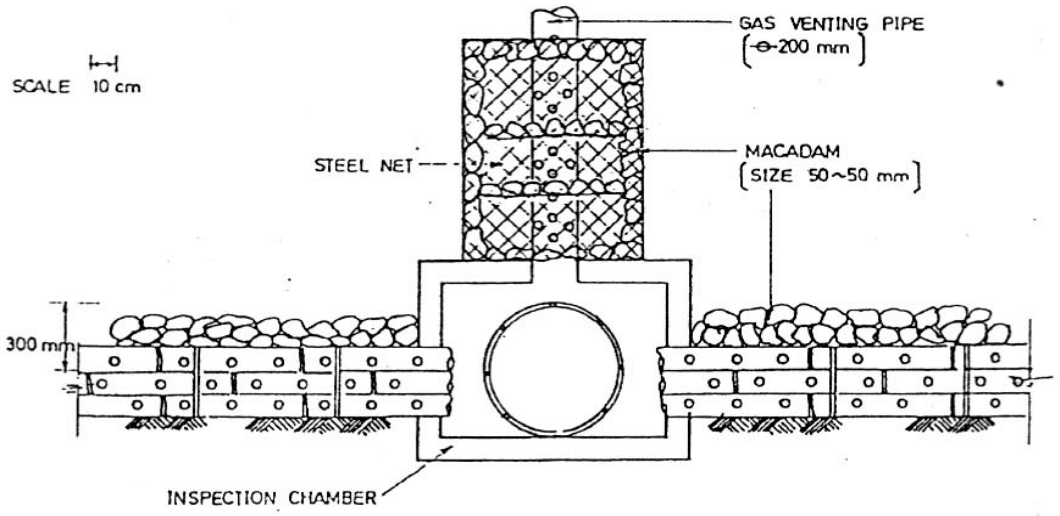
RE-CIRCULATORY SEMIAEROBIC LANDFILL TYPE

FIG.12



GAS VENTILATION FACILITY & LEACHATE COLLECTION PIPE

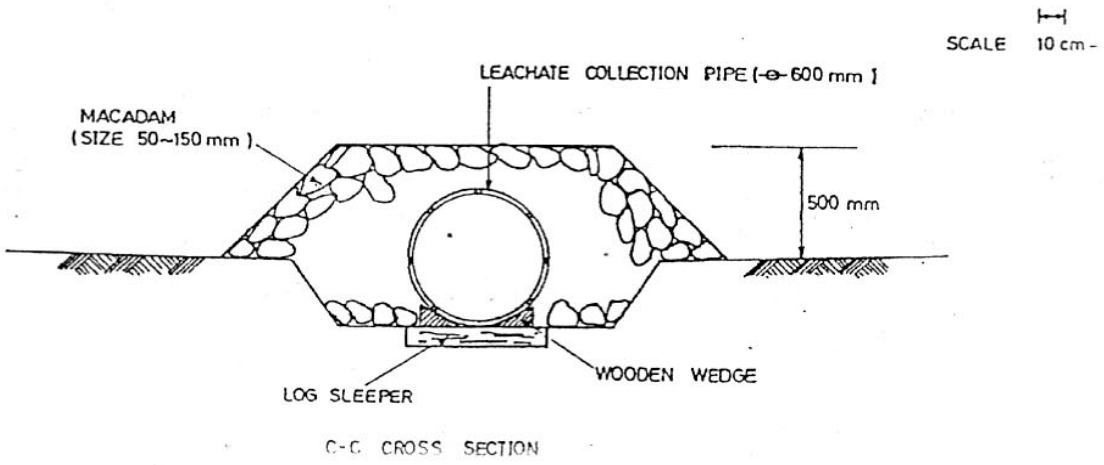
Fig. 13



B-B CROSS SECTION

GAS VENTILATION FACILITY

Fig. 14



C-C CROSS SECTION

LEACHATE COLLECTION FACILITY

IMAGES OF GEO MEMBRANE

LINNING ARRANGEMENTS OF GEO MEMBRANE

Plasticity Characteristics.

Plasticity characteristics describe a material's ability to behave as a plastic or moldable material. Soils containing clay are generally categorized as plastic. Soils that do not contain clay are non-plastic and typically considered unsuitable materials for compacted clay liners, unless soil amendments such as bentonite clay are introduced.

Plasticity characteristics are quantified by three parameters: liquid limit, plastic limit, and plasticity index. The liquid limit is defined as the minimum moisture content (in percent of oven-dried weight) at which a soil- water mixture can flow. The plastic limit is the minimum moisture content at which a soil can be molded. The plasticity index is defined as the liquid limit minus the plastic limit and defines the range of moisture content over which a soil exhibits plastic behavior. When soils with high plastic limits are too dry during placement, they tend to form clods, or hardened clumps, that are difficult to break down during compaction. As a result, preferential pathways can form around these clumps allowing leachate to flow through the material at a higher rate. Soil plasticity indices typically range from 10 percent to 30 percent. Soils with a plasticity index greater than 30 percent are cohesive, sticky and difficult to work with in the field. Common testing methods for plasticity characteristics include the methods specified in ASTM D-4318, also known as Atterberg limits tests.

Percent fines and percent gravel.

Typical soil liner materials contain at least 30 percent fines and can contain up to 50 percent gravel, by weight. Common testing methods for percent fines and percent gravel are specified in ASTM D-422, also referred to as grain size distribution tests.5 Fines refer to silt and clay- sized particles. Soils with less than 30 percent fines can be worked to obtain hydraulic conductivities below 1×10^{-7} cm/sec (4×10^{-8} in./sec), but use of these soils requires more careful construction practices.

Gravel is defined as particles unable to pass through the openings of a Number 4 sieve, which has an opening size equal to 4.76 mm (0.2 in.). Although gravel itself has a high hydraulic conductivity, relatively large amounts of gravel, up to 50 percent by weight, can be uniformly mixed with clay materials without significantly increasing the hydraulic conductivity of the material. Clay materials fill voids created between gravel particles, thereby creating a gravel-clay mixture with a low hydraulic conductivity. As long as the percent gravel in compacted clay

mixture remains below 50 percent, creating a uniform mixture of clay and gravel, where clay can fill in gaps, is more critical than the actual gravel content of the mixture.

You should pay close attention to the percent gravel in cases where a compacted clay liner functions as a bottom layer to a geosynthetic, as gravel can cause puncturing n geosynthetic materials. Controlling the maximum particle size and angularity of the gravel should help prevent puncturing, as well as prevent gravel from creating preferential flow paths. Similar to gravel, soil particles or rock fragments also can create preferential flow paths. To help prevent the development of preferential pathways and an increased hydraulic conductivity, it is best to use soil liner materials where the soil particles and rock fragments are typically small (e.g., 3/4 inch in diameter).

Interactions with Waste

Waste placed in a unit can interact with compacted clay liner materials, thereby influencing soil properties such as hydraulic conductivity and permeability. Two ways that waste materials can influence the hydraulic conductivity of the liner materials are through dissolution of soil minerals and changes in clay structure. Soil minerals can be dissolved, or reduced to liquid form, as a result of interaction with acids and bases. For example, aluminum and iron in the soil can be dissolved by acids, and silica can be dissolved by bases. While some plugging of soil pores by dissolved minerals can lower hydraulic conductivity in the short term, the creation of piping and channels over time can lead to an increased hydraulic conductivity in the long term. The interaction of waste and clay materials can also cause the creation of positive ions, or cations. The presence of cations such as sodium, potassium, calcium, and magnesium can change the clay structure, thereby influencing the hydraulic conductivity of the liner. Depending on the cation type and the clay mineral, an increased presence of such cations can cause the clay minerals to form clusters and increase the permeability of the clay. Therefore, before selecting a compacted clay liner material, it is important to develop a good understanding of the composition of the waste that will be placed in the waste management unit. EPA's Method 9100, in publication SW-846, measures the hydraulic conductivity of soil samples before and after exposure to permeants.

Locating and Testing Material

Although the selection process for compacted clay liner construction materials can vary from project to project, some common material selection steps include locating and testing materials at a potential borrow or commercial pit before construction, and observing and testing material

performance throughout construction. First, investigate a potential borrow or commercial pit to determine the volume of materials available. The next step is to test a representative sample of soil to determine material properties such as plasticity characteristics, percent gravel, and percent fines. To confirm the suitability of the materials once construction begins, you should consider requesting that representative samples from the materials in the borrow or commercial pit be tested periodically after work has started.

Material selection steps will vary,, depending on the origin of the materials for the project. For example, if a commercial pit provides. the materials, locating an appropriate onsite borrow pit is not necessary In addition to the tests performed on the material, it is recommended that a qualified inspector make visual observations throughout the construction process to ensure that harmful materials, such as stones or other large matter, are not present in the liner material.

What issues should be considered in the construction of a liner and the operation of a unit?

You should develop test pads to demonstrate construction techniques and material performance on a small scale. During unit construction and operation, some additional factors influencing the performance of the liner include: preprocessing, sub-grade preparation, method of compaction, and protection against desiccation and cracking. Each of these steps, from preprocessing through protection against desiccation and cracking, should be repeated for each lift or layer of soil.

Test Pads

Preparing a test pad for the compacted clay liner helps verify that the materials and methods proposed will yield a liner that meets the desired hydraulic conductivity. A test pad also provides an opportunity to demonstrate the performance of alternative materials or methods of construction. A test pad should be constructed with the soil liner materials proposed for a particular project, using the same preprocessing procedures, compaction equipment, and construction practices proposed for the actual liner. A complete discussion of test pads (covering dimensions, materials, and construction) can be found in Chapter 2 of EPA's 1993 technical guidance document Quality Assurance and Quality Control for Waste Containment Facilities (U.S. EPA, 1993c). A discussion of commonly used methods to measure in-situ hydraulic conductivity is also contained in that chapter.

Preprocessing

Although some liner materials can be ready for use in construction immediately after they are excavated, many materials will require some degree of preprocessing. Preprocessing methods include: water content adjustment, removal of oversized particles, pulverization of any clumps, homogenization of the soils, and introduction of additives, such as bentonite.

Water content adjustment.

For natural soils, the degree of saturation of the soil liner at the time of compaction, known as molding water content, influences the engineering properties of the compacted material. Soils compacted at water contents less than optimum tend to have a relatively high hydraulic conductivity. Soils compacted at water contents greater than optimum tend to have low hydraulic conductivity and low strength.

Proper soil water content revolves around achieving a minimum dry density, which is expressed as a percentage of the soil's maximum dry density. The minimum dry density typically falls in the range of 90 to 95 percent of the soil's maximum dry density value. From the minimum dry density range, the required water content range can be calculated, as shown in Figure 1. In this example the soil has a maximum dry density of 115 lb/cu ft. Based upon a required minimum dry density value of 90 percent of maximum dry density which is equal to 103.5 lb/cu ft, the required water content ranges from 10 to 28 percent.

It is less problematic to compact clay soil at the lower end of the required water content range because it is easier to add water to the clay soil than to remove it. Thus, if precipitation occurs during construction of a site which is being placed at the lower end of the required water content range, the additional water might not result in a soil water content greater than the required range. Conversely, if the site is being placed at the upper end of the range, for example at 25 percent, any additional moisture will be excessive, resulting in water content over 28 percent and making the 90 percent maximum dry density unattainable. Under such conditions construction should halt while the soil is aerated and excess moisture is allowed to evaporate.

Removal of oversized particles. Preprocessing clay materials, to remove cobbles or large stones that exceed the maximum allowable particle size, can improve the soil's compactibility and protect any adjacent geomembrane from puncture. Particle size should be small (e.g., 3/4 inch in diameter) for compaction purposes. If a geomembrane will be placed over the compacted clay,

only the upper lift of clay needs to address concerns regarding puncture resistance. Observation by quality assurance and quality control personnel is the most effective method to identify areas where oversized particles need to be removed. Cobbles and stones are not the only materials that can interfere with compactive efforts. Chunks of dry, hard clay, also known as clods, often need to be broken into smaller pieces to be properly hydrated, remolded, and compacted. In wet clay, clods are less of a concern since wet clods can often be remolded with a reasonable compactive effort.

Soil amendments. If the soils at a unit do not have a sufficient percentage of clay, a common practice is to blend bentonite with them to reduce the hydraulic conductivity Bentonite is a clay mineral that expands when it comes into contact with water. Relatively small amounts of bentomte, on the order of 5 to 10 percent, can be added to sand or other non-cohesive soils to increase the cohesion of the material and reduce hydraulic conductivity.

Sodium bentonite is a common additive used to amend soils. However, this additive is vulnerable to degradation as a result of contact with certain chemicals and waste leachates. Calcium bentonite, a more permeable material than sodium bentonite, is another common additive used to amend soils. Approximately twice as much calcium bentonite is needed to achieve a hydraulic conductivity comparable to that of sodium bentonite. Amended soil mixtures generally require mixing in a pug mill, cement mixer, or other mixing equipment that allows water to be added during the mixing process. Throughout the mixing and placement processes, water content, bentonite content, and particle distribution should be controlled. Other materials that can be used as soil additives include lime cement and other clay minerals, such as atapulgite. It can be difficult to mix additives thoroughly with cohesive soils, or clays; the resultant mixture might not achieve the desired level of hydraulic conductivity throughout the entire liner.

Subgrade Preparation

It is important to ensure that the subgrade on which a compacted clay liner will be constructed is properly prepared. When a compacted clay liner is the lowest component of a liner system, the subgrade consists of native soil or rock. Subgrade preparation for these systems involves compacting the native soil to remove any soft spots and adding water to or removing water from the native soil to obtain a specified firmness. Alternatively, in some cases, the compacted clay liner can be placed on top of a geosynthetic material, such as a geotextile. In such cases,

subgrade preparation involves ensuring the smoothness of the geosynthetic on which the clay liner will be placed and the conformity of the geosynthetic material to the underlying material.

Compaction

The main purpose of compaction is to densify the clay materials by breaking and remolding clods of material into a uniform mass. Since amended soils usually do not develop clumps, the primary objective of compaction for such materials is to increase the material's density. Proper compaction of liner materials is essential to ensure that a compacted clay liner meets specified hydraulic conductivity standards. Factors influencing the effectiveness of compaction efforts include: the type of equipment selected, the number of passes made over the materials by such equipment, the lift thickness, and the bonding between the lifts. Molding water content, described earlier under preprocessing, is another factor influencing the effectiveness of compaction.

Type of equipment Factors to consider when selecting compaction equipment include: the type and weight of the compactor, the characteristics of any feet on the drum, and the weight of the roller per unit length of drummed surface. Heavy compactors, weighing more than 50,000 pounds, with feet long enough to penetrate a loose lift of soil, are often the best types of compactor for clay liners. For bentonite-soil mixtures, a footed roller might not be appropriate. For these mixtures, where densification of the material is more important than kneading or remolding it to meet low hydraulic conductivity specifications, a smooth-drum roller or a rubber-tired roller might produce better results. Figure 2 depicts two types of footed rollers, a fully penetrating footed roller and a partially-penetrating footed roller.

For placement of liners on side slopes, consider the angle and length of the slope. Placing continuous lifts on a gradually inclined slope will provide better continuity between the bottom and sidewalls of the liner. Since continuous lifts might be impossible to construct on steeper slopes due to the difficulties of operating heavy compaction equipment on these slopes, materials might need to be placed and compacted in horizontal lifts. When sidewalls are compacted horizontally, it is important to avoid creating seepage planes, by securely connecting the edges of the horizontal lift with the bottom of the liner. Because the lift needs to be wide enough to accommodate compaction equipment, the thickness of the horizontal lift is often greater than the thickness specified in the design. In such cases, you should consider trimming soil material from the constructed side slopes and sealing the trimmed surface using a sealed drum roller.

It is common for contractors to use several different types of compaction equipment during liner construction. Initial lifts might need the use of a footed roller to fully penetrate a loose lift. Final lifts also might need the use of a footed roller for compaction, however, they might be formed better by using a smooth roller after the lift has been compacted to smooth the surface of the lift in preparation for placement of an overlying geomembrane.

Number of passes The number of passes made by a compactor over clay materials can influence the overall hydraulic conductivity of the liner. The minimum number of passes that is reasonable depends on a variety of site-specific factors and cannot be generalized. In some cases, where a minimum coverage is specified, it might be possible to calculate the minimum number of passes to meet such a specification. At least 5 to 15 passes with a compactor over a given point are usually necessary to remold and compact clay liner materials thoroughly.

An equipment pass can be defined as one pass of the compaction equipment or as one pass of a drum over a given area of soil. It is important to clearly define what is meant by a pass in any quality assurance or quality control plans. It does not matter which definition is agreed upon, as long as the definition is used consistently throughout the project.

Life thickness.

You should determine the appropriate thickness (as measured before compaction) of each of the several lifts that will make up the clay liner. The initial thickness of a loose lift will affect the compactive effort needed to reach the lower portions of the lift. Thinner lifts allow compactive efforts to reach the bottom of a lift and provide greater assurance that compaction will be sufficient to allow homogenous bonding between subsequent lifts. Loose lift thicknesses typically range between 13 and 25 cm (5 and 10 in.). Factors influencing lift thickness are: soil characteristics, compaction equipment, firmness of the foundation materials, and the anticipated compaction necessary to meet hydraulic conductivity requirements.

Bonding between lifts.

Since it is inevitable that some zones of higher and lower hydraulic conductivity, also known as preferential pathways, will be present within each lift, lifts should be joined or bonded in a way that minimizes extending these zones or pathways between lifts. If good bonding is achieved, the

preferential pathways will be truncated by the bonded zone between the lifts. At least two recommended methods exist for preparing proper bonds. The first method involves kneading, or blending the new lift with the previously compacted lift using a footed roller. Using a roller with feet long enough to fully penetrate through the top lift and knead the previous lift improves the quality of the bond. A second method involves using a disc harrow or similar equipment to scarify, or roughen, and wet the top inch of the recently placed lift, prior to placing the next lift.

Protection Against Desiccation and Cracking

You should consider how to protect compacted clay liners against desiccation and freezing during and after construction. Protection against desiccation is important, because clay soil shrinks as it dries. Depending on the extent of shrinkage, it can crack. Deep cracks, extending through more than one lift, can cause problems. You should measure water content to determine whether desiccation is occurring.

There are several ways to protect compacted clay liners from desiccation. One preventive measure is to smooth roll the surface with a steel drummed roller to produce a thin, dense skin of soil; this layer can help minimize the movement of water into or out of the compacted material. Another option is to wet the clay periodically in a uniform manner; however, it is important to make sure to avoid creating areas of excessive wetness. A third measure involves covering compacted clay liner materials with a sheet of white or clear plastic or tarp to help prevent against desiccation and cracking. The cover should be weighted down with sandbags or other material to minimize exposure of the underlying materials to air. Using a light-colored plastic will help prevent overheating, which can dry out the clay materials. If the clay liner is not being covered with a geosynthetic, another method to prevent desiccation involves covering the clay with a layer of protective cover soil or intentionally overbuilding the clay liner and shaving it down to liner grade.

Protection against freezing is another important consideration, because freezing can increase the hydraulic conductivity of a liner. It is important to avoid construction during freezing weather. If

freezing does occur and the damage affects only a shallow depth, the liner can be repaired by rerolling the surface. If deeper freezing occurs, the repairs might be more complicated. For a general guide to frost depths, see Figure 1 of Chapter 11— Performing Closure and Post-Closure Care.

Geomembranes or flexible membrane liners

Geomembranes or flexible membrane liners are used to contain or prevent waste constituents and leachate from escaping a waste management unit. Geomembranes are made by combining one or more plastic polymers with ingredients such as carbon black, pigments, fillers, plasticizers, processing aids, crosslinking chemicals, anti-degradants, and biocide. A wide range of plastic resins are used for geomembranes, including high density polyethylene (HDPE), linear low density polyethylene (LLDPE), low density linear polyethlene (LDLPE), very low density polyethlene (VLDPE), polyvinyl chloride (PVC), flexible polypropylene (IPP), chlorosulfonated polyethylene (CSPE or Hypalon), and ethylene propylene diene termonomer (EPDM). Most manufacturers produce geomembranes through extrusion or calendering. In the extrusion process, a molten polymer is stretched into a nonremforced sheet; extruded geomembranes are usually made of HDPE and LLDPE. During the calendaring process, a heated polymeric compound is passed through a series of rollers. In this process, a geomembrane can be reinforced with a woven fabric or fibers. Calendered geomembranes are usually made of PVC and CSPE.

What are the thickness recommendations for geomembrane liners?

Geomembranes range m thicknesses from 20 to 120 mil (1 mil = 0.001 in.). A good design should include a minimum thickness of 30 mil, except for HDPE liners, which should have a minimum thickness of 60 mil. These recommended minimum thicknesses ensure that the liner material will withstand the stress of struction and the weight load of the waste, and allow adequate seaming to bind separate geomembrane panels. Reducing the potential for tearing or puncture, through proper construction and quality control, is essential for a geomembrane to perform effectively.

What issues should be considered in the design of a geomembrane liner?

Several factors to address in the design include: determining appropriate material and testing to ensure these proper are met, understanding how the liner will interact with the intended waste stream, for all stresses imposed by the design, and ensuring adequate friction.

Material Properties and Selection

When designing a geomembrane liner, you should examine several properties of the geomembrane material in addition to thickness, including: tensile behavior, tear resistance, puncture resistance, susceptibility to environmental stress cracks, ultraviolet resistance, and carbon black content.

Tensile behavior.

Tensile behavior refers to the tensile strength of a material and its ability to elongate under strain. Tensile strength is the ability of a material to resist pulling stresses without tearing. The tensile properties, of a geomembrane must be sufficient to satisfy the stresses anticipated during its service life.

These stresses include the self-weight of the geomembrane and any down drag caused by waste settlement on side slope liners.

Puncture and tear resistance.

Geomembrane liners can be subject to tearing during installation due to high winds or handling. Puncture resistance is also important to consider since geomembranes are often placed above or below materials that might have jagged or angular edges. For example, geomembranes might be installed above a granular drainage system that includes gravel.

Susceptibilfty to environmental stress cracks.

Environmental factors can cause cracks or failures before a liner is stressed to its manufactured strength. These imperfect what dons, referred to as environmental stress cracks, often occur in areas where a liner has been scratched or stressed by fatigue. These cracks can also result in areas where excess surface wetting agents have been applied. In surface impoundments, where the geomembrane properties brine liner has greater exposure to the atmosphere and temperature changes, such exposure can increase the potential for environmental stress cracking.

Interactions With Waste

Since the main purpose of a geomembrane is to provide a barrier and prevent contaminants from penetrating through the geomembrane, chemical resistance is a critical consideration. Testing for chemical resistance might be warranted depending on the type, volumes, and characteristics of waste managed at a particular unit and the type of geomembrane to be used.

Stresses Imposed by Liner Design

A liner design should take into account the stresses imposed on the liner by the design configuration. These stresses include: the differential settlement in foundation soil, strain requirements at the anchor trench, strain requirements over long, steep side slopes, stresses resulting from compaction, and seismic stresses. Often an anchor trench designed to secure the geomembrane during construction is prepared along the perimeter of a unit cell. This action can help prevent the geomembrane from slipping down the interior side slopes. Trench designs should include a depth of burial sufficient to hold the specified length of liner. If forces larger than the tensile strength of the liner are inadvertently developed, then the liner could tear. For this reason, the geomembrane liner should be allowed to slip or give in the trench after construction to prevent such tearing. To help reduce unnecessary stresses in the liner design, it is advisble to avoid using horizontal seams.

Design for Adequate Friction

Adequate friction between the geomembrane liner and the soil subgrade, as well as between any geosynthetic components, is necessary to prevent extensive slippage or sloughing on the slopes of a unit. Design equations for such components should evaluate: 1) the ability of a liner to support its own weight on side slopes, 2) the ability of a liner to withstand down-dragging during and after waste placement, 3) the best anchorage configuration for the liner, 4) the stability of soil cover on top of a liner, and 5) the stability of other geosynthetic components, such as geotextiles or geonets, on top of a liner. An evaluation of these issues can affect the choice of geomembrane material, polymer type, fabric reinforcement, thickness, and texture necessary tO achieve the design requirements. Interface strengths can be significantly improved by using textured geomembranes.

What issues should be considered in the construction of a geomembrane liner*?*

When preparing to construct a geomembrane liner, you should plan appropriate shipment and handling procedures, perform testing prior to construction, prepare the subgrade, consider temperature effects, and account for wind effects. In addition, you should select a seaming process, determine a material for and method of backfilling, and plan for testing during construction.

Shipment, Handling, and Site Storage

We should follow quality assurance and quality control procedures to ensure proper handling of geomembranes. Different types of geomembrane liners require different types of packaging for shipment and storage. Typically a geomembrane manufacturer will provide specific instructions outlining the handling, storage, and construction specifications for a product. In general, HDPE and LIDPE geomembrane liners are packaged in a roll form, while PVC and CSPE-R liners (CSPE-R refers to a CSPE geomembrane liner reinforced with a fabric layer) are packaged in panels, accordion-folded in two directions, and placed onto pallets. ‘Whether the liner is shipped in rolls or panels, you should provide for proper storage. The rolls and panels should be packaged so that fork lifts or other equipment can safely transport them. For rolls, this involves preparing the roll to have a sufficient inside diameter so that a fork lift with a long rod, known as a stinger, can be used for lifting and moving. For accordion panels, proper packaging involves using a structurally-sound pallet, wrapping panels in treated cardboard or plastic wrapping to

protect against ultraviolet exposure, and using banding straps with appropriate cushioning. Once the liners have been transported to the site, the rolls or panels can be stored until the subgrade or subbase (either natural soils or another geosynthetic) is prepared.

Subgrade Preparation

Before a geomembrane liner is installed, you should prepare the subgrade or subbase. The subgrade material should meet specified grading, moisture content, and density requirements. In the case of a soil subgrade, it is important to prevent construction equipment used to place the liner from defonning the underlying materials. If the underlying materials are geosynthetics, such as geonets or geotextiles, We should remove all folds and wrinkles before the liner is placed.

Testing Prior to Construction

Before any construction begins, is it recommended that you test both the geomembrane materials from the manufacturer and the installation procedures. Acceptance and conformance testing is used to evaluate the performance of the manufactured geomembranes. Constructing test strips can help evaluate how well the intended construction process and quality control procedures will work.

Acceptance and conformance testing.

We should perform acceptance arid conformance testing on the geomembrane liner received from the manufacturer to determine whether the materials meet the specifications requested. While the specific ASTM test methods vary depending on geomembrane type, recommended acceptance and conformance testing for geomembranes includes evaluations of thickness, tensile strength and elongation, and puncture and tear resistance testing, as appropriate. For most geomembrane liner types, the recommended ASTM method for testing thickness is ASTM D5199. For measuring the thickness of textured geomembranes, We should use ASTM D-5994. For tensile strength and elongation, ASTM D-638 is recommended for the HDPE and UJ)PE sheets, while ASTM D-882 and ASTM D-751 are recommended for PVC and CSPE geomembranes, respectively. Puncture resistance testing is typically recommended for HDPE and LLDPE geomembranes using ASTM D-4833.To evaluate tear resistance for HDPE, LLDPE, and PVC geomembrane liners, the recommended testing method is ASTM D-1004, Die C.’2 For

CSPE-R geomembranes, ply adhesion is more of a concern than tear or puncture resistance and can be evaluated using ASTM D-413, Machine Method,

Test strips. In preparation for liner placement and field seaming, We should develop test strips and trial seams as part of the construction process. Construction of such samples should be performed in a manner that reproduces all aspects of field production. Providing an opportunity to test seaming methods and workmanship helps ensure that the quality of the seams remains constant and meets specifications throughout the entire seaming process.

Temperature Effects

Liner material properties can be altered by extreme temperatures. High temperatures can cause geomembrane liner surfaces to stick together, a process commonly referred to as blocking. On the other hand, low temperature can cause the liner to crack when unrolled or unfolded. Recommended maximum and minimum allowable sheet temperatures for unrolling or unfolding geomembrane liners are 50°C (122°F) and 0°C (32°F), respectively. In addition to sticking and cracking, extreme temperatures can cause geomembranes to contract or expand. Polyethylene geomembranes expand when heated and contract when cooled. Other geomembranes can contract slightly when heated. Those responsible for placing the liner should take temperature effects into account as they place, seam, and backfill in the field.

Wind Effects

It is recommended that you take measures to protect geomembrane liners from wind damage. Windy conditions can increase the potential for tearing as a result of uplift; if wind uplift is a potential problem, panels can be weighted down with sand bags.

Seaming Processes

Once panels or rolls have been placed, another critical step involves field-seaming the separate panels or rolls together. The selected seaming process, such as thermal or chemical seaming, will depend on the chemical composition of the liner. To ensure the integrity of the seam, you should use the seaming method recommended by the manufacturer. Thermal seaming uses heat to bond together the geomembrane panels. Examples of thermal seaming processes include extrusion welding and thermal fusion (or melt bonding). Chemical seaming involves the use of solvents,

cement, or an adhesive. Chemical seaming processes include chemical fusion and adhesive seaming.

Consistent quality in fabricating field seams is paramount to liner performance. Conditions that could affect seaming should be monitored and controlled during installation. Factors influencing seam construction and performance include; ambient temperature, relative humidity, wind uplift, changes in geomembrane temperature, subsurface water content, type of supporting surface used, skill of the seaming crew, quality and consistency of chemical or welding materials, preparation of liner surfaces to be joined, moisture at the seam interface, and cleanliness of the seam interface.

To help control some of these factors, no more than the amount of sheeting that can be used during a shift or a work day should be deployed at one time. To prevent erosion of the underlying soil surface or washout of the geomembrane, proper storm water control measures should be employed. Ambient temperature can become a concern, if the geomembrane liner has a high percentage of carbon black. Although the carbon black will help to prevent damage resulting from ultraviolet radiation, because its dark color absorbs heat, it can increase the ambient temperature of the geomembrane, making installation more complicated. To avoid surface moisture or high subsurface water content, geomembranes should not be deployed when the subgrade is wet.

Regardless of how well a geomembrane liner is designed, its ability to meet performance standards depends on proper quality assurance and quality control during installation.

Geomembrane sheets and seams are subject to tearing and puncture during installation; punctures or tears can result from contact with jagged edges or underlying materials or by applying stresses greater than the geomembrane sheet can handle. Proper quality assurance and quality control can help minimize the occurrence of pinhole or seam leaks. For example, properly preparing the underlying layer and ensuring that the gravel is of an acceptable size reduces the potential for punctures.

Protection and Back filling

Geomembrane liners that can be damaged by exposure to weather or work activities should be covered with a layer of soil or a geosynthetic as soon as possible after quality assurance activities associated with geomembrane testing are completed. If the backfill layer is a soil material, it will

typically be a drainage material like sand or gravel. If the cover layer is a geosynthetic, it will typically be a geonet or geocomposite drain placed directly over the geomembrane. Careful placement of backfill materials is critical to avoid puncturing or tearing the geomembrane material.

For soil covers, three considerations determine the amount of slack to be placed in the underlying geomembrane. These considerations include selecting the appropriate type of soil, using the proper type of equipment, and establishing a placement procedure for the soil. When selecting a soil for backfilling, characteristics to consider include particle size, hardness, and angularity, as each of these can affect the potential for tearing or puncturing the liner. To prevent wrinkling, soil covers should be placed over the geomembrane in such a way that construction vehicles do not drive directly on the liner. Care should be taken not to push heavy loads of soil over the geomembrane in a continuous manner. Forward pushing can cause localized wrinkles to develop and overturn in the direction of movement. Overturned wrinkles create sharp creases and localized stress in the liner and can lead to premature failure. A recommended method for placing soil involves continually placing small amounts of soil or drainage material and working outward over the toe of the previously placed material.

Another recommended method involves placing soil over the liner with a large back- hoe and spreading it with a bulldozer or similar equipment. If a predetermined amount of slack is to be placed in the geomembrane, the temperature of the liner becomes an important factor, as it will effect the ability of the liner to contract and expand. Although the recommended methods for covering geomembrane liners with soil can take more time than backfilling with larger amounts of soil, these methods are designed to prevent damage caused by covering the liner with too

Nondestructive testing.

Unlike destructive tests, which examine samples taken from the geomembrane liner in the containment area, nondestructive tests are designed to evaluate the integrity of larger portions of geomembrane seams without removing pieces of the geomembrane for testing. Common nondestructive testing methods include: the probe test, air lance, vacuum box, ultrasonic methods (pulse echo, shadow, and impedance planes), electrical spark test, pressurized dual seam, and electrical resistivity. You should select the test method most appropriate for the material and seaming method. If sections of a seam fail to meet the acceptable criteria of the appropriate nondestructive test, then those sections need to be delineated and patched, reseamed, or retested.

If repairing such sections results in large patches or areas of reseaming, then destructive test methods are recommended to verify the integrity of such pieces

Geosynthetic Clay Liners

If a risk evaluation recommended the use of a single liner, another option to consider is a geosynthetic clay liner (GCL). GCI_s are factory-manufactured, hydraulic barriers typically consisting of bentonite clay (or other very low permeability materials), supported by geotextiles or geomembranes held together by needling, stitching, or chemical adhesives. GCIs can be used to augment or replace compacted clay liners or geomembranes, or they can be used in a composite manner to augment the more traditional compacted clay or geomembrane materials. GCLs are typically used in areas where clay is not readily available or where conserving air space is an important factor. As GCLs do not have the level of long-term field performance data that geomembranes or compacted clay liners do, states might request a demonstration that performance of the GCL design will be corn parable to that of compacted clay or geornembrane liners.

What are the mass per unit area and hydraulic conductivity recommendations for geosynthetic clay liners?

Geosynthetic clay liners are often designed to perform the same function as compacted clay and geomembrane liner components. For geosynthetic clay liners, you should design for a minimum of 3.7 kg/rn2 (0.75 lb/ft^2) dry weight (oven dried at 105°C) of bentonite clay with a hydrated hydraulic conductivity of no more than 5 x 10^{-9} cm/sec (2 x 10 in/see). It is important to follow manufacturer specifications for proper GCL installation.

What issues should be considered in the design of a geosynthetic clay liner?

Factors to consider in GCL design are the specific material properties needed for the liner and the chemical interaction or compatibility of the waste with the GCL. When considering material properties, it is important to keep in mind that bentonite has a low shear strength when it is hydrated. Manufacturers have developed products designed to increase shear strength.

Materials Selection and Properties

For an effective GCL design, material properties should be clearly defined in the specifications used during both manufacture and construction. The properties that should be specified include:

type of bonds, thickness, moisture content, mass per unit area, shear strength, and tensile strength. Each of these properties is described below.

Type of bonds. Geosynthetic clay liners are available with a variety of bonding designs, which include a combination of clay, adhesives, and geomembranes or geotextiles. The type of adhesives, geotextiles, and geomembranes used as components of GCLs varies widely. One type of available GCL design uses a bentonite clay mixed with an adhesive bound on each side by geotextiles. A variation on this design involves stitching the upper and lower geotextiles together through the clay layer. Alternatively, another option is to use a GCL where geotextiles on eachside of adhesive or nonadhesive bentonite clay are connected by needle punching. A fourth variation uses a clay mixed with an adhesive bound to a geomembrane on one side; the geomembrane can be either the lower or the upper surface. Figure 3 displays cross section sketches of the four variations of GCL bonds. While these options describe GCLs available at the time of this Guide, emerging technologies in GCL designs should also be reviewed and considered.

Thickness. The thickness of the various available GCL products ranges from 4 to 6 mm (160 to 320 mil). Thickness measurements are product dependent. Some GCLs can be quality controlled for thickness while others cannot.

Moisture content. GCLs are delivered to the job site at moisture contents ranging from 5 to 23 percent, referred to as the “dry” state. GCLS are delivered dry to prevent premature hydration, which can cause unwanted variations in the thickness of the clay component as a result of uneven swelling.

Stability and shear strength. GCLs should be manufactured and selected to meet the shear strength requirements specified in design plans. In this context, shear strength is the ability of two layers to resist forces moving them in opposite directions. Since hydrated bentonite clay has low shear strength, bentonite clay can be placed between geotextiles and stitch bonded or needle-punched to provide additional stability For example, a GCL with geotextiles supported by stitch bonding has greater internal resistance to shear in the clay layer than a GCL without any stitching. Needle-punched GCLs tend to provide greater resistance than stitch-bonded GCLs and can also provide increased friction resistance against an adjoining layer, because they require the use of nonwoven geotextiles. Increased friction is an important consideration on side slopes..

Mass per unit area. Mass per unit area refers to the bentonite content of a GCL. It is important to distribute bentonite evenly throughout the GCL in order to meet desired hydraulic conductivity specifications. All GCL products available in North America use a sodium bentonite clay with a mass per unit area ranging from 3.2 to 6.0 kg/rn2 (0.66 to 1.2 lb/ft9, as manufactured.

Interaction With Waste

During the selection process .for a GCL liner, you should evaluate the chemical compatibility of the liner materials with the types of waste that are expected to be placed in the. unit. Certain chemicals, such as calcium, can have an adverse effect on GCLs, resulting in a loss of liner integrity. Specific information on GCL compatibilities should be available from the manufacturer.

What issues should be considered in the construction of a geosynthetic clay liner?

Prior to and during construction, it is recommended that a qualified professional should prepare construction specifications for the GCL. In these specifications, procedures for shipping and storing materials, as well as performing acceptance testing on delivered materials, should be identified. The specifications should also address methods for sub- grade preparation, joining panels, repairing sections, and protective backfilling.

Shipment, Handling, and Site Storage

GCLs are manufactured in widths of approximately 2 to 5 m (7 to 17 ft) and lengths of 30 to 60 m (100 to 200 ft). Directly after manufacturing, GCLs are rolled around a core and covered with a thin plasuc protective covering. This waterproof covering serves to protect the material from premature hydration. GCLs should be stored at the factory with these protective coverings. Typical storage lengths range from a few days to 6 months. To ensure protection of the plastic covering and the rolls themselves during loading and unloading, it is recommended that qualified professionals specify the equipment needed at the site to lift and deploy the rolls properly.

To reduce the potential for accidental damage or for GCIs to absorb moisture at the site, you should try to arrange for “Justin-time-delivery” for GCL.s transported from the factory to the field. Even with “just-in- time-delivery,” it might be necessary to store GCLs for short periods of time at the site. Often the rolls can be delivered in trailers, which can then serve as temporary storage. To help protect the GCLS prior to deployment, you should use wooden pallets to keep

the rolls off the ground, placing heavy waterproof tarps over the GCL rolls to protect them from precipitation, and using sandbags to help keep the tarps in place.

Manufacturer specifications should also indicate how high rolls of GCIs can be stacked horizontally during storage. Over- stacking can cause compression of the core around which the GCL is wrapped. A damaged core makes deployment more difficult and can lead to other problems. For example, rolls are sometimes handled by a fork lift with a stinger attached. The stinger is a long tapered rod that fits inside the core. If the core is crushed, the stinger can damage the liner during deployment.

Acceptance and Conformance Testing

Acceptance and conformance testing is recommended either upon delivery of the GCL rolls orat the manufacturer's facility prior to delivery. Conformance test samples are used to ensure that the GCL meets the project plans and specifications. GCLs should be rewrapped and replaced in dry storage areas immediately after test samples are removed. liner specifications should prescribe sampling frequencies based on either total area or on number of rolls. Since variability in GCLs can exist between individual rolls, it is important for acceptance and conformance testing to account for this. Conformance testing can include the following.

Mass per unit area test. The purpose of evaluating mass per unit area is to ensure an even distribution of bentonite throughout the GCL panel. Although mass per unit area varies from manufacturer to manufacturer, a typical minimum value for oven dry weight is 3.7 kg/rn2 (0.73 lb/ft') Mass per unit area should be tested using ASTM D-5993.'4 This test measures the mass of bentonite per unit area of GCL. Sampling frequencies should be determined using ASTM D-435415

Free swell test. Free swell refers to the

ability of the clay to absorb liquid. Either ASTM D-5890 or GRI-GCL1, a test method developed by the Geosynthetic Research Institute, can be used to evaluate the free swell of the material.

Direct shear test. Shear strength of the GCL.s can be evaluated using ASTM D-5321. The sampling frequency for this performance- oriented test is often based on area, such as one test per 10,000 m^2 (100,000 ft^2).

Hydraulic conductivity test. Either ASTM D-5084 (modified) or GRI-GCL2 will measure the ease with which liquids can move through the GCL.'8

Other tests. Testing of any geotextiles or geomembranes should be made on the original rolls of the geotextiles or geomembranes and before they are fabricated into the GCL. product. Once these materials have been made part of the GCL product, their properties can change as a result of any needling, stitching, or gluing. Additionally, any peel tests performed on needle punched or stitch bonded GCLs should use the modified ASTM D-413 with a recommended sampling frequency of one test per 2,000 m2 (20,000 ft2)."

Subgrade Preparation

Because the GCL layer is relatively thin, the first foot of soil underlying the GCL should have a hydraulic conductivity of 1 x 10' cm/sec or less. Proper subgrade preparation is essential to prevent damage to the GCL layer as it is installed. This includes clearing away any roots or large particles that could potentially puncture the GCL and its geotextile or geomembrane components. The soil subgrade should be of the specified grading, moisture content, and density required by the installer and approved by a construction quality assurance engineer for placement of the GCL. Construction equipment deploying the rolls should not deform or rut the soil subgrade excessively. To help ensure this, the soil subgrade should be smooth rolled with a smooth-wheel roller and maintained in a smooth condition prior to deployment.

Joining Panels

GCLs are typically joined by overlapping panels, without sewing or mechanically connecting pieces together. To ensure proper joints, you should specify minimum and maximum overlap distances. Typical overlap distances range from 150 to 300 mm (6 to 12 in.). For some GCLs, such as needle punched GCLs with nonwoven geotextiles, it might be necessary to place bentonite on the area of overlap. If this is necessary you should take steps to prevent fugitive bentonite particles from coming into contact with the leachate collection system, as they can cause physical clogging.

Repair of Sections Damaged During Liner Placement

During installation, GCLs might incur some damage to either the clay component or to any geotextiles or geomembranes. For damage to geotextile or geomembrane components, repairs

include patching using geotextile or geomembrane materials. If the clay component is disturbed, a patch made from the same GCL product should be used to perform any repairs.

Protective Back filling

As soon as possible after completion of quality assurance and quality control activities, you should cover GCLs with either a soil layer or a geosynthetic layer to prevent hydration. The soil layer can be a compacted clay liner or a layer of coarse drainage material. The geosynthetic layer is typically a

SALIENT FEATURES

1. Operation and Maintenance of 02 (two) weigh bridge, installed on the site, on 24/7 basis. The contractor will weigh all incoming loaded garbage vehicle and he will also weigh the empty out going garbage vehicle to determine the net weight of the received garbage. The contractor will provide one weigh slip to driver of garbage. The contractor will provide one weigh slip to driver of garbage vehicle one to KMC and keep one for his own record.
2. Preparation of landfill base.
3. Provide and laying or leachate collection system according to fukouka method semi – aerobic system and as per the direction of engineer in charge.
4. Providing and erection of landfill gas ventilation system according to fukouka method semi-aerobic system and as per the direction of engineer in charge.
5. Construction and maintenance of leachate recycling system according to fukouka method semi-aerobic system and as per the direction of engineer in charge.
6. Spreading and compaction of waste on prepared cell thickness of waste should not be more than 03 feet to get required compaction. The density of compacted waste must be greater than 600 kg cubic meters. The highest compaction is obtained by compacting from base of the landfill.
7. A minimum of 03 horizontal to one vertical waste slopes should be maintained on all internal waste faces.
8. Providing daily soil cover of 6 inches thickness.
9. Providing intermediate clay cover of the 2 feet thickness for lifts greater than 9 meters.
10. Construction of temporary swales to divert the surface water away from the landfill site.
11. Construction of earth dam around active cell to prevent the run off waste contact liquid from the landfill.
12. Construction of temporary internal roads and its maintenance.
13. Spraying of water on internal kacha roads for dust control.
14. Installation of clear and visible on site directional signs for proper traffic routing.
15. Providing and posting of armed security guards at the land fill area to make sure that no burning of waste and proper dumping at the active area. At least 12 arms guard must be posted on 24/7 basis.
16. Providing, installation and maintenance of one generator 0f 30KV
17. The contractor shall level the burned garbage /ash and cover with soil with 30 cm of thickness at open areas of the landfill site or transfer the same to the through dumpers on contractor’s expenses and same will not be weighed on the landfill weighbridge for any kind of payment.
18. Construction and erection of 50 numbers gas ventilation pipes in the old waste dumps lift up to 15 feet.
19. If the garbage is being dumped to on area other than the old or new cell than the contractor will pay a penalty of Rs. 20,000/ per day.
20. The contractor will adopt all safety issue on his own behalf and the department will not be responsible for any safety issue or accident if happen during the contract period.

21. The contractor will be bound with all the Federal & Provincial Rules regarding environment and he will follow all the rules and regulations as an imposed by the Environmental Regulatory agencies or authorities.
22. The contractor before start of the work will provide work management plan with complete list of number of Tools and Plants and Field staff.
23. The contractor will provide Weekly Progress Report of the work to the Director Office with the signature of deputed designated field staff or Engineer concerned from the department head.
24. The contractor will also prepare and submit a comprehensive presentation of the project at the end or completion of the work before final payment.
25. The contractor will maintain the quality of the work in any condition and specially the work of spreading and laying of Geomembrane and Rubber sheet will be done as per International standard and as per direction of the Engineer-in-charge.

KARACHI METROPOLITAN CORPORATION

OFFICE OF THE CHIEF ENGINEER (CONTRACT MANAGEMENT)

MUNICIPAL SERVICES DEPARTMENT

Room # 409, 4th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi

No. CE (CM)/MS/KMC/316/15 **Dated:02 -11-2015**

NOTICE INVITING TENDER

Tender in sealed covers are invited for the following work from reputable firms, having experience of similar nature work:

Sr.#	Tender Reference No.	Name of Scheme	Estimated Cost	Bid Security in shape of Pay Order or Bank Guarantee in favour of KMC	Tender Cost In shape of paid Challan in favour of KMC (Non-Refundable)	Eligibility Criteria
1	2	3	4	5	6	7
1.	KMC/MS/CM/ 13/15-16	Providing and Fixing Tires & Tubes for Fire Vehicles and Allied Vehicles for Fire Brigade Department, MS, KMC.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
2.	KMC/MS/CM/ 14/15-16	Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant supply.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
3.	KMC/MS/CM/ 15/15-16	Rate Running Contract of the work of Repair and Maintenance of Mechanical Sweepers, Tractor MF-240 and Tractor MF-385 (MPD) MS, KMC for the year of 2015-16. (Re-invite).	Offer Rate	Rs.8,00,000/-	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
4.	KMC/MS/CM/ 16/15-16	Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II).	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
5.	KMC/MS/CM/ 17/15-16	Remote Controlled Trailer Mounted Lighting Towers 04 Nos. for disasters & Fire Fighting Purpose for Fire Brigade Department.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
6.	KMC/MS/CM/ 18/15-16	Modification of Grab Crane increase of Boom with Hydraulically operated etc.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
7.	KMC/MS/CM/ 19/15-16	Refurbishment of Wheel Loader Model Lie Gong-856.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
8.	KMC/MS/CM/ 20/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional**

						Tax.
9.	KMC/MS/CM/ 21/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

TERMS & CONDITIONS

1. Tender schedule shall be as follows:

SCHEDULE	DATE & TIME	VENUE
1. Receiving of Application & Issuance of Tender	**From 12-11-2015** To **04-12-2015** During Office Hours	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
		Office of Director (Planning), F&A Department, 6th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
		Office of Deputy Director (Accounts), Administrator Secretariat, Karachi 1st Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
2. Dropping of Tender	**07-12-2015** at **2:00 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
3. Opening of Tender	**07-12-2015** at **2:30 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.

2. The tender documents will be issued to the firms on submission of application in their original letter head alongwith original paid challan in the prescribed account of KMC for tender cost as mentioned above. This challan can be obtained from the office of tender sale as mentioned in this NIT.

3. The tender in sealed cover superscripted with the name of work should be dropped in the tender box kept in the committee room of the office of Sr. Director (Municipal Services) KMC.

4. In case the date of opening declared as a public holiday by the Government, or Non working day due to force Majeure the next official working day shall be deemed to be the date for submission and opening of tenders at the same time.

5. **Substantially Responsive Bid:-**

   Only those bids, which comply with the each eligibility & minimum qualification criteria attached with the tender documents shall be declared substantially responsive bids and will be eligible for further evaluation, otherwise the same will be declared as non responsive / rejected.

6. Bid Security of bid amount in the form of a pay order or bank guarantee from any schedule bank should be enclosed with the tender which will be retained till finalization of the case.
7. Canvassing in connection with tenders is strictly prohibited and tenders submitted by the contractors who report canvassing will liable for rejection.
8. KMC may reject all or any bids or proposals at any time prior to the acceptance of a bid or proposals, subject to the relevant provisions of SPP Rules 2010.

Sd/=

Chief Engineer (CM) MS, KMC

KARACHI METROPOLITAN CORPORATION

Bank Deposit Challan

MUNCIPAL SERVICES DEAPRTMENT, KMC

The Manger,
Habib Bank Ltd,
KMC Branch

BANK CODE	0	1

BANK ACCOUNT NO.	2	6	0	4	-	5	7		

DATE

BRANCH CODE	0	0	1	5

BANK ACCOUNT CODE	5	7

BANK BRANCH Please receive the amount as noted below for credit to the account of KMC mentioned above and as specified here below:-

Depositor's Name & Address	Particulars (To be filled up by Department)	☐ Cheque / Pay Order / Demand Draft			Amount
		Name of Bank	No.	Date	Rs.
M/s	Deposit of tender Cost Fee for the work of Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site Tender Enquiry # **KMC/MS/CM/21/15-16** To be opened on 07-12-2015				
		☐ **Cash Rs.**			
				Total	

Rupees in Words _____

Note: It is valid if to be deposited on or before the last date of sale of tender as mentioned in the NIT or its corrigendum, if any. If the same are furnished on the given date of sale in the office of the tender issuing authority, the tender will be issued.

Bank Stamp

Signature Bank Cashier

Signature of Depositor

Signature with stamp
Accountant/Assistant Accounts Officer
Drawing & Disbursing Officer

Signature Bank Officer

CHALLAN NO.

BIDDING DATA

A	Name of Procuring Agency:	Karachi Metropolitan Corporation (KMC)
B	Brief Description of Work:	**DEVELOPMENTS OF ENGINEERED SANITARY LANDFILL SITE FOR MUNICIPAL SOLID WASTE FOR GONDPASS LANDFILL SITE**
C	Procuring Agency Address:	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
D	Estimated Cost:	Offer Rate
E	Amount of Bid Security:	Offer Rate
F	Period of Bid validity (Days):	90 Days
G	Security Deposit (i/c Bid Security):	(10 % of Quoted Amount)
H	Percentage, if any, to be deducted from bills:	(5% to be deducted from Running Bills)
I	Deadline for submission of bid along with time:	04-12-2015 (During Office Hours)
J	Venue, Time and date of Bid Opening:	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
K	Liquidity Damages:	
I	Deposit Receipt No. Date & Amount:	

PRICE SCHEDULE

SUBJECT: - **DEVELOPMENTS OF ENGINEERED SANITARY LANDFILL SITE FOR MUNICIPAL SOLID WASTE FOR GONDPASS LANDFILL SITE.**

Sr. #	Description	Quantity Per Day	Rate	Rate in Word	Unit	Amount
1	2	3	4	5	6	7
A.	The amount of garbage dumped to designated landfill site as per scope of work and terms and conditions of the tender documents	1000			Ton	
B.	The amount of garbage dumped to designated landfill site as per scope of work and terms and conditions of the tender documents	1001 upto 1500			Ton	
C.	The amount of garbage dumped in old constructed cell up to the period of new constructed cell (03 months)	1000			Ton	

Sr. #	Description	Quantity Per Day	Rate	Rate in Word	Unit	Amount
1	2	3	4	5	6	7
D.	The amount of garbage dumped in old constructed cell up to the period of new constructed cell (03 months)	1001 upto 1500			Ton	
					Total Amount Quoted	
Amounts in Word: -						

NOTE: - For the calculation purpose the rate of the lowest bidder will be average of A,B,C & D.

Detailed of 2% Earnest Money: -

1500 Tons x365 Days x Average Quoted Rate (A,B,C,D) x 2%

Checked & Verified by:
Additional Director (SWM), MS, KMC

I/We quoted the price schedule and bound ourselves to comply all terms and conditions of this contract with all existing rules and regulations of KMC and I have attached an 2% Earnest Money in shape of Pay Order / Bank Guarantee _____ No. _____

(Pay Order / Bank Guarantee)

Dated_____ issued from _____

Amounting Rs._____/- in favour of Karachi Metropolitan Corporation (KMC).

We / I read the standard Bidding Documents available in SPPRA / KMC WEB site and agreed to abide all of them and also provide all these documents with our signature as & when directed

Signature of Bidder with Stamp

TERMS AND CONDITIONS SPECIAL

1. The contractor must quote the rates as per the tons tipping fee however, to calculate the rates an estimate annexed at A for convenience. The payment will be made as per actual quantity of waste received per day.

2. The current rate of diesel fuel, which is Rs.86 /liter (one hundred and three Rupees per liter), shall be the basic rate for calculate of bid value by the contractor .Any increase/ decrease in the basic rate during the currency of the contract shall be payable /receivable to or by the contractor on the basis of diesel consumption per day for all fill operation. The difference shall be calculated as follows.

   Difference in the basic rate X consumption of diesel per day X no. of days work done.
   The contractor shall produce receipt of diesel if the contractor claims any increase in diesel prices. However, in case of any decrease in the diesel rate if the contractor fails to produce diesel receipts the diesel consumption /day for the all operations at the landfill site be considered 400 litters.

3. The bids shall be inclusive of all incidental charges in connection with the work.

4. Unless otherwise directed the contractor shall continue to work at the same rates and on same terms and conditions of contract till such time arrangement are made by the employer for fresh contract and award of further work even after expiry of present contract.

5. The contract for 12 month and may be extended for 01 to 03 years subject to satisfactory performance of contractor.

6. In the event contractor leaves the work before stipulated period of contract, the security deposit shall be forfeited.

7. The contactor shall be submitted its bills on fortnightly basis which shall be checked scrutinized for the fulfillment of contractor obligation under the contract and shall be paid after verification and approval of the authority.

8. Daily received garbage from respective DMC and other agencies and KMC must be written on the board present in the office and monthly DMC,s report also be written on another board which is also present in the office. The contractor will also submit monthly report regarding the total of tonnage of waste coming from each DMC, other agencies.

9. The KMC shall be at liberty to direct the contractor to remove forthwith any person provided by the contractor at the work, who in opinion of KMC misconduct himself, or is in competent or negligent in proper performance of his duties or whose presence on site is otherwise considered by KMC to be undesirable, and such person shall not again allowed upon the work without the consent of KMC. Any person removed from the work shall be replaced as soon as possible.
10. The contractor shall at all times take all reasonable precaution to prevent any lawful, riotous or disorderly conduct by or amongst employee and for the preservation of peace and protection of person and property in neighborhood of the work

11. The contractor shall not recruit or attempt to recruit his staff and labor amongst person in service or employee.

12. Contractor shall provide of list of their employees.

13. Contractor shall keep all the equipment and other facilities handed over to him by the KMC in good conditions.

14. In case of failure to complete new cell in 03 month of fresh contract penalty of Rs. 50000 (fifty thousands) imposed per day, which shall be deducted from contractor bills.

15. Contractor shall not make alteration in vehicle or machinery with out written approval of the department concerned.

16. The vehicle will be parked at designated landfill work shop area on contractor responsibility.

17. No staff vehicle will be used for any work other than assigned in the contract.

18. Contractor shall provide within one month of contract one 1000 CC Car which will be property of KMC after completion of contract.

19. Contractor shall provide all employee proper clothing which is suitable for work

20. Contractor shall ensure that this staff are courteous with general public

21. Contractor must adhere to health and safety work laws of GOP.

22. The contractor must provide corporate address mailing address telephone no fax no of the contractor main office / companies be intimated to the employer in writing.

23. In case of weighbridge defect the contractor will be paid on average of last 30 days basis but only for a period of one month. The weighbridge must be repaired within one month of period.

24. In case of robbery or theft from the site, contractor will be responsible and if the stolen property will be of KMC then he will pay money according to market rate without any hesitation.

25. The contractor has to abide by t eh national law standards and EPA guideline if any to perform the required work.

26. The contractor will follow the KMC / Govt... Of Sindh rules pertaining to the said project.

27. For the purpose of identification and security contractor shall issue identity card jackets caps etc to its entire employee who may be detailed to work within area under contract. If any employee of the contractor is found with out these items a penalty of Rs. 5000 rupees will be fine per person as penalty imposed and deducted from month bills of the contractor.

Eligibility & Minimum Qualification Criteria

The evidence / documents for the following minimum qualification / eligibility criteria will be checked during opening process of tender evaluation & if anyone is missing then the tender will be summarily rejected at the moment by the tender opening committee.

PART-A: Eligibility Criteria

- Having Experience in Specific Field.
- EPA Certificate Valid. (Handling for Hazardous & Non-Hazardous Waste)
- NTN Certificate
- Valid Profession TAX

PART-B:
Minimum Qualification Criteria

i). Bid Security, as mentioned in the NIT & Bidding Documents, should be furnished.

ii). All rates quoted including the total amount of the bid shall be in figures & words (both).

iii). All corrections / overwriting shall be clearly re-written with initials & duly stamped by the bidder.

iv). The bid shall be properly signed, named & stamped by the authorized person of the firm and authorization letter for signatory shall be enclosed with the tender by the authorized person, if other than the signatory of the firm.

v). Bidders Business experience in Last 05 years of same Work (Specially the experience of land fill site Fukooka Simierovic Method) .

vi). The bidder will provide the complete profile of Mechanical Engineer having five 05 years experience in this relevant / specific field.

KARACHI METROPOLITAN CORPORATION

MUNICIPAL SERVICES DEPARTMENT

(CONTRACT MANAGEMENT)

TENDER DOCUMENTS

DEVELOPMENTS OF ENGINEERED SANITARY LANDFILL SITE FOR MUNICIPAL SOLID WASTE FOR JAM CHAKRO LANDFILL SITE

Estimated Cost:-	**Offer Rate**	**Tender Cost:**	**Rs. 3,000/-**
Time Limit:-	**12 Months**	**Penalty**	**Rs. 3000/-**
To be Opened on:-	**07-12-2015**	**Validity of Tender:**	**90 Days**

Chief Engineer (CM)
Municipal Services, KMC

Tender Issued:

No: KMC/MS/CM/20/15-16

Issue to M/s. _____ **P.O / Challan No. _____**

_____ **Dated _____**

_____ **Bank: _____**

Signature & Stamp of Issuing Authority

Section –I introduction

Location

Karachi is located at latitude 24° 48 N and longitude 66° 59 E. The urban sprawl starts from the westernmost mouth of the River Indus and goes up to the mountains and hills that form the southernmost edges of the Kirthar Mountain Range. The Arabian Sea is the southern boundary of the city.

Geography

Karachi is mostly made up of flat or rolling plains with hills on the western and northern boundaries of the urban sprawl. Two rivers pass through the city the Malir River (north cast to center) and the Lyari River (north to south). Many other smaller rivers pass through the city as well with general drainage being from the western and northern areas towards the south. The Karachi harbour is a protected bay to the south west of the city. The harbour is protected from storms by Keemari Island. Manora Island and Oyster Rocks, which together block the greater part of the harbour entrance in the vest. The southern limit of the city is the Arabian Sea and forms a chain of beautiful sandy beaches.

Government

Karachi as a city is governed by the Karachi Metropolitan Corporation (KMC). The KMC has an elected city council that looks after the working of the KMC.

The city district of Karachi is divided into 06 District. These District names are as follow:

1. District Central
2. District West
3. 3. District East
4. District South
5. District Malir
6. District Korangi

Demographics

Karachi's current population is estimated to be about 20 million. A much larger figure than it was in 1947 (400,000). The city's population has grown at a very enormous rate. So much so that no it is one of the largest cities in the world. The 16th Largest.

The breakup of Karachi's population is as under. Men form 53.7% of Karachities. 37.6% of us are under the age of 15. 4.4% of us are older than 50. 70.1% of us arc literate. 22.1% of us are migrants from other places.

Area:

Karachi is spread over a vast area of about 450 sq. km.

1.2 Municipal Waste Management Situation in Karachi

The population of Karachi produces around 12000 tons of municipal garbage / day out of which about 40% is disposed off to landfill Sites by the present set-up of Solid Waste Management Department of EX-TMA.

At present, there are a large number of scavengers operating in Karachi which collect about 100 kg/each of recyclable materials like paper, glass, ferrous waste, plastic bottles etc..

In most parts of Karachi there is Communal Collection of Waste. Large containers ranging from 5 cubic yards to 30 cubic yards are placed at any available spot. Mostly these containers are full and overloading. The picking is mainly done at these spots.
Karachi's households may be divided as follows:

- High Income Group: With low population density. From 500 sq. yards plots to 2000 sq. yards plots.

- Middle Income Group: With medium population density. From 200 sq. yards plots to 500 sq. yards plots and high rise buildings.
- Low Income Group: 80 yards plots to 100 yards plots.
- Peri-urban. or informal housing areas.
- Old City Areas with narrow streets and heavy traffic congestion
- Commercial Areas with high rise buildings, shops and offices.

At present, there is a fraction of door to door collection in small societies/areas where certain groups are operating with small carts and collecting Rs. 50-100 per household depending on the area served. Mostly NGOs are trying to perform this service. At present there is no organized commercial company providing such services except in Clifton Cantonment Board and Defense Housing Society. The DHA has given a contract to a private company.

Waste Recycling is a major un-organized industry in 'Karachi. Materials like paper, card boards, packing materials, glass bottles, plastics. Ferrous items, bones are collected either from the producers or from the communal garbage dumps. The yard waste and kitchen waste is usually thrown on the street sides to rot and produce bad smell, attract vermin and cause unhealthy and ugly esthetics.

1.3 Existing Facilities

Landfill site Jam Chakro = 500 Acres
02 Land fill sites

ACTION PLANT

The department is carrying out the "SEMI AEROBIC, Fukuka Method of Japan" Land Filling selecting 40 Acres out of 500 of landfill site for 01 year.
The department carrying out Gas ventilating pipe on the One going Land Fill Site.

SECTION-II- INSTRUCTION TO CONTRACTORS

2.1 Purpose for Contracting out SWM

The purpose of this document is to invite reputed and experienced Waste Management Firms to submit their bids for Providing of Services for Construction & Operation of Landfill according to Scope of Work as mentioned in Section-IV (A&B) for a period of I year. The scope of work is according to modem technology of "Fukuka Semi Aerobic Method" of Japan for Land filling Site.

2.2 Communication Regarding Tender

All intended Contractors interested in participating in the project may reach the following officer either in person or through written correspondence:

Director (Solid Waste Management)

Old KBCA Building KBCA officer club civic center Karachi
PH # 992301341-2

2.3 Evaluation Criteria

The successful bidder should have full fill the following criteria:

a) Experience in operation and maintenance of landfill site.
b) 2% Earnest Money of quoted rate on the basis on 1500 ton / day.
c) The contractor should quote the rate as follows:

   i) Per Ton tipping fee up to 1000 Tons per Day.
   ii) Per Ton tipping fee from 1001 Tons per Day and More.

The rate of the contractor will be considered for the average rate / per ton of the above & (ii)

2.4 Validity of Bids

Contractors should state in writing and confirm that all furnished information, including unit cost and prices will remain valid for a period of 120 days from the date of opening of the bids.

2.5 Supporting Documents

All supporting documents submitted by the contract will become the property of the government and none of the documents will be returned to successful or unsuccessful bidders. The document is to be submitted along with bid with stamp and signature of the bidder on each page.

2.6 References

The Contractor shall include any reference of their previous work carried out in the similar field.

SECTION — III — Additional Terni's & Conditions

3.0 Address for Notices

Concessionaire shall indicate in the space provided, their fill and proper address at which notice may be legally served on them and to which all correspondence in connection with this tender and contract to be sent.

3.1 No Alteration / Addition in Bill of Quantities / Schedule of Item of works and Terms of the Contract.

No alteration or addition shall be made by the Contractor in schedule of quantities/item of works and terms of the contract. The rates must be filled in ink or typed out, both in figures and words clearly. All corrections must be initialed by the Bidders. Any tender which does not comply with the condition will be liable to summarily rejected and will not be considered.

3.2 Increase or Decrease in Cost

Concessionaire attention is drawn to the fact that there is no provision in the contract for variation in contract price in respect of any rise or fall in the cost of labour. material or on tools, equipments, machinery if required or any other matter effecting the cost of works due to national or provincial ordinance or Law or any other Regulation or Bylaws of arty local or other duly constituted authority or otherwise, except as mentioned in clause 6.4.

3.3 Organization Chart of Concessionaire

The Concessionaire shall submit an organization chart of the supervisory staff and workers which he proposes to employ for the execution of work.

3.4 Labour Cost

Concessionaire must estimate and determine for themselves what wage rate they will have to pay to secure the workers and supervisory staff they will require for the performance of the contract, there is no provision in the contract for escalation in contract price due to fluctuation of labour wage rates as a result of Government statutes ordinance and decree or otherwise.

Concessionaire are also advised to study the Labour Laws of Pakistan and Pak P.W.D. Contractors Labour Regulations.

The Contractor shall be responsible for compliance of provision of payment of wages Act and Rules made by the Government and for payment of compensation, which may became payable under worker-men's compensation act of under any other Law prevailing in the country.

3.5 Period of Contract

The contractual period shall be Twelve (12) months starting from the date of hand over the site or the date of start mentioned in the work order extendable to further period with mutual consent without prejudice to the terms and conditions of the contract.

3.6 Work during Holidays in Emergency

The contractor shall made special arrangement for performing works under the contract on all gazetted holidays and in emergency on written directives of CDGK.

3.7 Contractor's failure To Start To Work

If the Contractor fail to start the work from the date specified in the work order, the earnest money will forfeited and the work will be treated as cancelled.

3.8 Decision of Authority and Dispute

Notwithstanding anything to the contrary contained herein, all dispute, controversies or deficiencies which may arise between the Incharge Officer. KMC and the Contractor or in relation to or in connection with this contract except to any matter the decision of which is specially provided for herein, the matter in dispute shall be referred to Mayor / City Nazim KMC has decision shall be final and binding on both the parties.

3.9 Work Schedule / Programme

Maximum operation of Solid Waste Management Activities will be performed at night.

3.10 Arrangement of Water

The Contractor should make his own arrangement of water if required for execution of work and as well as for drinking purposes.

3.11 Taxation

The rate and prices in the tender submitted by the Contractor shall include all business taxes income taxes and other taxes that may be levied according to the Laws and Regulations is being prior to the closing date for submission of tenders on the equipment. Machinery required for the purpose of the contract and on the services performed tinder the contract. Nothing in the contract shall relieve the Contractor from his responsibilities to pay any taxes that may be levied on the profit made to him in respect of contract.

3.12 Tender Validity

Tender shall remain valid and open for acceptance for a period of one hundred and twenty (120) calendar days after opening offender

3.13 13 Earnest Money & Security Deposit

The total amount of security deposit shall be 10% (Ten Percent) of contract price approved by the Employer, including 2% earnest money. The tender must be accompanied with an earnest money equal to 2% of contract prices in Pakistani

Rupees in the following shape of Bank draft / Pay Order / Bank Guarantee drawn on any approved scheduled bank in Karachi payable to CDGK

The 8% retention money will be deducted from each running bills submitted by the successful Contractor during the period of contract.

3.14. Refund of Security Deposit

The security deposit shall be refundable after three months of the completion of work contract to the satisfaction of authority and after issuance of completion certificate by the authorized Incharge Officer of the Contract.

3.15 Tender to be non responsive without 2% Earnest Money

Any tender which is not accompanied with required Earnest Money of (2% Bid Price) in the shape described above will be rejected as non-responsive.

3.16 Income Tax clearance Certificate

The Contractor shall have to produce income tax clearance certificate before entering into contract and prior to execution of agreement.

3.17 Professional Tax Clearance Certificate

The Contractor shall be required to produce professional Tax Clearance Certificate before entering into contract agreement.

3.18 Termination of Contract

The City Dist. Government Karachi shall have the option for terminating the contract without giving any reason at any time by serving written Notices of
30 days. However in case of termination of contract by KMC wherein Contractor is not at fault the security deposit shall be refunded to Contractor after three months from the date of such termination. No claim of Contractor shall be entertained by KMC in this regard.

3.20 Concessionaire to Carefully Examine Documents

The Concessionaire is expected to examine carefully all instruction, terms and conditions in the tender documents. Failure to comply with the requirements of the tender submission will be at the Contractor's own risk. Tenders, which are not substantially responsive to the requirements of Tender Documents, will be rejected.

3.21 Award Criteria

Employer may award the contract to the tender whose tender has been determines to be substantially responsive to the tender documents and who has offered the lowest evaluated tender price, provided further that the Concessionaire has the capability and resources to carry out the contract effectively.

3.22 Disorderly Conduct (etc.)

The Contractor shall at all times take all reasonable precautions to prevent any Lawful Riotous or disorderly conduct by or amongst his employees and for the preservation of peace and protection of persons and property in neighborhood of the work.

3.23 Employment of Persons in Services of others

The Contractor shall not recruit or attempt to recruit his staff and labour from amongst persons in service of Employer.

3.24 Tender Amount to Be Quoted In Figures As Well As IN Words

The Concessionaire should quote the tender amount in figures as well as in words in English Language clearly.

3.25 Each Page of Tender Document should be signed by the Concessionaire

The Concessionaire should sign each page of the tender Documents as Well as corrections and over writing in the form. Schedules of quantities etc., before submitting his tender.

3.27 Employer's Right to accept any Tender and to reject any or all Tenders

The Employer's reserves the right to accept any tender, or reject any/all tenders an any time prior to award of contract without notice thereby without incurring liability to the effected tenders or Concessionaire or any obligations to inform the effected tenders or tender of ground for Employer's action.

3.28 Rates to included of all incidental charges

The Tender rate shall be inclusive of all incidental charges in connection with the work.

3.29 Shift Pattern of Contractor's Staff! Workers and Time allowed to carry out the Work

Shift pattern of Contractor Staff! Workers and Time allowed to carry out the work and detail program of work shall be submitted by the Contractor for approval of Employees. Timing of work and shift pattern is the essence of the contract. The maximum activities regarding SWM should be performed in Night Time.

3.30 Expiry of the Contract and Employers Directives

Unless otherwise directed, the Contractor shall continue to work at the same rates and on same terms and conditions of contract till such time arrangements are made by the Employer for fresh contract and award of further work even after expiry of present contract.

3.31 Contractor Not to Leave the Work before stipulated period of Contract

In the event Contractor leaves the work before stipulated period of contract, the security deposit shall be for forfeited in favour of CDGK.

3.32 Contractor's General Responsibilities

The Contractor shall at all time responsible with due care and diligence to execute the operation of land fill area under contract as defined in the scope of work and for making all necessary arrangements for the fulfillment of the work to the entire satisfaction of the Employer, the Contractor shall be fully responsible for payment of wages, allowances, right(s). Facility, liability or benefit to its employees deployed at this contract as per applicable rates, KMC shall not in any way accept the liabilities of the Contractor.

3.33 Contract Agreement

The Contractor shall if called upon so to do, enter into contract and execute the contract agreement to be prepared and completed at the cost of Contractor, including cost of Stamp Paper Duties etc. as per rule, will be paid by Contractor.

3.34 Contractor's Superintendence

The Contractor shall provide all necessary superintendence during execution of work and as long thereafter as the Officer Incharge may consider necessary for the proper fulfilling of Contractor's obligations under the contract. The Contractor or his competent authorized representative approved by the City District Government Karachi (which approval may at any time be withdrawn) shall give his whole time to the superintendence of the work such authorized representative shall receive on behalf of the Contractor, instructions from the Incharge Office.

3.35 KMC to Object

The KMC shall be at liberty to object to and require the Contractor to remove forthwith from the works any person provided by the Contractor, who in the opinion of KMC misconducts himself, or is incompetent or negligent in proper performance of his duties or whose presence on site of work is otherwise considered by KMC to be undesirable, and such person shall not again allowed upon the works without the consent of KMC. Any persons removed from the work shall be replaced as soon as possible.

3.36 Identification of workers of the Contractor.

For the purpose of identification, and security Contractor, shall issue proper identity cards, jackets, caps etc. to all of its employees who may be detailed to work within the area under contract, if any employee of the Contractor is found without identity card, jacket, cap etc. a penalty Rs. 25/- per person per day will be imposed and deducted from monthly bill of the Contractor.

3.37 Contact on the basis of Tonnage

The contractor should quote the rate as follows:

i) Per ton tipping fee up to 1000 Tons per day.

ii) Per ton tipping fee from 1001 Ton per day and more.

The rate of the contractor will be considered for the average Rate! Ton of the above i , ii& iiiper day.

3.38 Emergency and Contractor Recourses at the Contract

In case of emergency Contractor resources, (sanitary works equipment and machinery detailed at the contract) may be utilized on the directives of KMC to some other areas beyond the contract limits, and the same may be adjusted without any additional cost and the Contractor shall be bound to do so.

3.40 Bill to be submitted by Contractor on Fortnightly Basis

The Contractor shall be required to submit its bill on Fortnightly basis, which shall be checked, scrutinized for the fulfillments of Contractor obligation under contractor and shall be paid after verification of Incharge Officer and approval of authority.

SCOPE OF WORK

Landfill Method

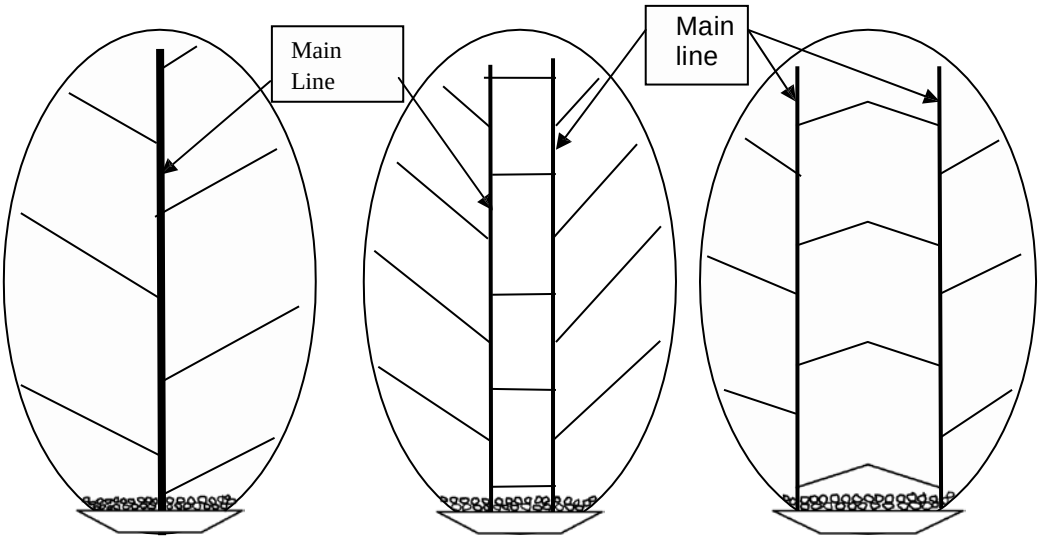
Area Method

The area method is used when the terrain is unsuitable for the excavation of trenches. Earth dike with a height of one lift (2-3m) is first constructed to get the support for compaction. The wastes are unloaded at the toe of the earth dike and spread and compacted on the slope of the dike in a series of layers that vary in depth from 30 - 60 cm. The recommended slope of these layers is 1 to 3. The width of the working face should be as narrow as possible to confine the waste to the smallest possible area but at the same time it should be wide enough to give necessary maneuverability to bulldozers. At the end of every week operation, a 15cm to 30 cm layer of cover soil is placed over that weeks completed fill. This one day's completed fill including the cover soil is called a cell. However, in the case of large landfills with the amount of solid waste more than 1200 ton per day, two or more cells should be constructed each day to avoid the decrease of structural stability caused by large cells. The wastes should be unloaded at the top of the last cell and spread and compacted using the slope of the cell as the support for compaction. When all the area is converted by one layer of cells it is called a lift. One more lift can be constructed on the top of the preceding lift whenever it does not surpass the final topography set by the design.

Considerations for ensuring cross section of leachate collection discharge pipe

(1) Requirements

Leachate collection discharge pipes are set in the bottom of the land fill area and maintenance control after starting the landfill is difficult. As an obstacle for air inflow cross section of the leachate collection discharge pipe, retention of leachate inside the leachate collection discharge pipe covering a large portion of the cross section or collecting of filthy water in the bottom of the leachate collection discharge pipe and blocking the cross section can occur. These types of things are difficult to estimate beforehand during the design stage. Therefore, from experience, it is desirable to use a pipe diameter of at least 600 mm for the leachate collection discharge pipe when using the "Fukuoka Method". However, when using pipe materials that can be obtained in developing countries, the larger the pipe the more there is anxiety regarding the strength of the pipe. In this case, uses a pipe diameter of 450 mm for the main leachate collection discharge pipe and use a design with several of these placed as in Fig.2-1



Placement pattern for leachate collection discharge pipes

Considerations for ensuring height of leachate collection discharge pipe and covering material

(1) Requirements

In the “Fukuoka Method”, fresh air must be introduced into the landfill through the leachate collection discharge pipes. However, in the examples so far, the leachate collection discharge pipe are laid deep in trenches that have been dug and there are cases where in the event that

leachate is retained in the landfill area, the cross section for air flow is completely blocked off.

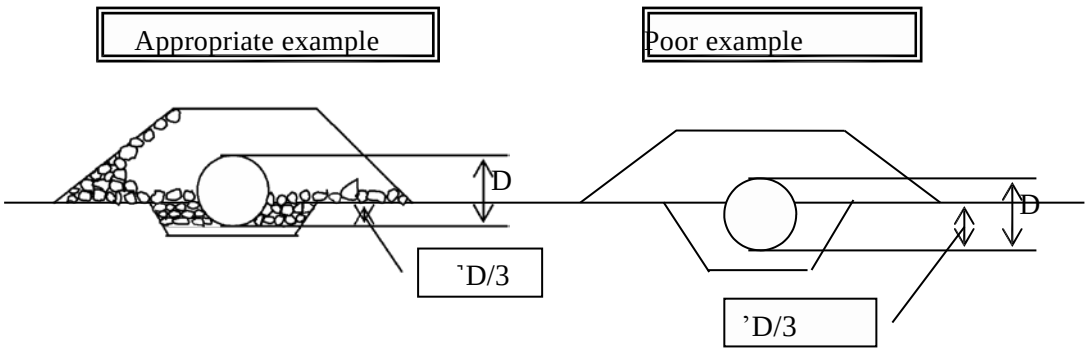


Fig. 2.2 Placement examples of leachate collection discharge pipes

(1) It is easy for the leachate collection discharge pipe to become submerged if water is retained in the landfill
(2) Infiltration of sludge becomes easier

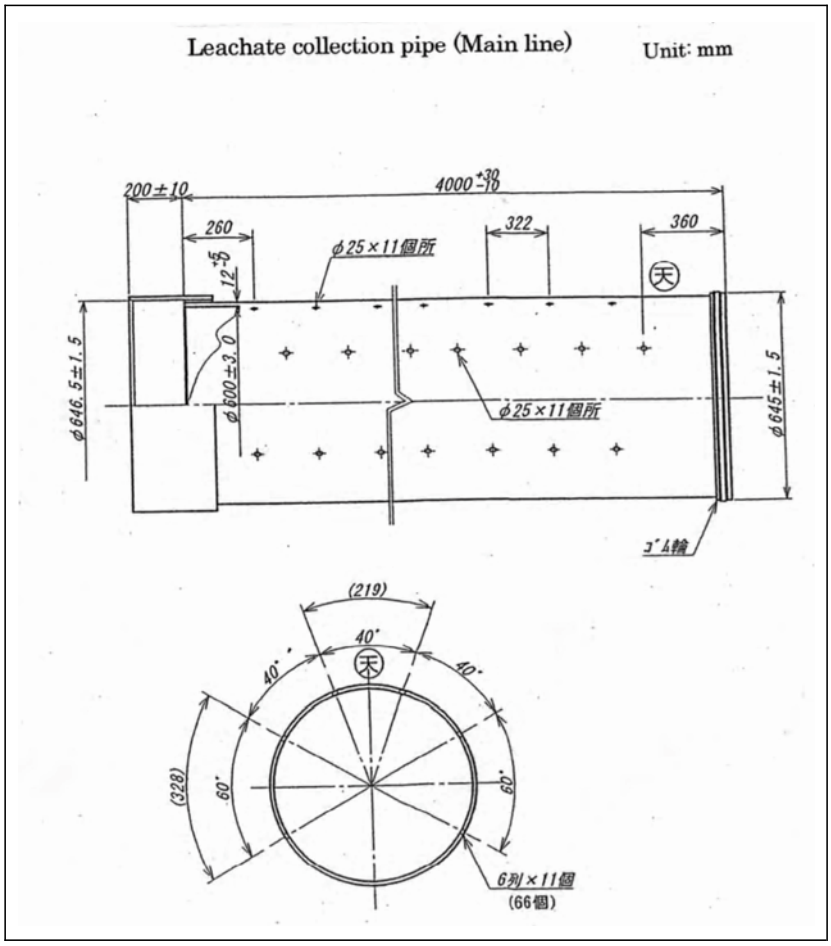
Picture2-3 Good example of leachate collection facilities

Picture 2-4 Good example of main leachate collection pipe

Considerations for ensuring perforated areas in the leachate collection discharge pipe

(1) Requirements

In the “Fukuoka Method”, fresh air must be introduced into the landfill through the leachate collection discharge pipes. Supply of air to the landfill layer through the leachate collection discharge pipe is provided through holes in the leachate collection discharge pipes. Therefore, measures must be taken so that the perforations of the leachate collection discharge pipe exhibit their function.



Example of perforations in leachate collection discharge pipes

(2) Application Example

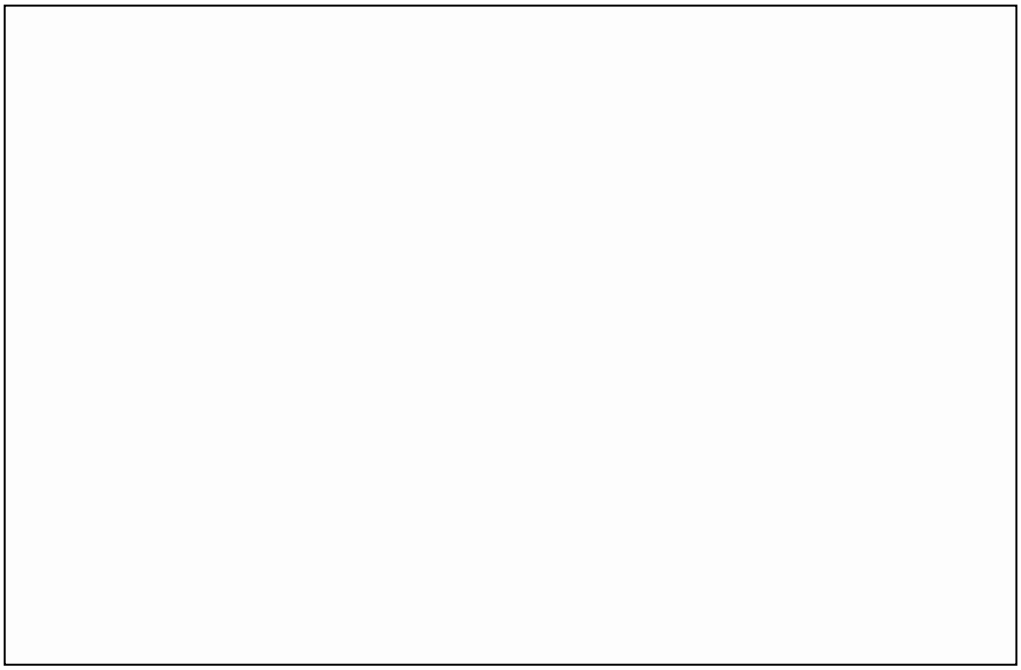
The good example or counter example configuration shown in chapter 2-6 must be used to achieve ensuring that the holes in the leachate collection discharge pipes stay open. Comparing these, the countermeasure example of Fig. 2-8 has less chance of the perforations being blocked by sludge etc.

Picture 2-5 Suitable placement example for ensuring perforation areas stay open

2-6 Considerations for reliable protection of leachate collection discharge pipes

(1) Requirements

In the “Fukuoka Method”, installing leachate collection discharge pipes suitably in the bottom of the landfill area rapidly discharges leachate in the landfill area and in addition causes fresh air to flow into the landfill through natural convection and thus supplying of air promotes aerobic decomposition in the landfill layer. Therefore, as the leachate collection discharge pipes are key equipment in the “Fukuoka Method”, they must be suitably protected so that they are not damaged through operation of the landfill or pressure caused by landfill waste.



(1) Requirements

In the “Fukuoka Method”, it is necessary to enable maintaining of the landfill layer in an aerobic environment. It follows that it is necessary to place gas venting pipes in the landfill area at suitable intervals.

In order to reliably install gas venting pipes, the configuration for raising the gas venting pipes must use materials that can be obtained locally to the landfill site and use a configuration that can be implemented using the control structure at the landfill site.

In cases where there is a lot of organic material that can be decomposed in the landfill waste and the landfill layer is at optimal aerobic decomposition conditions, the oxygen in the landfill layer will be rapidly consumed and may switch to anaerobic. In this case, in order to smoothly introduce fresh air into the landfill layer, air flow pipes must be placed every 10 ~ 15 m of height of the landfill. (See Fig. 2-8)

The roles and purposes of the vertical gas venting pipes are as follows.

(i) Suppress generation of CH4 through expanding aerobic area

(ii) Rapid removal of leachate function

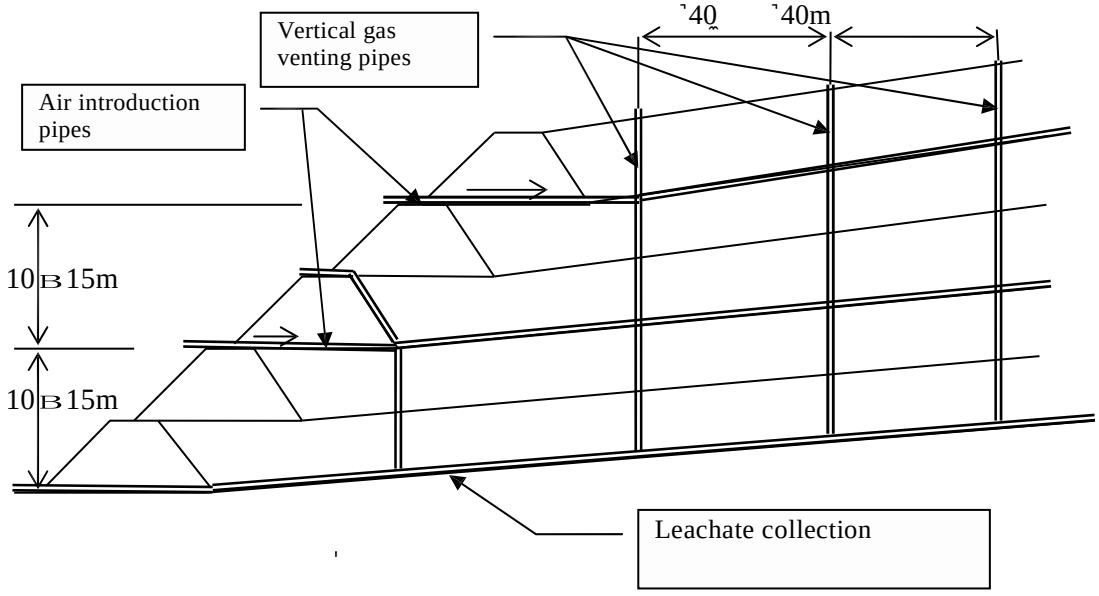
(iii) Circulation of leachate using vertical gas venting pipes

(2) Application Example

In the “Fukuoka Method”, it is recommended that gas venting pipes be installed every 20 to 40 m for flat landfill sites. If the landfill layer thickness is less than 10 m, a 40 m interval is suitable, if the landfill layer thickness is 10 m to 20 m, use a 30 m interval and if more than this, an interval of 20 m is suitable. Using an interval of less than 20 m enables increased aerobic decomposition but as the gas venting pipes would hinder landfill operation, this can not be recommended.

In cases where the amount of material requiring placement in the landfill is high, large number of gas venting pipes impede landfill operation and also become complex to erect. In this case,by taking into account installation of horizontal air flow pipes every 15 m of waste landfill layer, the installation interval can be widened to roughly 40 m.

In order to ensure reliable installation of gas venting pipes, it is necessary to use materials that can be obtained at the site and a configuration that can easily be implemented. The material noted in chapter 2-1 can be used as an example.

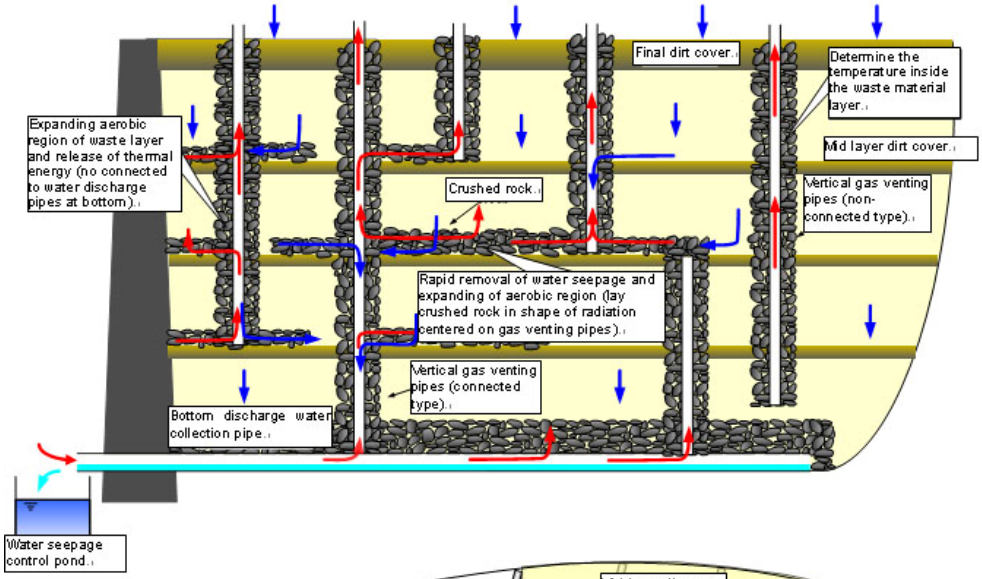


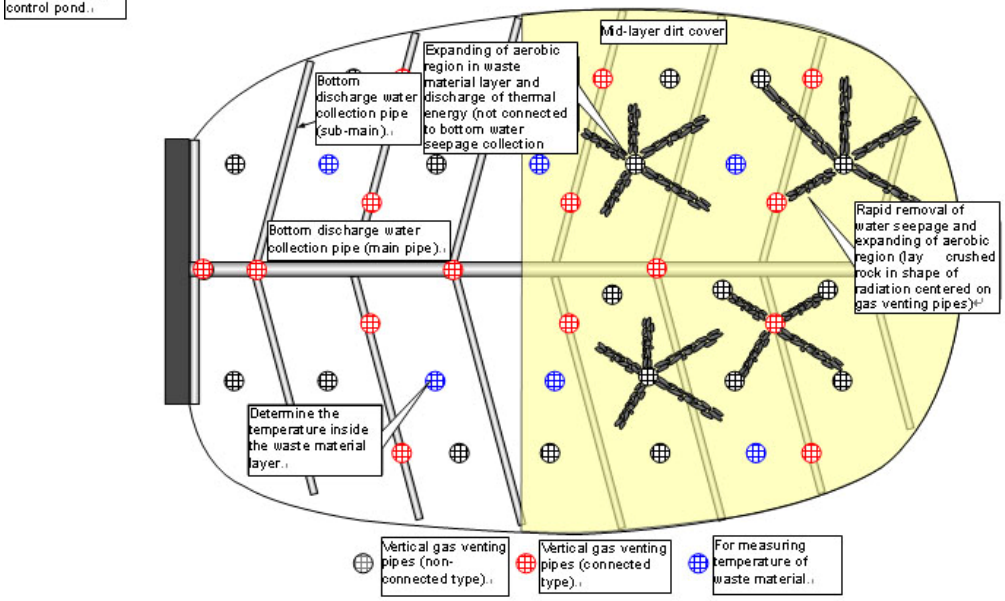
discharge pipes

Fig. 2-9 Illustration of application of air introduction pipes in the case that the landfill height is high

Picture 2-10 Installation example of gas venting pipes

In the case that there is not a slope where gas introduction pipes can be installed, suitably forming of a layer of crushed rock enabling supplying of air from the vertical gas venting pipes into the landfill layer can be considered as a countermeasure. An illustration of this countermeasure is shown in the following diagrams.


Final dirt cover
Determine the temperature inside the waste material layer.
Expanding aerobic region of waste layer and release of thermal energy (no connected to water discharge pipes at bottom).
Mid layer dirt cover.
Crushed rock.
Vertical gas venting pipes (non-connected type).
Rapid removal of water seepage and expanding of aerobic region (lay crushed rock in shape of radiation centered on gas venting pipes).
Vertical gas venting pipes (connected type).
Bottom discharge water collection pipe.
Water seepage control pond.


Mid-layer dirt cover
Expanding of aerobic region in waste material layer and discharge of thermal energy (not connected to bottom water seepage collection
Bottom discharge water collection pipe (sub-main).
Bottom discharge water collection pipe (main pipe).
Rapid removal of water seepage and expanding of aerobic region (lay crushed rock in shape of radiation centered on gas venting pipes).
Determine the temperature inside the waste material layer.
Vertical gas venting pipes (non-connected type).
Vertical gas venting pipes (connected type).
For measuring temperature of waste material.

(1) Requirements

The “Fukuoka Method” is a method that promotes decomposition of organic material inside the landfill layer through introduction of fresh air into the landfill layer and this can not be achieved by simply installing leachate collection discharge pipes. This is that discharging of gas in the landfill layer warmed by heat generated through decomposition of organic material through gas venting pipes to the top of the landfill pulls fresh air through leachate discharge pipe openings based on convection.

In general, the functions of gas venting pipes are not understood in developing countries and they are installed in an inappropriate manner, leading to cases where the function of the “Fukuoka Method” is lost. It follows that protection of the gas venting pipes must be clearly shown in the drawings during the design stage and the installation procedure must be specified.

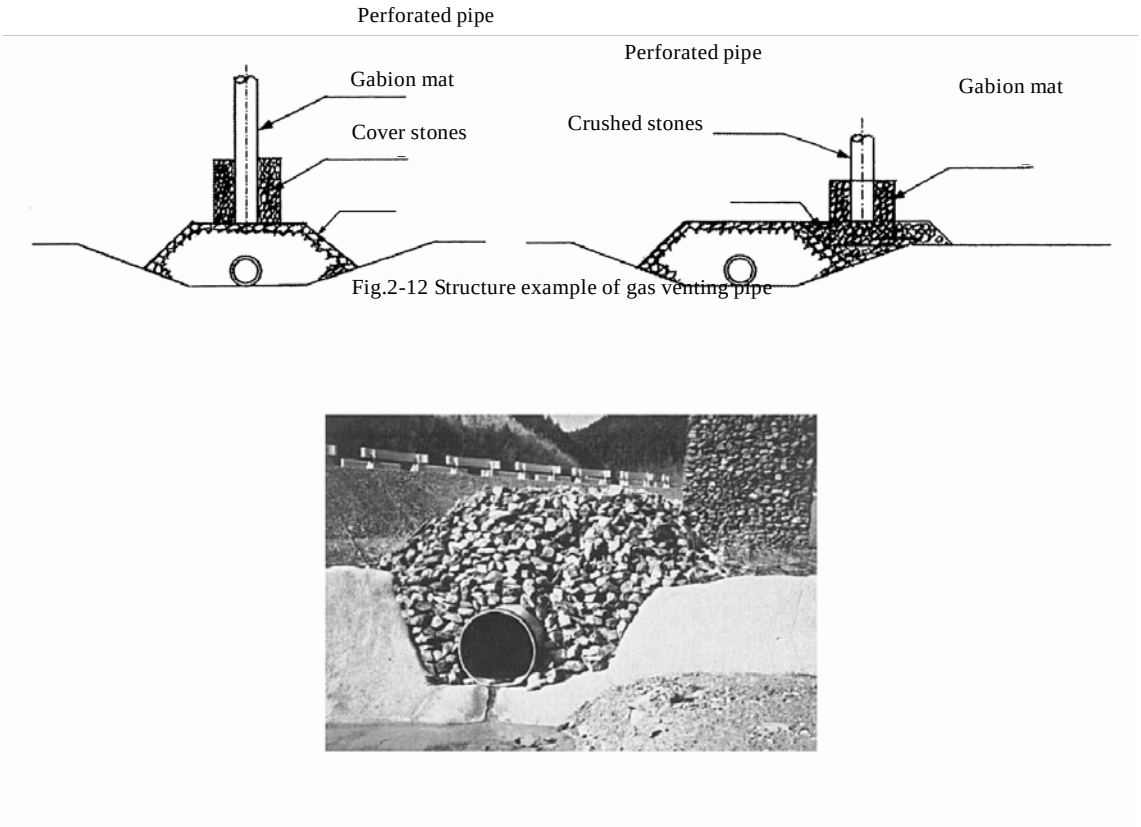


Fig.2-12 Structure example of gas venting pipe

Picture2-13 Example of bottom leachate collection pipe and gas venting pipe

(2) Application Example

In the “Fukuoka Method”, for protection of the gas venting pipes, it is desirable that the dimensions shown in Fig. 2-14 below are used as a basis and that structure is determined based on actual conditions for developing countries and each landfill site.

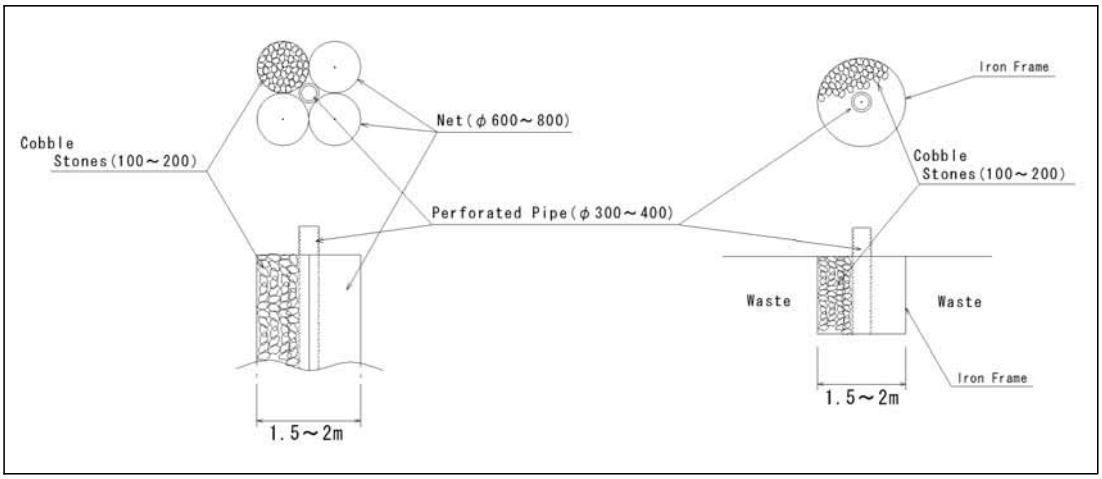


Fig. 2-14 Gas venting pipe production standard dimensions

(1) Requirements

As the “Fukuoka Method” is called a semi-aerobic landfill, there are also areas that are anaerobic in addition to the aerobic areas and while decomposition of biological pollution material proceeds in the aerobic areas, the combination of both aerobic and anaerobic areas has the function of nitrogen removal treatment. As the nitrogen is removed from the leachate, the nitrogen in the leachate has to go through the process of being oxidized and reduced but through saturating the landfill layer with leachate that has been discharged again, this function can be utilized to its utmost.

In the “Fukuoka Method”, circulating leachate by returning leachate discharged from the landfill site back to the landfill site is effective at both purifying the water quality of the leachate and reducing the amount of leachate. Circulation of leachate can be achieved using a simple system. If introduction of leachate treatment equipment is difficult from a financial perspective, use of circulation is desirable. Furthermore, in the case that introduction of leachate treatment equipment is feasible, this reduces the load on the leachate treatment equipment and suppresses treatment costs and use is therefore desirable. However, circulation requires a pump to return leachate to the landfill area.

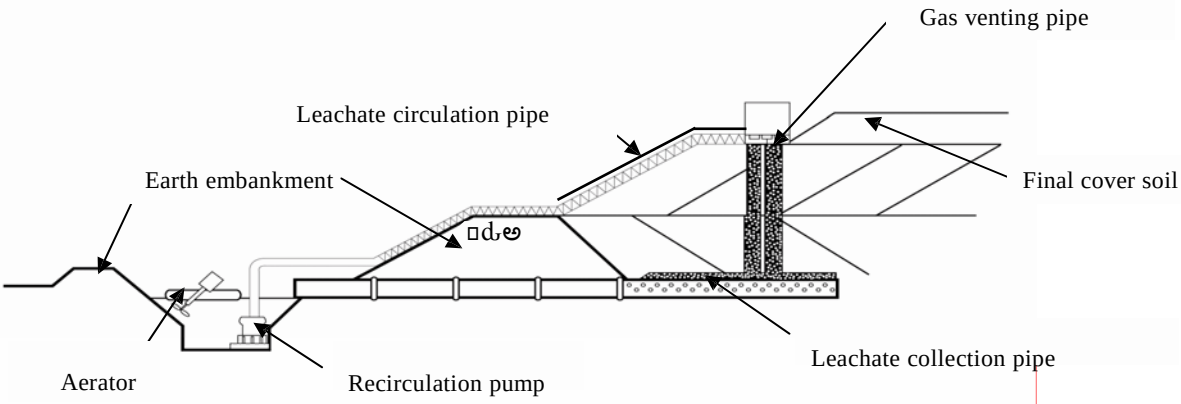


Fig. 2-15 Example of Ampang Jajar landfill site in Malaysia that uses a water seepage circulation system

Picture 2-16 Example of Malaysia Ampang Jajar landfill site

3. Landfill operation

3-1 Considerations for maintaining function of the leachate collection discharge pipes

(1) Requirements

The Fukuoka Method (semi anaerobic structure) has (1) leachate collection discharge pipes installed in the bottom, and (2) gas venting facilities as facility for supplying air (oxygen) to the waste layer. Of these, the leachate collection discharge pipes have the most important role and things that would reduce their function such as breakage or blockage of the pipes must be completely avoided. Therefore, sufficient care must be taken during landfill operation to maintain the functionality of the leachate collection discharge pipes.

(2) Application Example

(i) Consideration for type of waste material disposed of near the leachate collection discharge pipes. (Avoid small particle shaped items that can easily wash away.)

During use of the landfill, there is the possibility that the filter material of the leachate collection discharge pipes that are installed at the bottom of the landfill will become plugged with small particles in the soil covering and waste materials as well as insoluble materials included in the leachate. (See Fig. 3-1)

Especially when the first layer is buried, soil covering material and waste particles that flow with rain water may flow into the filter material at locations where the leachate collection discharge pipes are directly exposed and plug the filter material. Furthermore, the filter material may be plugged by non-soluble materials included in the leachate that is generated through decomposition of waste that is being processed in the landfill.

Picture 3-1 Plugging of leachate collection discharge pipes

The function of the leachate collection discharge pipes must be maintained over the long period of time unit the disposal site is closed. It follows that when land filling close to the leachate collection discharge pipes, that care must be taken to suppress clogging of the filter material.

One method for doing this is to avoid particles that can flow easily as landfill waste in the vicinity of the leachate collection discharge pipes and instead fill with bulky waste materials that have non-uniform shape and are rough and that are not soluble such as rubble from construction materials and pieces of concrete. (See Picture 3-2 ~ 3)

Picture 3-2 Example of landfill of large waste material in the vicinity of leachate collection discharge pipes

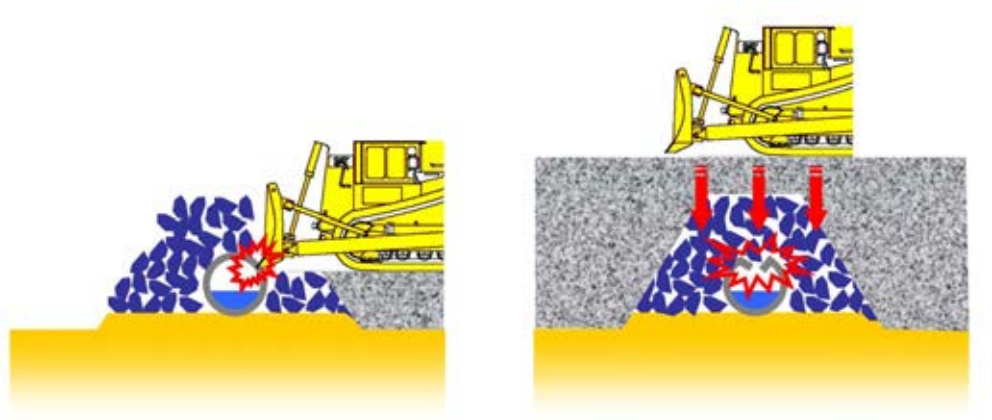
Picture 3-3 Example of landfill of rough waste material in the vicinity of leachate collection discharge pipe

(ii) Landfill method that does not break the leachate collection discharge pipes

The leachate collection discharge pipes installed on the bottom must be designed with the strength to withstand the static weight of waste layers of landfill up to the height planned for the landfill. However, initially when the landfill thickness is less than 3 m, the pipes directly receive the kinetic force of transport vehicles and heavy machinery driving over the surface of the landfill area. Furthermore, as the leachate collection discharge pipes are exposed for the first layer, heavy machinery used for landfill operation may directly contact the leachate collection discharge pipes and cause damage. If the leachate collection discharge pipes are damaged, waste material may get into the pipe directly at the damaged location and hinder flow of leachate and/or supply of air. (See Fig. 3-1)

Therefore, in the early stages of landfill where there is less than 3 m, suitable measures must be taken when driving heavy landfill machinery or transport vehicles over the top of the leachate collection discharge pipes.

One method of preventing damage to leachate collection discharge pipes is to maintain a landfill thickness of crushed rock that is not affected by kinetic load of heavy machinery of at least 1 m and proceed with the landfill for the first layer.



(a) Damage due to contact with heavy machinery (b) Damage due to kinetic load of heavy machinery

Fig. 3-4 Damage phenomenon of leachate collection discharge pipes of the initial layers of landfill

In cases where sufficient landfill thickness can not be maintained or locations where heavy machinery or large vehicles cross frequently, lay a steel plate with a thickness of at least 20 mm with the purpose of distributing the kinetic load of the heavy machinery etc. (see Fig. 3-2) or use a special road with at least 1 m of fill for crossing to prevent damage of leachate collection discharge pipes.

(iii) Control of the leachate level (pipe end open at all times)

The Fukuoka Method mechanism uses decomposition thermal energy to introduce fresh air (oxygen) through the discharge opening of the leachate collection discharge pipes in the bottom and enables supply of oxygen to the waste layer through the leachate collection discharge pipes and gas venting pipes. Therefore, the water level of the leachate control pond must be controlled and the discharge pipe opening of the leachate collection discharge

pipes must be open to the atmosphere at all times.

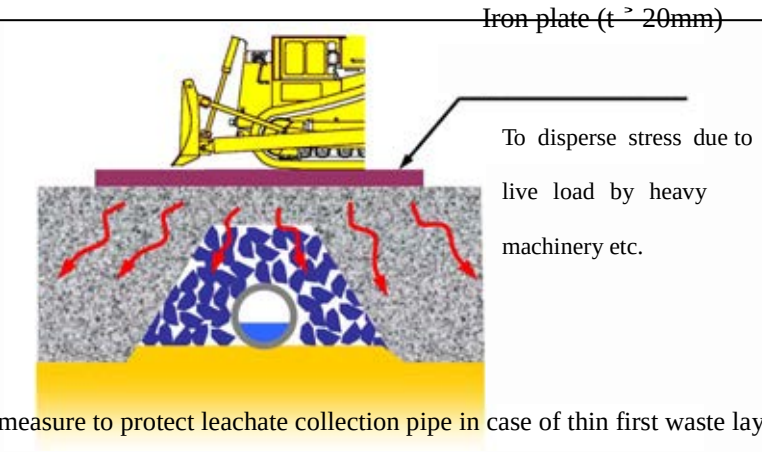


Fig.3-5 Example of measure to protect leachate collection pipe in case of thin first waste layer

(1) Requirements

Gas venting facility is important facility that enables smooth flow of air so that air in the landfill layer is not insufficient in the case that there is a lot of organic material to be decomposed. Therefore, maintaining of the function of the gas venting facility with regards to landfill operation must be sufficient considered.

(2) Support Example

(i)Vertical pipes (gas venting facility) reliable, suitable installation. (Meandering is better)

In the Fukuoka Method (semi-aerobic structure), leachate collection discharge pipe on the bottom and vertical pipes (gas venting facility) are important facilities that have the function of promoting discharge of leachate and supplying air (oxygen).Therefore, it is necessary to install the vertical pipes (gas venting facility) in suitable locations and to reliably connect and raise them in conjunction with proceeding of the waste landfill.

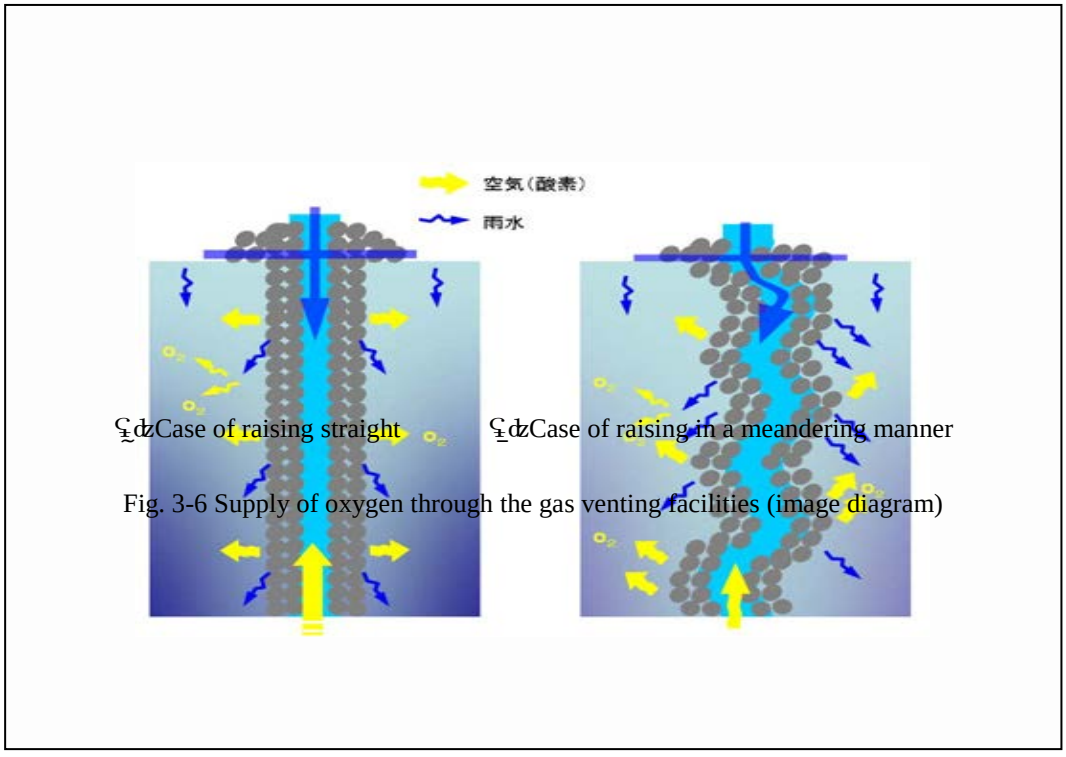


Fig. 3-6 Supply of oxygen through the gas venting facilities (image diagram)

In order to more fully exhibit efficiency in the function of the vertical pipes, it is desirable to link the vertical pipes directly to the leachate collection discharge pipes and install them roughly with a horizontal distance of roughly 20 m. Furthermore, in order to ensure better contact surface and suppress plugging of the vertical pipes at the same time, they should have a diameter of at least 10 cm and in addition be covered with at least 1 m in diameter of filter material that is not soluble.

Furthermore, in the case that the vertical pipes are raised (connected) along with the increasing height of the waste layer, use the same type of filter material and same diameter for raising of the vertical pipes. In this manner, the vertical pipes are not raised in a straight line; it is more desirable for them to meander. This configuration enables sufficient retention time of air and rainwater inside the gas venting facility and promotes supplying of oxygen. (See Fig. 3-4)

As a method for raising the gas venting facility while causing it to meander, connect and raise the system based on the following elements (see Fig. 3-5).

a) Install the gas venting pipe at an inclination as in Fig. 3-5 and fill with crushed rock as the gas venting facility for each waste layer.

b) When connecting and raising the next layer, install the gas venting facility centered on the center of the gas venting pipe that is above the surface and install the gas venting pipe in a direction that is different from the previous layer and fill with crushed rock.

c) Repeating i) and ii) will enable raising the gas venting pipe in a meandering path.

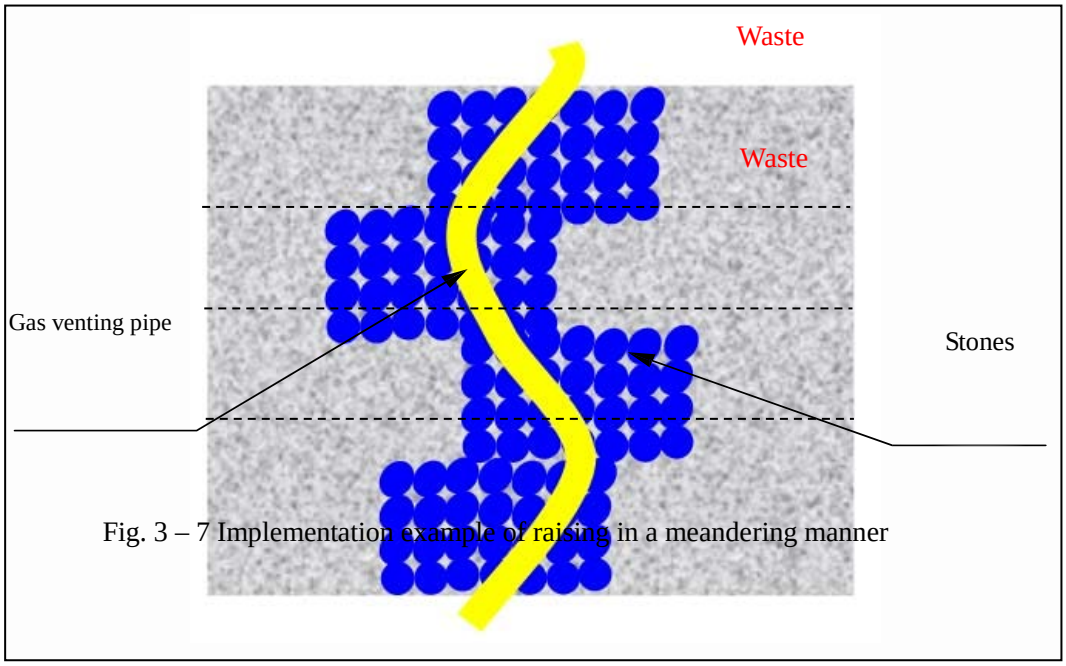


Fig. 3 – 7 Implementation example of raising in a meandering manner

(ii) Landfill method that does not break gas venting facilities

When performing landfill operations, vertical pipes can be knocked down, broken, or collapse due to contact with heavy machinery or load of landfill material; therefore, care is important when performing landfill operations.

For starting of the landfill for each layer, in general the vertical pipes and sloped surfaces for gas venting facilities target that for 1 layer (roughly 3 m). In this condition, if waste pushes from one side or contact is made with heavy machinery the vertical pipe may fall over, become damaged, or collapse. Especially for the first layer, the leachate collection discharge pipe directly connected to the gas venting facility may also be damaged; therefore, contact by heavy machinery must be prevented. Furthermore, if landfill is filled higher than independent gas venting facilities, the gas venting facility may become buried. If this happens this gas venting facility can no longer be added to or raised in the next landfill layer. If this is left as it is, air can no longer be supplied, the aerobic area inside the waste layer is reduced and the Fukuoka Method can not be maintained. (See
Picture 3-4 ~ 5)

Picture 3-8 Waste is higher than Gas venting facility (○) case (bad example)

Picture 3-9 Gas venting facility that is in the process of being plugged and buried (bad example)

• Preceding Independent type case

In the case of independent preceding type where gas venting facilities are raised to a height higher than the height for the landfill prior to implementing landfill operation and then proceed with landfill (see Fig. 3-6, picture 3-6), care is needed to perform landfill operation not from only one direction but in a uniform manner in the surrounding area to prevent falling down, damage, or breaking.

The independent height is higher than the planned height for waste and care must be taken

so that waste or covering soil does not flow into the facilities after landfill operation. In the case that there is a possibility of becoming buried, after landfill around the gas venting facility is complete pile crushed rock beforehand such that the gas venting facilities are at least 50

cm higher than the surrounding waste. (See Fig. 3-8)

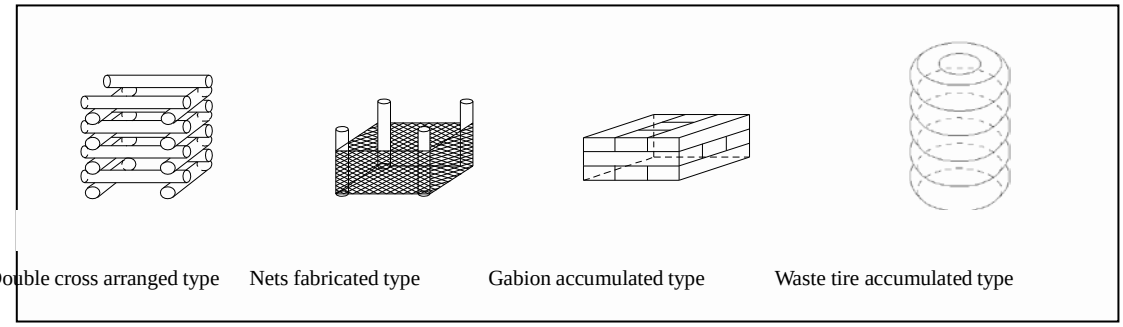


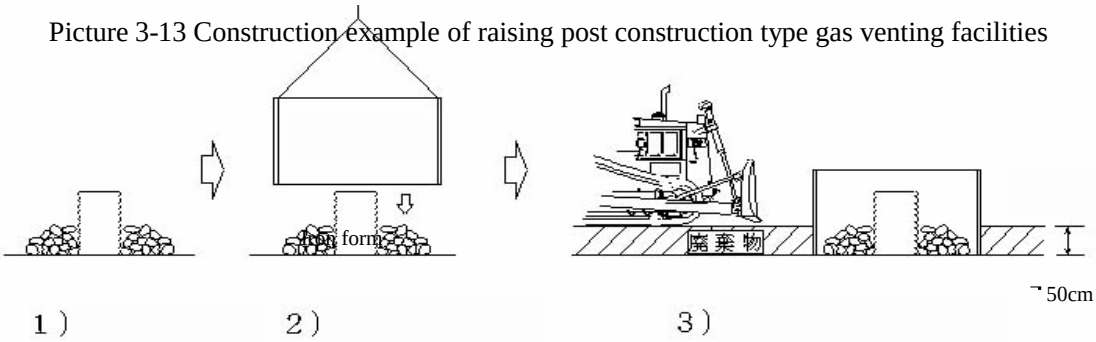
Fig. 3-10 Vertical pipe construction (preceding independent type) construction example

Picture 3-11 Vertical pipe construction (preceding independent type) construction example

Post construction type

A method of temporarily placing a steel frame of the gas venting facility that is scheduled to be raised and after burying the outer circumference of the steel frame, putting crushed rock in the steel frame and proceeding with raising (see Fig. 3-7) enables prevention of being knocked over, being damaged, or collapsing as well as achieving efficient raising operation.

Picture 3-13 Construction example of raising post construction type gas venting facilities



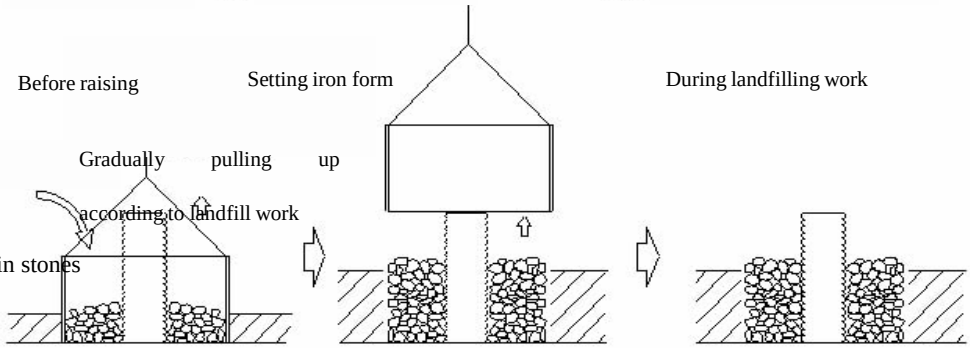
Before raising

Setting iron form

During landfilling work

Gradually pulling up according to landfill work

Throwing in stones



Connecting pipes, throwing in stones and pulling up iron form

Repeat procedure 4) and removing iron form finally

Completion of gas venting pipe raising

1) Install the steel frame using heavy machinery such as a backhoe

2) Perform landfill operation around the steel frame (from the perspective of plugging the pipe, waste material that is in rough pieces is suitable)

3) Connect the pipe and put crushed rock in the steel frame

4) Pull up the steel frame using the heavy machinery such as a backhoe

5) Repeat the above operation to raise the structures

Note 1 when a worker is working inside the steel frame, be sure to measure oxygen concentration before and during operation and take countermeasures for lack of oxygen as well as presence of toxic gases

4. Environmental Monitoring

4.1 Understanding Aerobic and Anaerobic Conditions

(1) Remarks

Decomposition of wastes (organic substances) is divided broadly into two processes of solubilization and gasification. In the solubilization process, soluble organic acids, ammonia, and CO2 etc. are produced, resulting the increase in the BOD load of leachate and the decrease in pH. In the gasification process, as gas is produced from the organic acids, etc. BOD load is reduced and pH increases. These two processes are influenced by the biological conditions of the wastes layer. In an aerobic condition, organic substances are decomposed by aerobic microorganisms; the time span of the first stage solubilization process (hydrolysis of organic substances) is short and transition to the second stage gasification process is rapid. In other words, as aerobic decomposition progresses, BOD load is reduced early on and pH increases. Therefore, monitoring BOD and pH enables understanding of the degree the wastes layer is aerobic.

Also, the final products generated through aerobic decomposition in the gasification process are oxides such as CO_2, nitrate and sulfate ions. On the other hands, in the case of anaerobic decomposition, the final products are reducing substances such as CH_4, H_2S, and ammonia. The products by the decomposition of organic wastes are different based on the biological conditions of wastes layer. The existence of aerobic area in wastes layer can be determined through measuring the quality and quantity of the gases generated from landfill and calculating these gases ratios. As these two processes are separated into 6 phases from the differences in concentration of pollutants and the generation volume of and

composition of gas (see Fig. 4-1, decomposition pattern), this can also be used as an indicator of landfill stabilization.

Furthermore, in the cases that metals are included in the wastes, iron and manganese are reduced in anaerobic conditions and as this makes them more soluble, the concentration of iron and manganese in the leachate increases. Therefore, the degree that the wastes layer is anaerobic can be determined through measuring the concentration of soluble iron and manganese in the leachate.

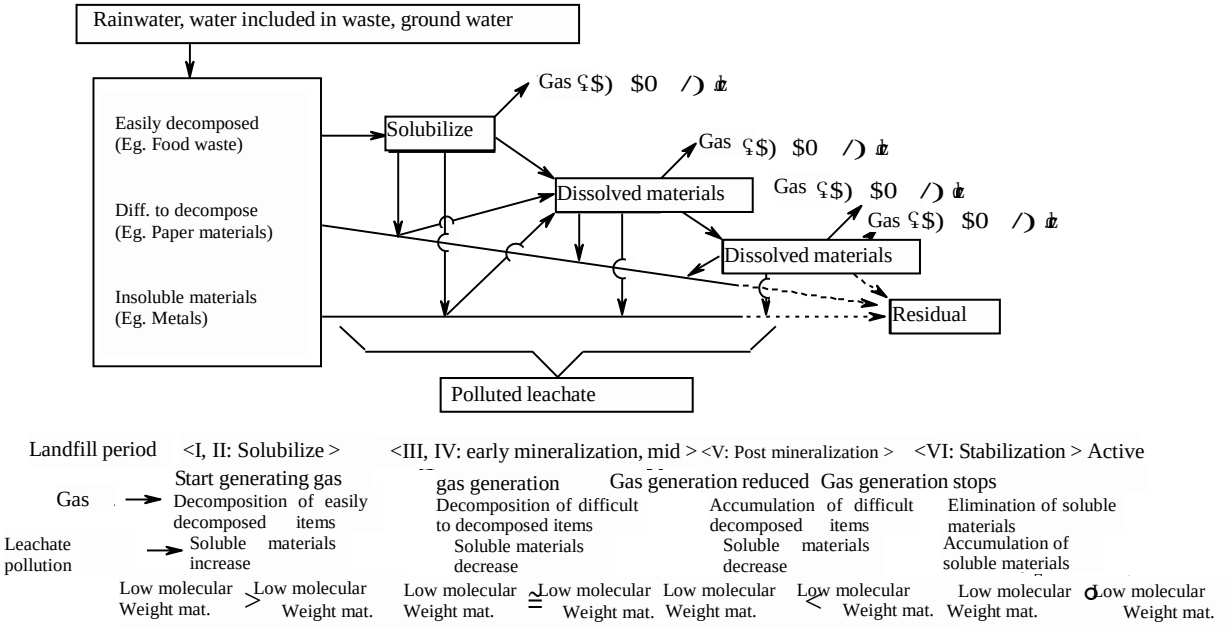


Fig. 4-1 Landfill waste material decomposition patterns

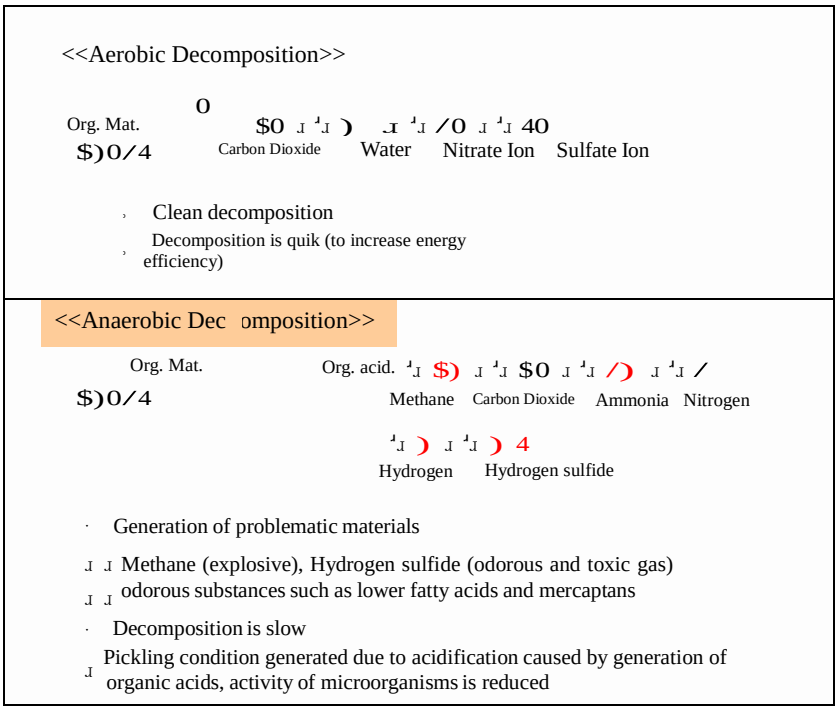


Fig. 4-2 Outline of Aerobic and Anaerobic Decomposition

(2) Measurement example

(i) pH and BOD concentration of leachate

a. pH measurement method and note for a measurement

pH test paper is best suited for measurement of pH on site. There are various types of pH test paper but a universal type of pH test paper is sufficient to gain a rough level of pH such acidic, neutral and alkali. Even if sample contains a lot of suspended matter, or if is colored, the pH can be measured within a error of roughly 0.2 to 0.4. Name of pH test papers and their applicable pH levels are shown in table 4-1.

If the pH test paper is left in leachate for a long period, the chemicals containing the test paper will dissolve into leachate and will be removed from test paper. If the test paper is touched by hand, it will change color due to sweat etc. so use tweezers or something similar for dipping in leachate. If tweezers are not available, pick up the edge of test paper and be careful not to immerse a part of paper that you are touching.

Use pH test paper with specified measuring range or a pH meter for accurate

measurement of pH. There is various type of pH meter with the different accuracy but devices for accurate measurement are not required. As the electrodes of pH meter are made with a thin glass film they are easy to break so be careful when using them. Store with the electrodes immersed in water.

Table 4-1 pH test paper names and applicable pH levels

CR	Cresol Red	0.2 – 2.0
		7.2 – 8.8
tb	Thymol Blue	1.4 – 3.0
		8.0 – 9.6
BPB	Bromophenol Blue	2.8 – 4.4
PB	Phenol Blue	3.2 – 5.6
BCG	Bromocresol Green	4.0 – 5.6
CPR	Chorphenol Red	5.0 – 6.6
MR	Methyl Red	5.4 – 7.0
BCP	Bromcresol Purple	5.6 – 7.2
BTB	Bromothymol Blue	6.2 – 7.8
PR	Phenol Red	0.0 – 1.6
		6.6 – 8.2
AZY	Alizarin Yellow	10.0 – 12.0
ALB	Alkali Blue	11.0 – 13.6

b. BOD measurement method and note for a measurement

The BOD is expressed by the amount of dissolved oxygen in sample that is consumed over a 5 day period at 20 °C. In Japan, the Winkler Azide modified method based on manganese oxidation by dissolved oxygen is used as a standard test method to measure the amount of dissolved oxygen. Also, the miller modified method that is based on the oxidation of iron by dissolved oxygen is used as a simple measurement method. In addition, there is a membrane electrode method that generates a current between metal electrodes based on the amount of dissolved oxygen and uses this value to determine the amount of dissolved oxygen. The Winkler Azide modified method and Miller modified

method are easily affected by reducing materials such as soluble iron and manganese etc. On the other hand, the membrane electrode method is not affected by reducing materials and measurement is easy but stabilization of the measurement value is difficult.

An important point for a measurement using the above 3 methods is that BOD components decompose and reduce while being stored so the test should be performed immediately after collecting the sample. In addition, as the test takes 5 days, if measurement does not go well, it is difficult to redo the measurement. Therefore, dilution ratio must be estimated accurately. These estimates are preformed based on past results and COD value, color, and smell of the sample. Cases where are 1/2, 1/4, 1/8, and 2, 4, 8 times of the base estimated BOD concentration must also be tested at the same time. Make sure that air can not get into the incubation bottles the incubation period (5 days).

c. Measurement example

The first period of solubilization phase (phase I) is a period where organic material hydrolyzes and where soluble pollutants such as organic acids are produced. Therefore, the BOD concentration is high and pH is acidic ranging 4 – 6 during this period. During the latter period of solubilization phase (phase II) and gasification phase (phase III), a portion of the solubilized organic substances is converted to gas so the BOD concentration is reduced and pH rise. In this period, CO_2 dissolves into the leachate and causes the pH to rise. A semi-aerobic type is more on CO_2 generation than an anaerobic type so that pH of Semi-aerobic type reach to as high as 8. During the middle to latter period of gasification phase (phase IV), gasification is the highest in both semi-aerobic and anaerobic type and therefore, the BOD concentration reduces further but the pH maintains a roughly neutral level. The most of decomposable organic substances is decomposed by the solubilization and gasification processes. Therefore, soluble organic subsutances vanishes and the BOD concentration is a low concentration of less then 10 mg/L in the stabilization phase (phase V). In addition, the alkalinity increases and a pH reach to 7 – 8 due to CO_2 produced in gasification phase.

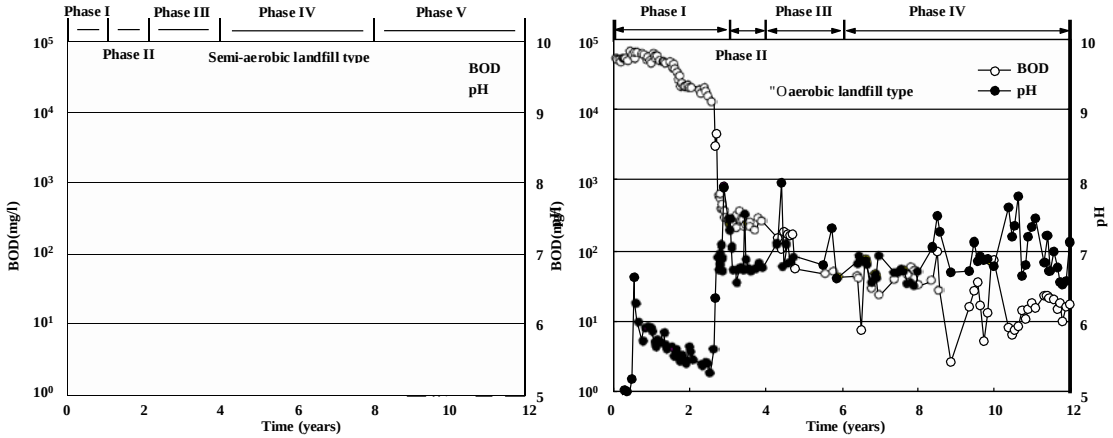


Fig.4-3 pH and BOD concentration variation with time

(ii) Ammonia and nitrate concentrations in leachate a.

Important points for measuring

Nitrogen compounds also biodegrade for storing and change to various type of nitrogen compounds such as ammonia and nitrate etc.. Therefore, measurement should be quickly performed after collecting sample.

b. Measurement example

Ammonia is produced through hydrolysis of organic material. Then, ammonia oxidizes under aerobic conditions and is converted to nitrite and nitrate. As nitrogen oxides are soluble, they dissolve in the leachate. On the other hand, as ammonia does not oxidize in an anaerobic condition and does not change. Ammonia is also soluble and dissolves in the leachate as well. In other words, detection of nitrogen oxides in leachate shows that wastes layer is an aerobic.

In the gasification process where pH increases, part of the ammonia is released as a gas. Therefore ammonia concentration gradually reduces during the gasification process.

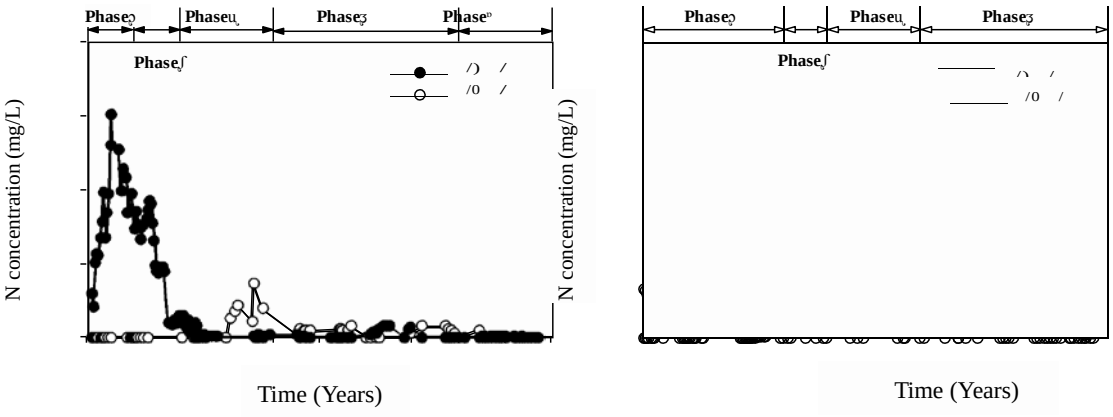


Fig.4-4 NH_4^+-N and NO_3^- N concentration variation with time

(iii) Soluble iron and soluble manganese concentrations in leachate

a. Important points for measuring

Soluble iron and soluble manganese are oxidized by air and become insoluble (precipitates). Therefore, after collecting a sample, quickly filter it and immediately perform acid treatment as pre-treatment for measurement or if this can not be done, add hydrochloric acid and adjust the pH to less than 1 for storage.

b. Measurement example

Heavy metals change from insoluble to soluble based on pH or oxidation/reduction potential. In general, most heavy metals are soluble with acidity. Heavy metals that change based on oxidation/reduction potential are arsenic, iron, and manganese etc. Especially, there is a relatively high amount of iron and manganese in wastes and they dissolve when the oxidation/reduction potential is low, or under anaerobic conditions, and concentrations of these metals increase in the leachate.

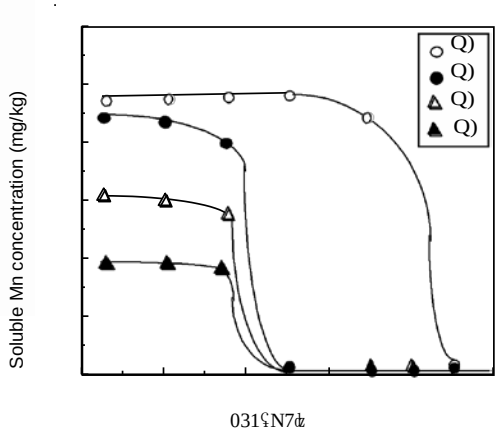


Fig. 4-5 pH ORP affect on solubility of Mn in soil

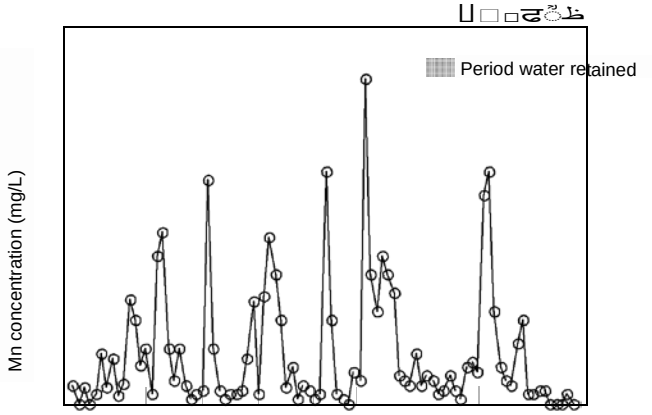


Fig. 4-6 Increase in Mn concentration based on water retention in landfill layer

(iv) $CH_4$and CO_2 concentrations in product gas

a. Measurement method and important points for measuring

Measuring methods for the composition of the landfill gas divided into two types broadly. One method is to analysis using gas chromatography in a lab. Another method is direct measurement at the landfill site. The first method enables analysis of several gas constituents at the same time and has high accuracy but equipment is expensive. Using the second method, one device can only measure one or two types of gas but it is inexpensive and does not require special measurement skills and can be applied to the measurement of CH_4 and CO_2 etc. with accuracy on the order of several %. A flammable gas detection device is used to measure CH_4 and an infrared absorption type or gas detection tube methods are used to detect CO_2. Flammable gas detection devices are developed with the purpose of preventing accidents caused by gas. There are LEL types and the actual concentration measurement type of flammable gas detection devices. The type that measures actual concentration needs to be selected for purchase as well as for measuring. Because the maximum detection range of LEL type is the explosion limit.

b. Measurement example

The gasification process has two path which is aerobic and anaerobic paths. Semi-aerobic type has both aerobic areas and anaerobic areas in the wastes layer. Therefore, the composition of the landfill gas will change based on the ratio of these two areas. As the aerobic area increases, the anaerobic gasification phase (phase IV) shortens and CH_4/CO_2 ratio of phase V and phase VI is reduced. The CH_4/CO_2 ratio based on landfill conditions is shown below.

Aerobic: CH_4 concentration is 0

Semi-aerobic (V, VI periods): $CH_4/CO_2 < 2$

Anaerobic (IV period): $CH_4/CO_2 > 2$

、Theoretically $CH_4/CO_2 = 1$ but CO_2 reacts with positive ions in the waste material where it is fixed and dissolves into leachate or precipitate and therefore its concentration in gas is reduced.

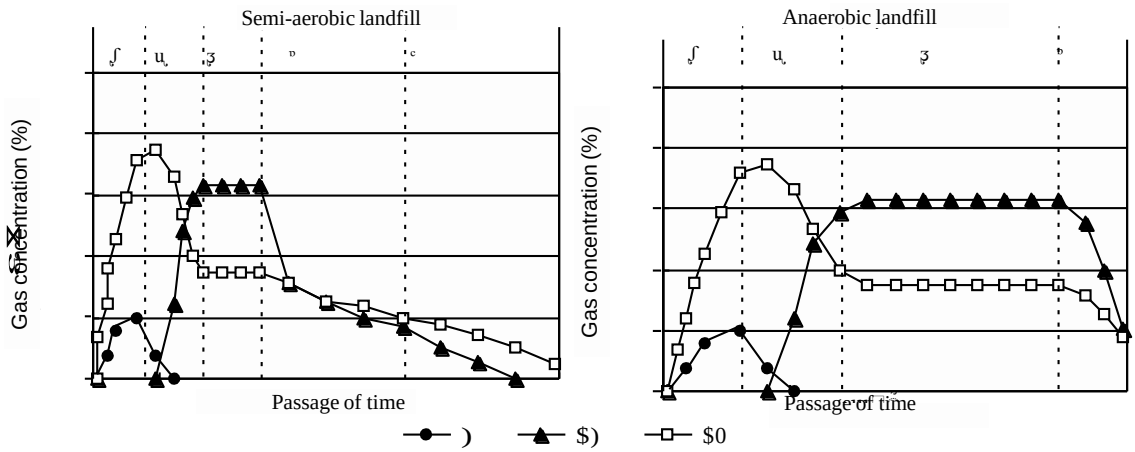


Fig. 4-7 Landfill product gas composition changes

(v)H_2S concentration in landfill gas

a. Measurement method and important points for measuring

Gas chromatography analysis can be used for hydrogen sulfide (H_2S) and for methyl mercaptans (CH_3SH), which are odorous constituents, similar to CH_4 and CO_2 but a induced type gas detection device is easy and inexpensive for measuring of these gases. Also, using this device a prescribed amount (maximum intake amount 100 mL for each time) of gas can be induced into the tip, the amount of intake can be reduced for gas with high concentrations and on the other hand, the number of intake can be increased if the concentration is low. The value noted on the tip is result from one intake so when the volume or number of intakes is changed, some type of calculation such as the dividing the value by the number of intakes is required and therefore care must be taken. There are several types of tips that are classified based on concentration and therefore one with an appropriate concentration range must be selected.

b. Measurement example

When organic sulfur compounds in the wastes are aerobically decomposed by

Microorganisms, they are converted to intermediate products and in the end to sulfuric acid. On the other hand, when anaerobic decomposition occurs, it changes to odorous substances such as hydrogen sulfide (H_2S) and methyl mercaptan (CH_3SH). Of the inorganic sulfur components, sulfur is converted to sulfuric acid by sulfur oxidation bacteria under the aerobic condition. Therefore, if there are sulfur compounds such as CH_3SH or H_2S detected during the initial (solubilization) phase of decomposition of organic substances, it shows that the wastes layer is under the anaerobic condition.

An anaerobic landfill, there has an aerobic area in the surface layer of the landfill. Therefore, a portion of inorganic sulfur in this aerobic area of the surface layer is converted to sulfate and dissolve into leachate. Then sulfate in leachate is changed again to H_2S by sulfate reducing bacteria in the anaerobic area of the middle wastes layer. Therefore, in an anaerobic landfill, H_2S is not only generated in the beginning of land filling but there are also cases where high concentrations are detected from 4 to 5 years after starting of landfill operation. In the semi-aerobic type, as there are aerobic areas in the bottom and around the gas venting pipes, H_2S that is produced in anaerobic areas is again oxidized to sulfate. Therefore the H_2S concentration in the gas is reduced. On the other hand, as the sulfate produced by oxidation of inorganic sulfur is soluble, it is discharged with the leachate. In other words, as the aerobic area increases, in addition to H2S concentration in gas being reduced, the sulfuric acid ion concentration in the leachate increases.

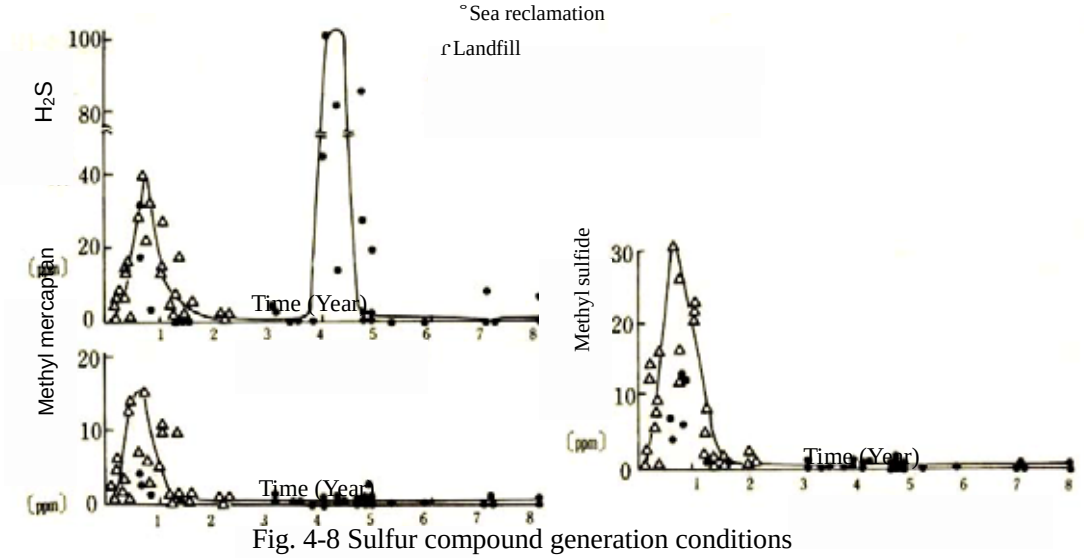


Fig. 4-8 Sulfur compound generation conditions

(1) Remarks

The target of a semi-aerobic landfill is the degradation of organic material by the micro bacteria that exist in the waste layer. Therefore, the effect of stabilization provided by semi-aerobic landfill can be evaluated by reduction in the amount of organic material. If there is any organic material, a portion of the energy generated by microorganisms is converted to thermal energy and biodegradation products dissolved pollutants and biogas. BOD of the dissolved pollutants indicates the amount of organic matter that is easily biodegradable, so the rate of BOD in the total amounts of organic material (COD) is reduced. The biodegradation is slowness when the amount of organic material is reduced, therefore there is a smaller amount of energy is generated, the temperature of waste layer is decreased, and also the amount of gas production is reduced. The leachate passes through most of the waste layer, so it can be considered that characteristics of the leachate reflect the inside of landfill, but the landfill gas can be measured only at a specific area such as the gas ventilation pipe, so it cannot be expected to reflect the whole landfill area. It is possible to measure the amount of gas production on the part of final cover soil but a lot of effort is required to measure the whole surface of a large landfill area.

A simple method for measuring amount of gas generated particularly methane gas is the investigation of vegetation on the soil cover. There are some types of vegetation that can be inhibited by gases such as methane. In other words, to observe the growth of these vegetations can be realized the reduction of methane production.

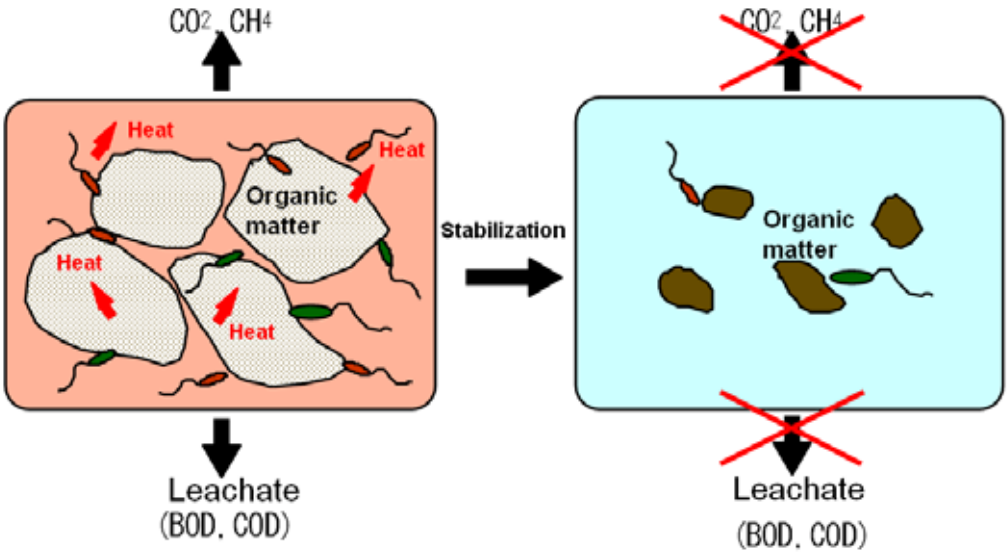


Fig. 4-9 conceptual scheme for stabilization of landfill

(2) Measurement example

(i) Temperature of leachate measurement

a. Advantage and simplicity method of leachate temperature

There is a heat balance in landfill to receive inside and release to outside. (see Fig. 4-10). In this figure, the way to recognize the state of waste degradation based on the temperature: (1) temperature from gas collecting pipes (2) leachate temperature from collecting pipe, and (3) temperature of waste layer, throw (2) is easy and low cost. The temperature of the leachate reflects the condition of inside the landfill because rain water passes through the waste layer and heat transfers to the leachate through heat exchange from the waste in the landfill and with the gases. Furthermore, the diagnosis with leachate temperature can estimate by the energy transfer with leachate and rain water temperature and amount of leachate.

b. Measurement method and note for a measurement

> Leachate temperature:

Temperature measurement of leachate using a thermometer and recorder must be measured at the outlet port of leachate collecting pipe or the collection pit. And the sampling water must be analyzed by thermometer just after taking, and the temperature of rain water is measured periodically by a thermometer.

>Leachate amount:

The leachate volume must be measured from collecting pit every day.

c. Measurement example

Biodegradation Diagnosis using water temperature is performed from (1) temporal change of leachate temperature and amount and (2) amount of thermal energy discharged by

Leachate calculated from the following equation.

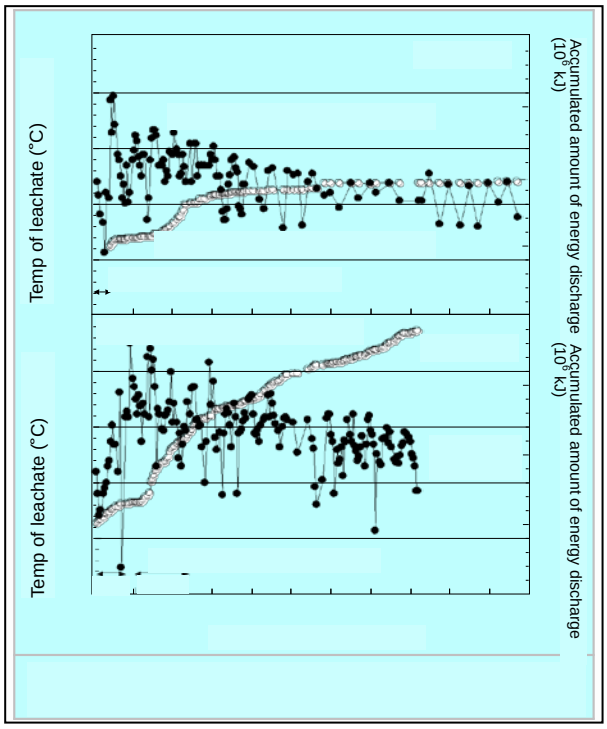
Amount of thermal energy transfer to leachate:

$$Q = V_L \, (_TL - T_W) \, C_P \, [J]$$

T_L: temperature of leachate [°C]; T_W: temperature of rainwater [°C]; V_L: volume of leachate [L]; C_P: specific heat of water = 4.18 [KJ/kg-K]

Temporal change of the leachate temperature and the accumulation of amount of energy

discharged based on the equation in every month show in Fig. 4-11.



From this figure, both of landfills A and B show a leachate temperature of 30 ~ 40 °C in the primary period, but after 15 years A landfill showed around 20 °C, the same temperature as ground water, means getting a stabilizing. It can be judged that it will take a little longer for B landfill to stabilize around 25 °C.

Change in temperature of leachate is easily affected by surroundings temperature such as the summer and winter as well as rain water, so there is a difficult case to judge it. From the results of the amount of thermal energy for each month in landfill A, is shown that the accumulation of energy discharged in the leachate in every month is low and it can be estimated that there is not any heat generation inside the landfill. The degradation of the waste is almost complete and the landfill can be judged to be stabilizing.

On the other hand, there is a lot of thermal energy generated in the B landfill and the accumulated amount of thermal energy shows still increasing. The landfill is generating thermal energy and therefore it can be judged that degradation is currently proceeding and that the landfill has not entered the stable period.

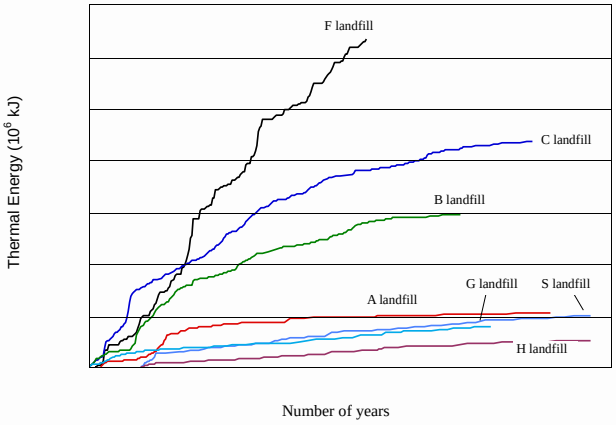


Fig. 4-12 Accumulated thermal energy discharged through seepage water

Examples of accumulated thermal energy amount discharged through leachate of several landfill sites are shown in Fig. 4-12. Based on Fig. 4-12, the amount of increase in accumulated energy discharged by leachate from the landfill sites A, G, H, and S. This result show that the waste in these landfill sites has been decomposed and reaches in a stable condition.

On the other hand, F landfill is in running so accumulated energy discharged to leachate still increases with time showing that decomposition of waste is activity in the landfill site. Landfill operation for B and C landfills is completed and as the increase in amount of accumulated thermal energy discharged is gradually going down, it shows a trend of stabilization of waste.

(ii) BOD/COD of leachate

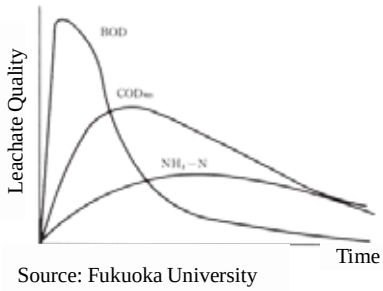
a. Measurement method and note for a measurement

Following 1) of chapter 4-1.

b. Measurement example

The quality and concentration of leachate is depending on the type of land filled waste. In generally, the trend of landfill which filled mainly with organic material is shown the water quality pattern as Fig. 4-13, and they show a trend of BOD > COD. In addition, as nitrogen components in waste material gradually degradable, so TN in leachate shows increasing

after long period. However, in a landfill site filled mainly with organic material, if the landfill is maintained with an aerobic condition, BOD is rapidly decomposed by microorganisms (see Fig. 4-14).



Source: Fukuoka University

Fig. 4-13 General trends of leachate quality

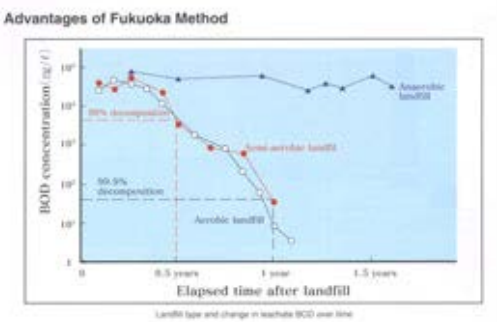


Fig. 4-14 BOD of leachate from landfills mainly filled with organic material

The leachate quality of a semi-aerobic landfill of incombustible waste and incineration residue is shown in Fig. 4-15. In a landfill site that sufficiently maintains the function of a semi-aerobic construction, the BOD (easily biodegradable organic matter) degrades in early stage and the COD (hardly biodegradable organic matter) decrease gradually, so it has a trend of BOD < COD. In addition, TN in leachate shows increasing due to nitrogen components in waste gradually degraded and dissolved into leachate after several years from the starting operation.

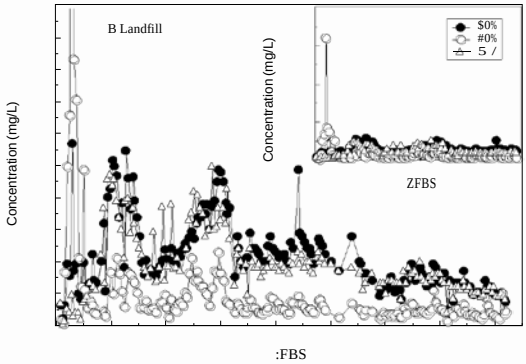


Fig. 4-15 Leachate quality of landfill by mainly incombustible waste with semi aerobic construction

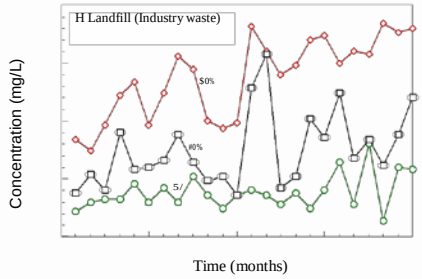


Fig. 4-16 Leachate quality from a landfill of industrial waste

This Fig 4-16 is an example of leachate quality from a landfill site of industrial waste. The H landfill site had a relationship of BOD < COD from just after startup of the landfill and it is the prior stage of TN discharge.

The quality of leachate discharged from the landfill is greatly influenced by differences in the land filled waste and also differences in aerobic/anaerobic environment of the landfill. However, if leachate is remained underwater (anaerobic condition) in the landfill, the quality became pejoration and in the case that leachate is not remained inside (aerobic or semi-aerobic condition) a BOD < COD trend that means the quality will quickly become favorable can observe.

(iii) Amount of gas production (final cover soil)

a. Measurement method and note for a measurement

As a method for measuring the amount of gas production from the final cover soil, a chamber method which set the chamber on the surface and calculating the flux of methane and carbon dioxide concentrations by the temporal change is generally used. In this method, the gas which is inside of the chamber should be sampled without any influence from the gas pressure, therefore a mixing device to maintain a homogeneous in the chamber is necessary. Also, the measurement time limit must be less than the time until each gas concentration reaches to gas saturation period, so the measurement time is less than 20 minutes in general.

In the case to evaluate the methane production by vegetation, these plants must be selected the normal plants that grow on bare land. However, as the vegetation differs with

regions, a type of vegetation that is highly sensitive to methane concentration needs to be confirmed in order to research the relationship between gas concentration and vegetation.

b. Measurement example

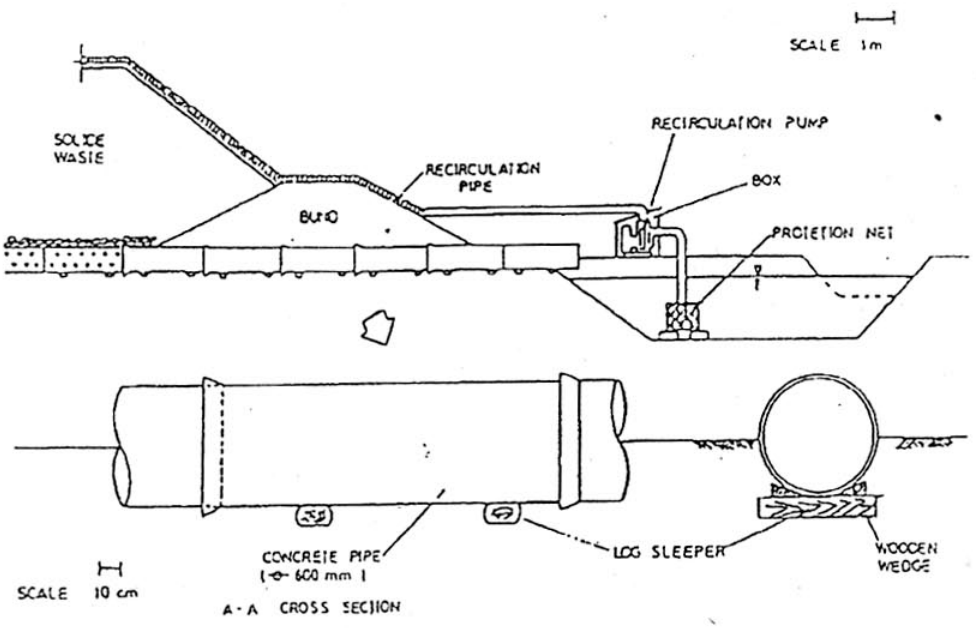
As mentioned before the amount of gas generated from the final disposal site differs with the landfill construction of the landfill. In an aerobic construction, 70% of the organic material in the landfill site is discharged as landfill gas, but in an anaerobic construction there is less gas generation. This is because in an anaerobic construction, the soluble organic components produced are discharged as leachate during degradation of organic material in the acid fermentation period. Also, the stabilization period which means after completely decomposition of organic material and the period where little or nothing generation of gas is prospected to be roughly 10 years for an aerobic construction. A semi-aerobic construction shows a similar gas generation pattern as aerobic construction but as the speed of generation is lower. Due to the period where gas generation is delayed compared to aerobic construction, it is considered that it will approach stabilization within 20 years. On the other hand, splitting the gas generation curve for an

anaerobic construction into two parts at the 5^{th} year, the curve for years 5 ~ 10 is a straight

line and there is no decrease in gas generation seen after the 10^{th} year.

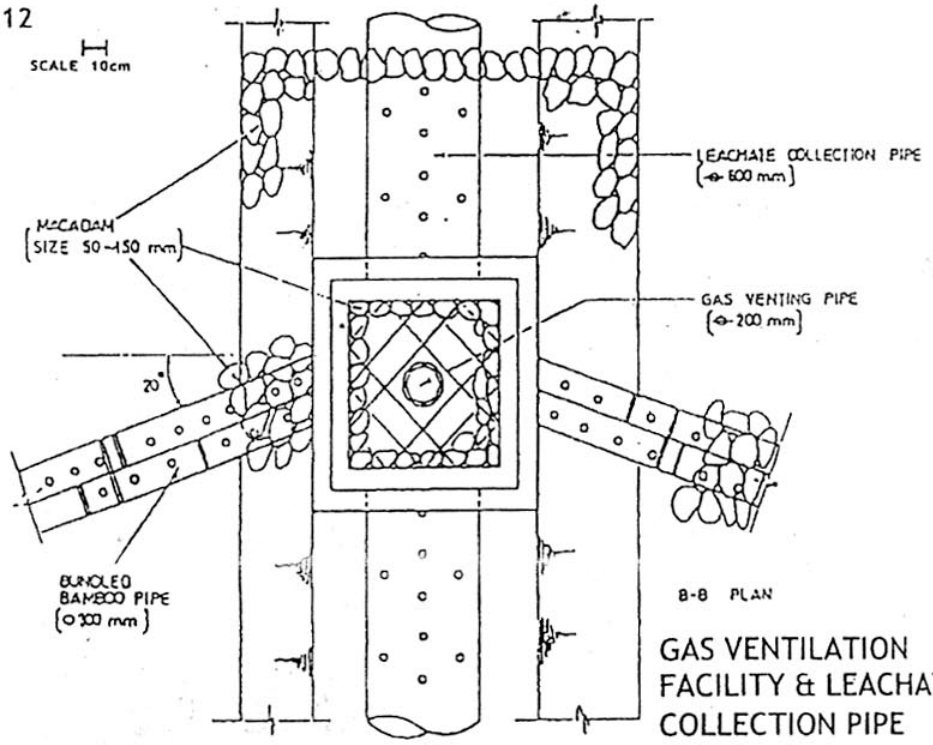
Measuring the amount of gas generated from the huge surface area such as the landfill requires a lot of work. Here, an example of evaluation of stabilization based on amount of gas generated using vegetation as a simple method is introduced. In general, methane affects growing of vegetation, but this effect differs greatly based on the type of vegetation. In the case that monitoring the amount of gas generated is necessary to choose some plants with high sensitivity to methane. Growth range of vegetation with respect to methane concentration is shown in Fig. 4-17. In the vegetation that grows naturally, growth of *arrowroot* and *tall golden rod* is hindered by a methane concentration of 0.02%. Growth of these plants is an indicator of reduction in methane concentration. In other words, if these plants are growing in the final cover soil, there is very little generation of methane which means it can be evaluated as being in stabilization stage.

FIG.11



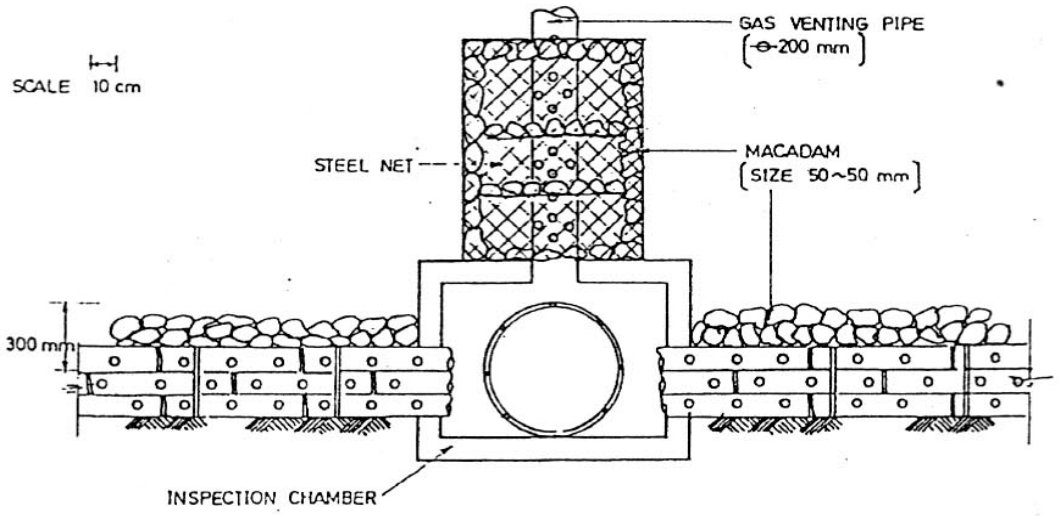
RE-CIRCULATORY SEMIAEROBIC LANDFILL TYPE

FIG.12



GAS VENTILATION FACILITY & LEACHATE COLLECTION PIPE

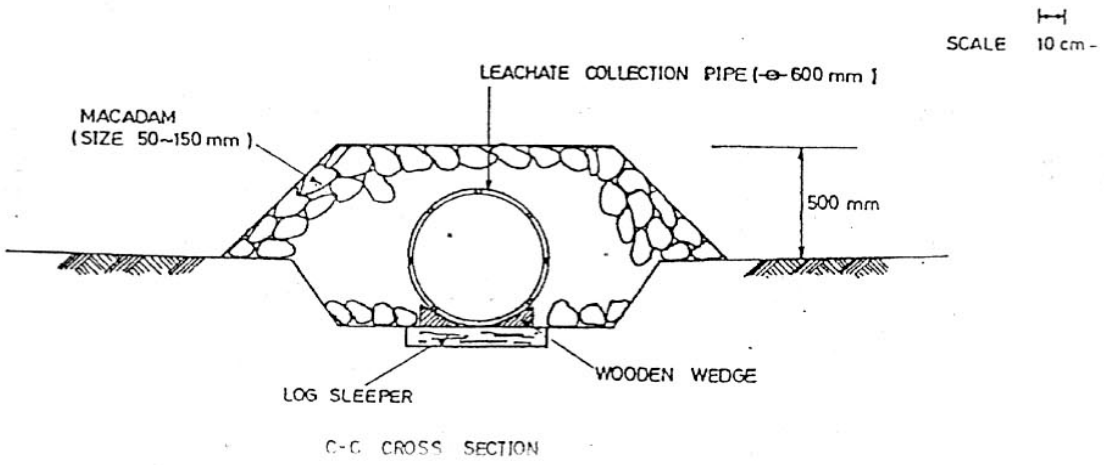
Fig. 13



B-B CROSS SECTION

GAS VENTILATION FACILITY

Fig. 14



C-C CROSS SECTION

LEACHATE COLLECTION FACILITY

IMAGES OF GEO MEMBRANE

LINNING ARRANGEMENTS OF GEO MEMBRANE

Plasticity Characteristics.

Plasticity characteristics describe a material's ability to behave as a plastic or moldable material. Soils containing clay are generally categorized as plastic. Soils that do not contain clay are non-plastic and typically considered unsuitable materials for compacted clay liners, unless soil amendments such as bentonite clay are introduced.

Plasticity characteristics are quantified by three parameters: liquid limit, plastic limit, and plasticity index. The liquid limit is defined as the minimum moisture content (in percent of oven-dried weight) at which a soil- water mixture can flow. The plastic limit is the minimum moisture content at which a soil can be molded. The plasticity index is defined as the liquid limit minus the plastic limit and defines the range of moisture content over which a soil exhibits plastic behavior. When soils with high plastic limits are too dry during placement, they tend to form clods, or hardened clumps, that are difficult to break down during compaction. As a result, preferential pathways can form around these clumps allowing leachate to flow through the material at a higher rate. Soil plasticity indices typically range from 10 percent to 30 percent. Soils with a plasticity index greater than 30 percent are cohesive, sticky and difficult to work with in the field. Common testing methods for plasticity characteristics include the methods specified in ASTM D-4318, also known as Atterberg limits tests.

Percent fines and percent gravel.

Typical soil liner materials contain at least 30 percent fines and can contain up to 50 percent gravel, by weight. Common testing methods for percent fines and percent gravel are specified in ASTM D-422, also referred to as grain size distribution tests.5 Fines refer to silt and clay- sized particles. Soils with less than 30 percent fines can be worked to obtain hydraulic conductivities below 1×10^{-7} cm/sec (4×10^{-8} in./sec), but use of these soils requires more careful construction practices.

Gravel is defined as particles unable to pass through the openings of a Number 4 sieve, which has an opening size equal to 4.76 mm (0.2 in.). Although gravel itself has a high hydraulic conductivity, relatively large amounts of gravel, up to 50 percent by weight, can be uniformly mixed with clay materials without significantly increasing the hydraulic conductivity of the material. Clay materials fill voids created between gravel particles, thereby creating a gravel-clay mixture with a low hydraulic conductivity. As long as the percent gravel in compacted clay mixture remains below 50 percent, creating a uniform mixture of clay and gravel, where clay can fill in gaps, is more critical than the actual gravel content of the mixture.

You should pay close attention to the percent gravel in cases where a compacted clay liner functions as a bottom layer to a geosynthetic, as gravel can cause puncturing n geosynthetic materials. Controlling the maximum particle size and angularity of the gravel should help prevent puncturing, as well as prevent gravel from creating preferential flow paths. Similar to gravel, soil particles or rock fragments also can create preferential flow paths. To help prevent the development of preferential pathways and an increased hydraulic conductivity, it is best to use soil liner materials where the soil particles and rock fragments are typically small (e.g., 3/4 inch in diameter).

Interactions with Waste

Waste placed in a unit can interact with compacted clay liner materials, thereby influencing soil properties such as hydraulic conductivity and permeability. Two ways that waste materials can influence the hydraulic conductivity of the liner materials are through dissolution of soil minerals and changes in clay structure. Soil minerals can be dissolved, or reduced to liquid form, as a result of interaction with acids and bases. For example, aluminum and iron in the soil can be dissolved by acids, and silica can be dissolved by bases. While some plugging of soil pores by dissolved minerals can lower hydraulic conductivity in the short term, the creation of piping and channels over time can lead to an increased hydraulic conductivity in the long term. The interaction of waste and clay materials can also cause the creation of positive ions, or cations. The presence of cations such as sodium, potassium, calcium, and magnesium can change the clay structure, thereby influencing the hydraulic conductivity of the liner. Depending on the cation type and the clay mineral, an increased presence of such cations can cause the clay minerals to form clusters and increase the permeability of the clay. Therefore, before selecting a compacted clay liner material, it is important to develop a good understanding of the composition of the waste that will be placed in the waste management unit. EPA's Method 9100, in publication SW-846, measures the hydraulic conductivity of soil samples before and after exposure to permeants.

Locating and Testing Material

Although the selection process for compacted clay liner construction materials can vary from project to project, some common material selection steps include locating and testing materials at a potential borrow or commercial pit before construction, and observing and testing material performance throughout construction. First, investigate a potential borrow or commercial pit to determine the volume of materials available. The next step is to test a representative sample of soil to determine material properties such as plasticity characteristics, percent gravel, and percent

fines. To confirm the suitability of the materials once construction begins, you should consider requesting that representative samples from the materials in the borrow or commercial pit be tested periodically after work has started.

Material selection steps will vary,, depending on the origin of the materials for the project. For example, if a commercial pit provides. the materials, locating an appropriate onsite borrow pit is not necessary In addition to the tests performed on the material, it is recommended that a qualified inspector make visual observations throughout the construction process to ensure that harmful materials, such as stones or other large matter, are not present in the liner material.

What issues should be considered in the construction of a liner and the operation of a unit?

You should develop test pads to demonstrate construction techniques and material performance on a small scale. During unit construction and operation, some additional factors influencing the performance of the liner include: preprocessing, sub-grade preparation, method of compaction, and protection against desiccation and cracking. Each of these steps, from preprocessing through protection against desiccation and cracking, should be repeated for each lift or layer of soil.

Test Pads

Preparing a test pad for the compacted clay liner helps verify that the materials and methods proposed will yield a liner that meets the desired hydraulic conductivity. A test pad also provides an opportunity to demonstrate the performance of alternative materials or methods of construction. A test pad should be constructed with the soil liner materials proposed for a particular project, using the same preprocessing procedures, compaction equipment, and construction practices proposed for the actual liner. A complete discussion of test pads (covering dimensions, materials, and construction) can be found in Chapter 2 of EPA's 1993 technical guidance document Quality Assurance and Quality Control for Waste Containment Facilities (U.S. EPA, 1993c). A discussion of commonly used methods to measure in-situ hydraulic conductivity is also contained in that chapter.

Preprocessing

Although some liner materials can be ready for use in construction immediately after they are excavated, many materials will require some degree of preprocessing. Preprocessing methods include: water content adjustment, removal of oversized particles, pulverization of any clumps, homogenization of the soils, and introduction of additives, such as bentonite.

Water content adjustment.

For natural soils, the degree of saturation of the soil liner at the time of compaction, known as molding water content, influences the engineering properties of the compacted material. Soils compacted at water contents less than optimum tend to have a relatively high hydraulic conductivity. Soils compacted at water contents greater than optimum tend to have low hydraulic conductivity and low strength.

Proper soil water content revolves around achieving a minimum dry density, which is expressed as a percentage of the soil's maximum dry density. The minimum dry density typically falls in the range of 90 to 95 percent of the soil's maximum dry density value. From the minimum dry density range, the required water content range can be calculated, as shown in Figure 1. In this example the soil has a maximum dry density of 115 lb/cu ft. Based upon a required minimum dry density value of 90 percent of maximum dry density which is equal to 103.5 lb/cu ft, the required water content ranges from 10 to 28 percent.

It is less problematic to compact clay soil at the lower end of the required water content range because it is easier to add water to the clay soil than to remove it. Thus, if precipitation occurs during construction of a site which is being placed at the lower end of the required water content range, the additional water might not result in a soil water content greater than the required range. Conversely, if the site is being placed at the upper end of the range, for example at 25 percent, any additional moisture will be excessive, resulting in water content over 28 percent and making the 90 percent maximum dry density unattainable. Under such conditions construction should halt while the soil is aerated and excess moisture is allowed to evaporate.

Removal of oversized particles. Preprocessing clay materials, to remove cobbles or large stones that exceed the maximum allowable particle size, can improve the soil's compactibility and protect any adjacent geomembrane from puncture. Particle size should be small (e.g., 3/4 inch in diameter) for compaction purposes. If a geomembrane will be placed over the compacted clay, only the upper lift of clay needs to address concerns regarding puncture resistance. Observation by quality assurance and quality control personnel is the most effective method to identify areas where oversized particles need to be removed. Cobbles and stones are not the only materials that can interfere with compactive efforts. Chunks of dry, hard clay, also known as clods, often need to be broken into smaller pieces to be properly hydrated, remolded, and compacted. In wet clay,

clods are less of a concern since wet clods can often be remolded with a reasonable compactive effort.

Soil amendments. If the soils at a unit do not have a sufficient percentage of clay, a common practice is to blend bentonite with them to reduce the hydraulic conductivity Bentonite is a clay mineral that expands when it comes into contact with water. Relatively small amounts of bentomte, on the order of 5 to 10 percent, can be added to sand or other non-cohesive soils to increase the cohesion of the material and reduce hydraulic conductivity.

Sodium bentonite is a common additive used to amend soils. However, this additive is vulnerable to degradation as a result of contact with certain chemicals and waste leachates. Calcium bentonite, a more permeable material than sodium bentonite, is another common additive used to amend soils. Approximately twice as much calcium bentonite is needed to achieve a hydraulic conductivity comparable to that of sodium bentonite. Amended soil mixtures generally require mixing in a pug mill, cement mixer, or other mixing equipment that allows water to be added during the mixing process. Throughout the mixing and placement processes, water content, bentonite content, and particle distribution should be controlled. Other materials that can be used as soil additives include lime cement and other clay minerals, such as atapulgite. It can be difficult to mix additives thoroughly with cohesive soils, or clays; the resultant mixture might not achieve the desired level of hydraulic conductivity throughout the entire liner.

Subgrade Preparation

It is important to ensure that the subgrade on which a compacted clay liner will be constructed is properly prepared. When a compacted clay liner is the lowest component of a liner system, the subgrade consists of native soil or rock. Subgrade preparation for these systems involves compacting the native soil to remove any soft spots and adding water to or removing water from the native soil to obtain a specified firmness. Alternatively, in some cases, the compacted clay liner can be placed on top of a geosynthetic material, such as a geotextile. In such cases, subgrade preparation involves ensuring the smoothness of the geosynthetic on which the clay liner will be placed and the conformity of the geosynthetic material to the underlying material.

Compaction

The main purpose of compaction is to densify the clay materials by breaking and remolding clods of material into a uniform mass. Since amended soils usually do not develop clumps, the

primary objective of compaction for such materials is to increase the material's density. Proper compaction of liner materials is essential to ensure that a compacted clay liner meets specified hydraulic conductivity standards. Factors influencing the effectiveness of compaction efforts include: the type of equipment selected, the number of passes made over the materials by such equipment, the lift thickness, and the bonding between the lifts. Molding water content, described earlier under preprocessing, is another factor influencing the effectiveness of compaction.

Type of equipment Factors to consider when selecting compaction equipment include: the type and weight of the compactor, the characteristics of any feet on the drum, and the weight of the roller per unit length of drummed surface. Heavy compactors, weighing more than 50,000 pounds, with feet long enough to penetrate a loose lift of soil, are often the best types of compactor for clay liners. For bentonite-soil mixtures, a footed roller might not be appropriate. For these mixtures, where densification of the material is more important than kneading or remolding it to meet low hydraulic conductivity specifications, a smooth-drum roller or a rubber-tired roller might produce better results. Figure 2 depicts two types of footed rollers, a fully penetrating footed roller and a partially-penetrating footed roller.

For placement of liners on side slopes, consider the angle and length of the slope. Placing continuous lifts on a gradually inclined slope will provide better continuity between the bottom and sidewalls of the liner. Since continuous lifts might be impossible to construct on steeper slopes due to the difficulties of operating heavy compaction equipment on these slopes, materials might need to be placed and compacted in horizontal lifts. When sidewalls are compacted horizontally, it is important to avoid creating seepage planes, by securely connecting the edges of the horizontal lift with the bottom of the liner. Because the lift needs to be wide enough to accommodate compaction equipment, the thickness of the horizontal lift is often greater than the thickness specified in the design. In such cases, you should consider trimming soil material from the constructed side slopes and sealing the trimmed surface using a sealed drum roller.

It is common for contractors to use several different types of compaction equipment during liner construction. Initial lifts might need the use of a footed roller to fully penetrate a loose lift. Final lifts also might need the use of a footed roller for compaction, however, they might be formed better by using a smooth roller after the lift has been compacted to smooth the surface of the lift in preparation for placement of an overlying geomembrane.

Number of passes The number of passes made by a compactor over clay materials can influence the overall hydraulic conductivity of the liner. The minimum number of passes that is reasonable depends on a variety of site-specific factors and cannot be generalized. In some cases, where a minimum coverage is specified, it might be possible to calculate the minimum number of passes to meet such a specification. At least 5 to 15 passes with a compactor over a given point are usually necessary to remold and compact clay liner materials thoroughly.

An equipment pass can be defined as one pass of the compaction equipment or as one pass of a drum over a given area of soil. It is important to clearly define what is meant by a pass in any quality assurance or quality control plans. It does not matter which definition is agreed upon, as long as the definition is used consistently throughout the project.

Life thickness.

You should determine the appropriate thickness (as measured before compaction) of each of the several lifts that will make up the clay liner. The initial thickness of a loose lift will affect the compactive effort needed to reach the lower portions of the lift. Thinner lifts allow compactive efforts to reach the bottom of a lift and provide greater assurance that compaction will be sufficient to allow homogenous bonding between subsequent lifts. Loose lift thicknesses typically range between 13 and 25 cm (5 and 10 in.). Factors influencing lift thickness are: soil characteristics, compaction equipment, firmness of the foundation materials, and the anticipated compaction necessary to meet hydraulic conductivity requirements.

Bonding between lifts.

Since it is inevitable that some zones of higher and lower hydraulic conductivity, also known as preferential pathways, will be present within each lift, lifts should be joined or bonded in a way that minimizes extending these zones or pathways between lifts. If good bonding is achieved, the preferential pathways will be truncated by the bonded zone between the lifts. At least two recommended methods exist for preparing proper bonds. The first method involves kneading, or blending the new lift with the previously compacted lift using a footed roller. Using a roller with feet long enough to fully penetrate through the top lift and knead the previous lift improves the quality of the bond. A second method involves using a disc harrow or similar equipment to scarify, or roughen, and wet the top inch of the recently placed lift, prior to placing the next lift.

Protection Against Desiccation and Cracking

You should consider how to protect compacted clay liners against desiccation and freezing during and after construction. Protection against desiccation is important, because clay soil shrinks as it dries. Depending on the extent of shrinkage, it can crack. Deep cracks, extending through more than one lift, can cause problems. You should measure water content to determine whether desiccation is occurring.

There are several ways to protect compacted clay liners from desiccation. One preventive measure is to smooth roll the surface with a steel drummed roller to produce a thin, dense skin of soil; this layer can help minimize the movement of water into or out of the compacted material. Another option is to wet the clay periodically in a uniform manner; however, it is important to make sure to avoid creating areas of excessive wetness. A third measure involves covering compacted clay liner materials with a sheet of white or clear plastic or tarp to help prevent against desiccation and cracking. The cover should be weighted down with sandbags or other material to minimize exposure of the underlying materials to air. Using a light-colored plastic will help prevent overheating, which can dry out the clay materials. If the clay liner is not being covered with a geosynthetic, another method to prevent desiccation involves covering the clay with a layer of protective cover soil or intentionally overbuilding the clay liner and shaving it down to liner grade.

Protection against freezing is another important consideration, because freezing can increase the hydraulic conductivity of a liner. It is important to avoid construction during freezing weather. If freezing does occur and the damage affects only a shallow depth, the liner can be repaired by rerolling the surface. If deeper freezing occurs, the repairs might be more complicated. For a general guide to frost depths, see Figure 1 of Chapter 11— Performing Closure and Post-Closure Care.

Geomembranes or flexible membrane liners

Geomembranes or flexible membrane liners are used to contain or prevent waste constituents and leachate from escaping a waste management unit. Geomembranes are made by combining one or more plastic polymers with ingredients such as carbon black, pigments, fillers, plasticizers, processing aids, crosslinking chemicals, anti-degradants, and biocide. A wide range of plastic resins are used for geomembranes, including high density polyethylene (HDPE), linear low density polyethylene (LLDPE), low density linear polyethlene (LDLPE), very low density polyethlene (VLDPE), polyvinyl chloride (PVC), flexible polypropylene (IPP), chlorosulfonated polyethylene (CSPE or Hypalon), and ethylene propylene diene termonomer (EPDM). Most manufacturers produce geomembranes through extrusion or calendering. In the extrusion process, a molten polymer is stretched into a nonremforced sheet; extruded geomembranes are usually made of HDPE and LLDPE. During the calendaring process, a heated polymeric compound is passed through a series of rollers. In this process, a geomembrane can be reinforced with a woven fabric or fibers. Calendered geomembranes are usually made of PVC and CSPE.

What are the thickness recommendations for geomembrane liners?

Geomembranes range m thicknesses from 20 to 120 mil (1 mil = 0.001 in.). A good design should include a minimum thickness of 30 mil, except for HDPE liners, which should have a minimum thickness of 60 mil. These recommended minimum thicknesses ensure that the liner material will withstand the stress of struction and the weight load of the waste, and allow adequate seaming to bind separate geomembrane panels. Reducing the potential for tearing or

puncture, through proper construction and quality control, is essential for a geomembrane to perform effectively.

What issues should be considered in the design of a geomembrane liner?

Several factors to address in the design include: determining appropriate material and testing to ensure these proper are met, understanding how the liner will interact with the intended waste stream, for all stresses imposed by the design, and ensuring adequate friction.

Material Properties and Selection

When designing a geomembrane liner, you should examine several properties of the geomembrane material in addition to thickness, including: tensile behavior, tear resistance, puncture resistance, susceptibility to environmental stress cracks, ultraviolet resistance, and carbon black content.

Tensile behavior.

Tensile behavior refers to the tensile strength of a material and its ability to elongate under strain. Tensile strength is the ability of a material to resist pulling stresses without tearing. The tensile properties, of a geomembrane must be sufficient to satisfy the stresses anticipated during its service life.

These stresses include the self-weight of the geomembrane and any down drag caused by waste settlement on side slope liners.

Puncture and tear resistance.

Geomembrane liners can be subject to tearing during installation due to high winds or handling. Puncture resistance is also important to consider since geomembranes are often placed above or below materials that might have jagged or angular edges. For example, geomembranes might be installed above a granular drainage system that includes gravel.

Susceptibilfty to environmental stress cracks.

Environmental factors can cause cracks or failures before a liner is stressed to its manufactured strength. These imperfect what dons, referred to as environmental stress cracks, often occur in areas where a liner has been scratched or stressed by fatigue. These cracks can also result in areas where excess surface wetting agents have been applied. In surface impoundments, where the geomembrane properties brine liner has greater exposure to the atmosphere and temperature changes, such exposure can increase the potential for environmental stress cracking.

Interactions With Waste

Since the main purpose of a geomembrane is to provide a barrier and prevent contaminants from penetrating through the geomembrane, chemical resistance is a critical consideration. Testing for chemical resistance might be warranted depending on the type, volumes, and characteristics of waste managed at a particular unit and the type of geomembrane to be used.

Stresses Imposed by Liner Design

A liner design should take into account the stresses imposed on the liner by the design configuration. These stresses include: the differential settlement in foundation soil, strain requirements at the anchor trench, strain requirements over long, steep side slopes, stresses resulting from compaction, and seismic stresses. Often an anchor trench designed to secure the geomembrane during construction is prepared along the perimeter of a unit cell. This action can help prevent the geomembrane from slipping down the interior side slopes. Trench designs should include a depth of burial sufficient to hold the specified length of liner. If forces larger than the tensile strength of the liner are inadvertently developed, then the liner could tear. For this reason, the geomembrane liner should be allowed to slip or give in the trench after construction to prevent such tearing. To help reduce unnecessary stresses in the liner design, it is advisble to avoid using horizontal seams.

Design for Adequate Friction

Adequate friction between the geomembrane liner and the soil subgrade, as well as between any geosynthetic components, is necessary to prevent extensive slippage or sloughing on the slopes of a unit. Design equations for such components should evaluate: 1) the ability of a liner to support its own weight on side slopes, 2) the ability of a liner to withstand down-dragging during

and after waste placement, 3) the best anchorage configuration for the liner, 4) the stability of soil cover on top of a liner, and 5) the stability of other geosynthetic components, such as geotextiles or geonets, on top of a liner. An evaluation of these issues can affect the choice of geomembrane material, polymer type, fabric reinforcement, thickness, and texture necessary tO achieve the design requirements. Interface strengths can be significantly improved by using textured geomembranes.

What issues should be considered in the construction of a geomembrane liner*?*

When preparing to construct a geomembrane liner, you should plan appropriate shipment and handling procedures, perform testing prior to construction, prepare the subgrade, consider temperature effects, and account for wind effects. In addition, you should select a seaming process, determine a material for and method of backfilling, and plan for testing during construction.

Shipment, Handling, and Site Storage

We should follow quality assurance and quality control procedures to ensure proper handling of geomembranes. Different types of geomembrane liners require different types of packaging for shipment and storage. Typically a geomembrane manufacturer will provide specific instructions outlining the handling, storage, and construction specifications for a product. In general, HDPE and LIDPE geomembrane liners are packaged in a roll form, while PVC and CSPE-R liners (CSPE-R refers to a CSPE geomembrane liner reinforced with a fabric layer) are packaged in panels, accordion-folded in two directions, and placed onto pallets. ‘Whether the liner is shipped in rolls or panels, you should provide for proper storage. The rolls and panels should be packaged so that fork lifts or other equipment can safely transport them. For rolls, this involves preparing the roll to have a sufficient inside diameter so that a fork lift with a long rod, known as a stinger, can be used for lifting and moving. For accordion panels, proper packaging involves using a structurally-sound pallet, wrapping panels in treated cardboard or plastic wrapping to protect against ultraviolet exposure, and using banding straps with appropriate cushioning. Once the liners have been transported to the site, the rolls or panels can be stored until the subgrade or subbase (either natural soils or another geosynthetic) is prepared.

Subgrade Preparation

Before a geomembrane liner is installed, you should prepare the subgrade or subbase. The subgrade material should meet specified grading, moisture content, and density requirements. In the case of a soil subgrade, it is important to prevent construction equipment used to place the liner from defonning the underlying materials. If the underlying materials are geosynthetics, such as geonets or geotextiles, We should remove all folds and wrinkles before the liner is placed.

Testing Prior to Construction

Before any construction begins, is it recommended that you test both the geomembrane materials from the manufacturer and the installation procedures. Acceptance and conformance testing is used to evaluate the performance of the manufactured geomembranes. Constructing test strips can help evaluate how well the intended construction process and quality control procedures will work.

Acceptance and conformance testing.

We should perform acceptance arid conformance testing on the geomembrane liner received from the manufacturer to determine whether the materials meet the specifications requested. While the specific ASTM test methods vary depending on geomembrane type, recommended acceptance and conformance testing for geomembranes includes evaluations of thickness, tensile strength and elongation, and puncture and tear resistance testing, as appropriate. For most geomembrane liner types, the recommended ASTM method for testing thickness is ASTM D5199. For measuring the thickness of textured geomembranes, We should use ASTM D-5994. For tensile strength and elongation, ASTM D-638 is recommended for the HDPE and UJ)PE sheets, while ASTM D-882 and ASTM D-751 are recommended for PVC and CSPE geomembranes, respectively. Puncture resistance testing is typically recommended for HDPE and LLDPE geomembranes using ASTM D-4833.To evaluate tear resistance for HDPE, LLDPE, and PVC geomembrane liners, the recommended testing method is ASTM D-1004, Die C.’2 For CSPE-R geomembranes, ply adhesion is more of a concern than tear or puncture resistance and can be evaluated using ASTM D-413, Machine Method,

Test strips. In preparation for liner placement and field seaming, We should develop test strips and trial seams as part of the construction process. Construction of such samples should be performed in a manner that reproduces all aspects of field production. Providing an opportunity

to test seaming methods and workmanship helps ensure that the quality of the seams remains constant and meets specifications throughout the entire seaming process.

Temperature Effects

Liner material properties can be altered by extreme temperatures. High temperatures can cause geomembrane liner surfaces to stick together, a process commonly referred to as blocking. On the other hand, low temperature can cause the liner to crack when unrolled or unfolded. Recommended maximum and minimum allowable sheet temperatures for unrolling or unfolding geomembrane liners are 50°C (122°F) and 0°C (32°F), respectively. In addition to sticking and cracking, extreme temperatures can cause geomembranes to contract or expand. Polyethylene geomembranes expand when heated and contract when cooled. Other geomembranes can contract slightly when heated. Those responsible for placing the liner should take temperature effects into account as they place, seam, and backfill in the field.

Wind Effects

It is recommended that you take measures to protect geomembrane liners from wind damage. Windy conditions can increase the potential for tearing as a result of uplift; if wind uplift is a potential problem, panels can be weighted down with sand bags.

Seaming Processes

Once panels or rolls have been placed, another critical step involves field-seaming the separate panels or rolls together. The selected seaming process, such as thermal or chemical seaming, will depend on the chemical composition of the liner. To ensure the integrity of the seam, you should use the seaming method recommended by the manufacturer. Thermal seaming uses heat to bond together the geomembrane panels. Examples of thermal seaming processes include extrusion welding and thermal fusion (or melt bonding). Chemical seaming involves the use of solvents, cement, or an adhesive. Chemical seaming processes include chemical fusion and adhesive seaming.

Consistent quality in fabricating field seams is paramount to liner performance. Conditions that could affect seaming should be monitored and controlled during installation. Factors influencing seam construction and performance include; ambient temperature, relative humidity, wind uplift, changes in geomembrane temperature, subsurface water content, type of supporting surface used,

skill of the seaming crew, quality and consistency of chemical or welding materials, preparation of liner surfaces to be joined, moisture at the seam interface, and cleanliness of the seam interface.

To help control some of these factors, no more than the amount of sheeting that can be used during a shift or a work day should be deployed at one time. To prevent erosion of the underlying soil surface or washout of the geomembrane, proper storm water control measures should be employed. Ambient temperature can become a concern, if the geomembrane liner has a high percentage of carbon black. Although the carbon black will help to prevent damage resulting from ultraviolet radiation, because its dark color absorbs heat, it can increase the ambient temperature of the geomembrane, making installation more complicated. To avoid surface moisture or high subsurface water content, geomembranes should not be deployed when the subgrade is wet.

Regardless of how well a geomembrane liner is designed, its ability to meet performance standards depends on proper quality assurance and quality control during installation.

Geomembrane sheets and seams are subject to tearing and puncture during installation; punctures or tears can result from contact with jagged edges or underlying materials or by applying stresses greater than the geomembrane sheet can handle. Proper quality assurance and quality control can help minimize the occurrence of pinhole or seam leaks. For example, properly preparing the underlying layer and ensuring that the gravel is of an acceptable size reduces the potential for punctures.

Protection and Back filling

Geomembrane liners that can be damaged by exposure to weather or work activities should be covered with a layer of soil or a geosynthetic as soon as possible after quality assurance activities associated with geomembrane testing are completed. If the backfill layer is a soil material, it will typically be a drainage material like sand or gravel. If the cover layer is a geosynthetic, it will typically be a geonet or geocomposite drain placed directly over the geomembrane. Careful placement of backfill materials is critical to avoid puncturing or tearing the geomembrane material.

For soil covers, three considerations determine the amount of slack to be placed in the underlying geomembrane. These considerations include selecting the appropriate type of soil, using the

proper type of equipment, and establishing a placement procedure for the soil. When selecting a soil for backfilling, characteristics to consider include particle size, hardness, and angularity, as each of these can affect the potential for tearing or puncturing the liner. To prevent wrinkling, soil covers should be placed over the geomembrane in such a way that construction vehicles do not drive directly on the liner. Care should be taken not to push heavy loads of soil over the geomembrane in a continuous manner. Forward pushing can cause localized wrinkles to develop and overturn in the direction of movement. Overturned wrinkles create sharp creases and localized stress in the liner and can lead to premature failure. A recommended method for placing soil involves continually placing small amounts of soil or drainage material and working outward over the toe of the previously placed material.

Another recommended method involves placing soil over the liner with a large back- hoe and spreading it with a bulldozer or similar equipment. If a predetermined amount of slack is to be placed in the geomembrane, the temperature of the liner becomes an important factor, as it will effect the ability of the liner to contract and expand. Although the recommended methods for covering geomembrane liners with soil can take more time than backfilling with larger amounts of soil, these methods are designed to prevent damage caused by covering the liner with too

Nondestructive testing.

Unlike destructive tests, which examine samples taken from the geomembrane liner in the containment area, nondestructive tests are designed to evaluate the integrity of larger portions of geomembrane seams without removing pieces of the geomembrane for testing. Common nondestructive testing methods include: the probe test, air lance, vacuum box, ultrasonic methods (pulse echo, shadow, and impedance planes), electrical spark test, pressurized dual seam, and electrical resistivity. You should select the test method most appropriate for the material and seaming method. If sections of a seam fail to meet the acceptable criteria of the appropriate nondestructive test, then those sections need to be delineated and patched, reseamed, or retested. If repairing such sections results in large patches or areas of reseaming, then destructive test methods are recommended to verify the integrity of such pieces

Geosynthetic Clay Liners

If a risk evaluation recommended the use of a single liner, another option to consider is a geosynthetic clay liner (GCL). GCI_s are factory-manufactured, hydraulic barriers typically consisting of bentonite clay (or other very low permeability materials), supported by geotextiles

or geomembranes held together by needling, stitching, or chemical adhesives. GCIs can be used to augment or replace compacted clay liners or geomembranes, or they can be used in a composite manner to augment the more traditional compacted clay or geomembrane materials. GCLs are typically used in areas where clay is not readily available or where conserving air space is an important factor. As GCLs do not have the level of long-term field performance data that geomembranes or compacted clay liners do, states might request a demonstration that performance of the GCL design will be corn parable to that of compacted clay or geornembrane liners.

What are the mass per unit area and hydraulic conductivity recommendations for geosynthetic clay liners?

Geosynthetic clay liners are often designed to perform the same function as compacted clay and geomembrane liner components. For geosynthetic clay liners, you should design for a minimum of 3.7 kg/rn2 (0.75 lb/ft^2) dry weight (oven dried at 105°C) of bentonite clay with a hydrated hydraulic conductivity of no more than 5 x 10^{-9} cm/sec (2 x 10 in/see). It is important to follow manufacturer specifications for proper GCL installation.

What issues should be considered in the design of a geosynthetic clay liner?

Factors to consider in GCL design are the specific material properties needed for the liner and the chemical interaction or compatibility of the waste with the GCL. When considering material properties, it is important to keep in mind that bentonite has a low shear strength when it is hydrated. Manufacturers have developed products designed to increase shear strength.

Materials Selection and Properties

For an effective GCL design, material properties should be clearly defined in the specifications used during both manufacture and construction. The properties that should be specified include: type of bonds, thickness, moisture content, mass per unit area, shear strength, and tensile strength. Each of these properties is described below.

Type of bonds. Geosynthetic clay liners are available with a variety of bonding designs, which include a combination of clay, adhesives, and geomembranes or geotextiles. The type of adhesives, geotextiles, and geomembranes used as components of GCLs varies widely. One type of available GCL design uses a bentonite clay mixed with an adhesive bound on each side by

geotextiles. A variation on this design involves stitching the upper and lower geotextiles together through the clay layer. Alternatively, another option is to use a GCL where geotextiles on eachside of adhesive or nonadhesive bentonite clay are connected by needle punching. A fourth variation uses a clay mixed with an adhesive bound to a geomembrane on one side; the geomembrane can be either the lower or the upper surface. Figure 3 displays cross section sketches of the four variations of GCL bonds. While these options describe GCLs available at the time of this Guide, emerging technologies in GCL designs should also be reviewed and considered.

Thickness. The thickness of the various available GCL products ranges from 4 to 6 mm (160 to 320 mil). Thickness measurements are product dependent. Some GCLs can be quality controlled for thickness while others cannot.

Moisture content. GCLs are delivered to the job site at moisture contents ranging from 5 to 23 percent, referred to as the “dry” state. GCLS are delivered dry to prevent premature hydration, which can cause unwanted variations in the thickness of the clay component as a result of uneven swelling.

Stability and shear strength. GCLs should be manufactured and selected to meet the shear strength requirements specified in design plans. In this context, shear strength is the ability of two layers to resist forces moving them in opposite directions. Since hydrated bentonite clay has low shear strength, bentonite clay can be placed between geotextiles and stitch bonded or needle-punched to provide additional stability For example, a GCL with geotextiles supported by stitch bonding has greater internal resistance to shear in the clay layer than a GCL without any stitching. Needle-punched GCLs tend to provide greater resistance than stitch-bonded GCLs and can also provide increased friction resistance against an adjoining layer, because they require the use of nonwoven geotextiles. Increased friction is an important consideration on side slopes..

Mass per unit area. Mass per unit area refers to the bentonite content of a GCL. It is important to distribute bentonite evenly throughout the GCL in order to meet desired hydraulic conductivity specifications. All GCL products available in North America use a sodium bentonite clay with a mass per unit area ranging from 3.2 to 6.0 kg/rn2 (0.66 to 1.2 lb/ft9, as manufactured.

Interaction With Waste

During the selection process .for a GCL liner, you should evaluate the chemical compatibility of the liner materials with the types of waste that are expected to be placed in the. unit. Certain chemicals, such as calcium, can have an adverse effect on GCLs, resulting in a loss of liner integrity. Specific information on GCL compatibilities should be available from the manufacturer.

What issues should be considered in the construction of a geosynthetic clay liner?

Prior to and during construction, it is recommended that a qualified professional should prepare construction specifications for the GCL. In these specifications, procedures for shipping and storing materials, as well as performing acceptance testing on delivered materials, should be identified. The specifications should also address methods for sub- grade preparation, joining panels, repairing sections, and protective backfilling.

Shipment, Handling, and Site Storage

GCLs are manufactured in widths of approximately 2 to 5 m (7 to 17 ft) and lengths of 30 to 60 m (100 to 200 ft). Directly after manufacturing, GCLs are rolled around a core and covered with a thin plasuc protective covering. This waterproof covering serves to protect the material from premature hydration. GCLs should be stored at the factory with these protective coverings. Typical storage lengths range from a few days to 6 months. To ensure protection of the plastic covering and the rolls themselves during loading and unloading, it is recommended that qualified professionals specify the equipment needed at the site to lift and deploy the rolls properly.

To reduce the potential for accidental damage or for GCIs to absorb moisture at the site, you should try to arrange for “Justin-time-delivery” for GCL.s transported from the factory to the field. Even with “just-in- time-delivery,” it might be necessary to store GCLs for short periods of time at the site. Often the rolls can be delivered in trailers, which can then serve as temporary storage. To help protect the GCLS prior to deployment, you should use wooden pallets to keep the rolls off the ground, placing heavy waterproof tarps over the GCL rolls to protect them from precipitation, and using sandbags to help keep the tarps in place.

Manufacturer specifications should also indicate how high rolls of GCIs can be stacked horizontally during storage. Over- stacking can cause compression of the core around which the GCL is wrapped. A damaged core makes deployment more difficult and can lead to other problems. For example, rolls are sometimes handled by a fork lift with a stinger attached. The

stinger is a long tapered rod that fits inside the core. If the core is crushed, the stinger can damage the liner during deployment.

Acceptance and Conformance Testing

Acceptance and conformance testing is recommended either upon delivery of the GCL rolls orat the manufacturer's facility prior to delivery. Conformance test samples are used to ensure that the GCL meets the project plans and specifications. GCLs should be rewrapped and replaced in dry storage areas immediately after test samples are removed. liner specifications should prescribe sampling frequencies based on either total area or on number of rolls. Since variability in GCLs can exist between individual rolls, it is important for acceptance and conformance testing to account for this. Conformance testing can include the following.

Mass per unit area test. The purpose of evaluating mass per unit area is to ensure an even distribution of bentonite throughout the GCL panel. Although mass per unit area varies from manufacturer to manufacturer, a typical minimum value for oven dry weight is 3.7 kg/rn2 (0.73 lb/ft') Mass per unit area should be tested using ASTM D-5993.'4 This test measures the mass of bentonite per unit area of GCL. Sampling frequencies should be determined using ASTM D-435415

Free swell test. Free swell refers to the

ability of the clay to absorb liquid. Either ASTM D-5890 or GRI-GCL1, a test method developed by the Geosynthetic Research Institute, can be used to evaluate the free swell of the material.

Direct shear test. Shear strength of the GCL.s can be evaluated using ASTM D-5321. The sampling frequency for this performance- oriented test is often based on area, such as one test per 10,000 m^2 (100,000 ft^2).

Hydraulic conductivity test. Either ASTM D-5084 (modified) or GRI-GCL2 will measure the ease with which liquids can move through the GCL.'8

Other tests. Testing of any geotextiles or geomembranes should be made on the original rolls of the geotextiles or geomembranes and before they are fabricated into the GCL. product. Once these materials have been made part of the GCL product, their properties can change as a result of any needling, stitching, or gluing. Additionally, any peel tests performed on needle punched or

stitch bonded GCLs should use the modified ASTM D-413 with a recommended sampling frequency of one test per 2,000 m2 (20,000 ft2).”

Subgrade Preparation

Because the GCL layer is relatively thin, the first foot of soil underlying the GCL should have a hydraulic conductivity of 1 x 10’ cm/sec or less. Proper subgrade preparation is essential to prevent damage to the GCL layer as it is installed. This includes clearing away any roots or large particles that could potentially puncture the GCL and its geotextile or geomembrane components. The soil subgrade should be of the specified grading, moisture content, and density required by the installer and approved by a construction quality assurance engineer for placement of the GCL. Construction equipment deploying the rolls should not deform or rut the soil subgrade excessively. To help ensure this, the soil subgrade should be smooth rolled with a smooth-wheel roller and maintained in a smooth condition prior to deployment.

Joining Panels

GCLs are typically joined by overlapping panels, without sewing or mechanically connecting pieces together. To ensure proper joints, you should specify minimum and maximum overlap distances. Typical overlap distances range from 150 to 300 mm (6 to 12 in.). For some GCLs, such as needle punched GCLs with nonwoven geotextiles, it might be necessary to place bentonite on the area of overlap. If this is necessary you should take steps to prevent fugitive bentonite particles from coming into contact with the leachate collection system, as they can cause physical clogging.

Repair of Sections Damaged During Liner Placement

During installation, GCLs might incur some damage to either the clay component or to any geotextiles or geomembranes. For damage to geotextile or geomembrane components, repairs include patching using geotextile or geomembrane materials. If the clay component is disturbed, a patch made from the same GCL product should be used to perform any repairs.

Protective Back filling

As soon as possible after completion of quality assurance and quality control activities, you should cover GCLs with either a soil layer or a geosynthetic layer to prevent hydration. The soil

layer can be a compacted clay liner or a layer of coarse drainage material. The geosynthetic layer is typically a

SALIENT FEATURES

1. Operation and Maintenance of 02 (two) weigh bridge, installed on the site, on 24/7 basis. The contractor will weigh all incoming loaded garbage vehicle and he will also weigh the empty out going garbage vehicle to determine the net weight of the received garbage. The contractor will provide one weigh slip to driver of garbage. The contractor will provide one weigh slip to driver of garbage vehicle one to KMC and keep one for his own record.
2. Preparation of landfill base.

3. Provide and laying or leachate collection system according to fukouka method semi – aerobic system and as per the direction of engineer in charge.
4. Providing and erection of landfill gas ventilation system according to fukouka method semi-aerobic system and as per the direction of engineer in charge.
5. Construction and maintenance of leachate recycling system according to fukouka method semi-aerobic system and as per the direction of engineer in charge.
6. Spreading and compaction of waste on prepared cell thickness of waste should not be more than 03 feet to get required compaction. The density of compacted waste must be greater than 600 kg cubic meters. The highest compaction is obtained by compacting from base of the landfill.
7. A minimum of 03 horizontal to one vertical waste slopes should be maintained on all internal waste faces.
8. Providing daily soil cover of 6 inches thickness.
9. Providing intermediate clay cover of the 2 feet thickness for lifts greater than 9 meters.
10. Construction of temporary swales to divert the surface water away from the landfill site.
11. Construction of earth dam around active cell to prevent the run off waste contact liquid from the landfill.
12. Construction of temporary internal roads and its maintenance.
13. Spraying of water on internal kacha roads for dust control.
14. Installation of clear and visible on site directional signs for proper traffic routing.
15. Providing and posting of armed security guards at the land fill area to make sure that no burning of waste and proper dumping at the active area. At least 12 arms guard must be posted on 24/7 basis.
16. Providing, installation and maintenance of one generator 0f 30KV
17. The contractor shall level the burned garbage /ash and cover with soil with 30 cm of thickness at open areas of the landfill site or transfer the same to the through dumpers on contractor’s expenses and same will not be weighed on the landfill weighbridge for any kind of payment.
18. Construction and erection of 50 numbers gas ventilation pipes in the old waste dumps lift up to 15 feet.
19. If the garbage is being dumped to on area other than the old or new cell than the contractor will pay a penalty of Rs. 20,000/ per day.
20. The contractor will adopt all safety issue on his own behalf and the department will not be responsible for any safety issue or accident if happen during the contract period.
21. The contractor will be bound with all the Federal & Provincial Rules regarding environment and he will follow all the rules and regulations as an imposed by the Environmental Regulatory agencies or authorities.
22. The contractor before start of the work will provide work management plan with complete list of number of Tools and Plants and Field staff.
23. The contractor will provide Weekly Progress Report of the work to the Director Office with the signature of deputed designated field staff or Engineer concerned from the department head.

24. The contractor will also prepare and submit a comprehensive presentation of the project at the end or completion of the work before final payment.
25. The contractor will maintain the quality of the work in any condition and specially the work of spreading and laying of Geomembrane and Rubber sheet will be done as per International standard and as per direction of the Engineer-in-charge.

KARACHI METROPOLITAN CORPORATION

OFFICE OF THE CHIEF ENGINEER (CONTRACT MANAGEMENT)

MUNICIPAL SERVICES DEPARTMENT

Room # 409, 4th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi

No. CE (CM)/MS/KMC/316/15 **Dated:02 -11-2015**

NOTICE INVITING TENDER

Tender in sealed covers are invited for the following work from reputable firms, having experience of similar nature work:

Sr.#	Tender Reference No.	Name of Scheme	Estimated Cost	Bid Security in shape of Pay Order or Bank Guarantee in favour of KMC	Tender Cost In shape of paid Challan in favour of KMC (Non-Refundable)	Eligibility Criteria
1	2	3	4	5	6	7
1.	KMC/MS/CM/ 13/15-16	Providing and Fixing Tires & Tubes for Fire Vehicles and Allied Vehicles for Fire Brigade Department, MS, KMC.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
2.	KMC/MS/CM/ 14/15-16	Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant supply.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
3.	KMC/MS/CM/ 15/15-16	Rate Running Contract of the work of Repair and Maintenance of Mechanical Sweepers, Tractor MF-240 and Tractor MF-385 (MPD) MS, KMC for the year of 2015-16. (Re-invite).	Offer Rate	Rs.8,00,000/-	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
4.	KMC/MS/CM/ 16/15-16	Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II).	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
5.	KMC/MS/CM/ 17/15-16	Remote Controlled Trailer Mounted Lighting Towers 04 Nos. for disasters & Fire Fighting Purpose for Fire Brigade Department.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
6.	KMC/MS/CM/ 18/15-16	Modification of Grab Crane increase of Boom with Hydraulically operated etc.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
7.	KMC/MS/CM/ 19/15-16	Refurbishment of Wheel Loader Model Lie Gong-856.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
8.	KMC/MS/CM/ 20/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**
9.	KMC/MS/CM/ 21/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

TERMS & CONDITIONS

1. Tender schedule shall be as follows:

SCHEDULE	DATE & TIME	VENUE
1. Receiving of Application & Issuance of Tender	**From 12-11-2015** To	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi. Office of Director (Planning), F&A Department, 6th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.

	04-12-2015 During Office Hours	Office of Deputy Director (Accounts), Administrator Secretariat, Karachi 1st Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
2. Dropping of Tender	**07-12-2015** at **2:00 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
3. Opening of Tender	**07-12-2015** at **2:30 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.

2. The tender documents will be issued to the firms on submission of application in their original letter head alongwith original paid challan in the prescribed account of KMC for tender cost as mentioned above. This challan can be obtained from the office of tender sale as mentioned in this NIT.

3. The tender in sealed cover superscripted with the name of work should be dropped in the tender box kept in the committee room of the office of Sr. Director (Municipal Services) KMC.

4. In case the date of opening declared as a public holiday by the Government, or Non working day due to force Majeure the next official working day shall be deemed to be the date for submission and opening of tenders at the same time.

5. **Substantially Responsive Bid:-**

   Only those bids, which comply with the each eligibility & minimum qualification criteria attached with the tender documents shall be declared substantially responsive bids and will be eligible for further evaluation, otherwise the same will be declared as non responsive / rejected.

6. Bid Security of bid amount in the form of a pay order or bank guarantee from any schedule bank should be enclosed with the tender which will be retained till finalization of the case.
7. Canvassing in connection with tenders is strictly prohibited and tenders submitted by the contractors who report canvassing will liable for rejection.
8. KMC may reject all or any bids or proposals at any time prior to the acceptance of a bid or proposals, subject to the relevant provisions of SPP Rules 2010.

Sd/=

Chief Engineer (CM) MS, KMC

KARACHI METROPOLITAN CORPORATION

Bank Deposit Challan

MUNCIPAL SERVICES DEAPRTMENT, KMC

The Manger,
Habib Bank Ltd,
KMC Branch

BANK CODE 0 1 | **BANK ACCOUNT NO.** 2 6 0 4 - 5 7 | **DATE**

BRANCH CODE 0 0 1 5 | **BANK ACCOUNT CODE** 5 7

BANK BRANCH Please receive the amount as noted below for credit to the account of KMC mentioned above and as specified here below:-

Depositor's Name & Address	Particulars (To be filled up by Department)	☐ Cheque / Pay Order / Demand Draft			Amount
		Name of Bank	No.	Date	Rs.
M/s	Deposit of tender Cost Fee for the work of Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site Tender Enquiry # **KMC/MS/CM/20/15-16** To be opened on 07-12-2015				
		☐ **Cash Rs.**			
				Total	

Rupees in Words _____

Note: It is valid if to be deposited on or before the last date of sale of tender as mentioned in the NIT or its corrigendum, if any. If the same are furnished on the given date of sale in the office of the tender issuing authority, the tender will be issued.

Bank Stamp

Signature Bank Cashier

Signature of Depositor

Signature with stamp
Accountant/Assistant Accounts Officer
Drawing & Disbursing Officer

Signature Bank Officer

CHALLAN NO.

BIDDING DATA

A	Name of Procuring Agency:	Karachi Metropolitan Corporation (KMC)
B	Brief Description of Work:	**DEVELOPMENTS OF ENGINEERED SANITARY LANDFILL SITE FOR MUNICIPAL SOLID WASTE FOR JAM CHAKRO LANDFILL SITE**
C	Procuring Agency Address:	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
D	Estimated Cost:	Offer Rate
E	Amount of Bid Security:	Offer Rate
F	Period of Bid validity (Days):	90 Days
G	Security Deposit (i/c Bid Security):	(10 % of Quoted Amount)
H	Percentage, if any, to be deducted from bills:	(5% to be deducted from Running Bills)
I	Deadline for submission of bid along with time:	04-12-2015 (During Office Hours)
J	Venue, Time and date of Bid Opening:	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
K	Liquidity Damages:	
I	Deposit Receipt No. Date & Amount:	

PRICE SCHEDULE

SUBJECT: - **DEVELOPMENTS OF ENGINEERED SANITARY LANDFILL SITE FOR MUNICIPAL SOLID WASTE FOR JAM CHAKRO LANDFILL SITE.**

Sr. #	Description	Quantity Per Day	Rate	Rate in Word	Unit	Amount
1	2	3	4	5	6	7
A.	The amount of garbage dumped to designated landfill site as per scope of work and terms and conditions of the tender documents	1000			Ton	
B.	The amount of garbage dumped to designated landfill site as per scope of work and terms and conditions of the tender documents	1001 Up-to 2500			Ton	
C.	The amount of garbage dumped in old constructed cell up to the period of new constructed cell (03 months)	1000			Ton	
D.	The amount of garbage dumped in old constructed					

Sr. #	Description	Quantity Per Day	Rate	Rate in Word	Unit	Amount
1	2	3	4	5	6	7
	cell up to the period of new constructed cell (03 months)	1001 Up-to 2500			Ton	
					Total Amount Quoted	
Amounts in Word: -						

NOTE: - For the calculation purpose the rate of the lowest bidder will be average of A,B,C & D.

Detailed of 2% Earnest Money: -

2500 Tons x365 Days x Average Quoted Rate (A,B,C,D) x 2%

Checked & Verified by:
Additional Director (SWM), MS, KMC

I/We quoted the price schedule and bound ourselves to comply all terms and conditions of this contract with all existing rules and regulations of KMC and I have attached an 2% Earnest Money in shape of Pay Order / Bank Guarantee _____ No. _____

(Pay Order / Bank Guarantee)

Dated_____ issued from _____

Amounting Rs._____/- in favour of Karachi Metropolitan Corporation (KMC).

We / I read the standard Bidding Documents available in SPPRA / KMC WEB site and agreed to abide all of them and also provide all these documents with our signature as & when directed

Signature of Bidder with Stamp

TERMS AND CONDITIONS SPECIAL

1. The contractor must quote the rates as per the tons tipping fee however, to calculate the rates an estimate annexed at A for convenience. The payment will be made as per actual quantity of waste received per day.

2. The current rate of diesel fuel, which is Rs.86 /liter (one hundred and three Rupees per liter), shall be the basic rate for calculate of bid value by the contractor .Any increase/ decrease in the basic rate during the currency of the contract shall be payable /receivable to or by the contractor on the basis of diesel consumption per day for all fill operation. The difference shall be calculated as follows.

   Difference in the basic rate X consumption of diesel per day X no. of days work done.
   The contractor shall produce receipt of diesel if the contractor claims any increase in diesel prices. However, in case of any decrease in the diesel rate if the contractor fails to produce diesel receipts the diesel consumption /day for the all operations at the landfill site be considered 400 litters.

3. The bids shall be inclusive of all incidental charges in connection with the work.

4. Unless otherwise directed the contractor shall continue to work at the same rates and on same terms and conditions of contract till such time arrangement are made by the employer for fresh contract and award of further work even after expiry of present contract.

5. The contract for 12 month and may be extended for 01 to 03 years subject to satisfactory performance of contractor.

6. In the event contractor leaves the work before stipulated period of contract, the security deposit shall be forfeited.

7. The contactor shall be submitted its bills on fortnightly basis which shall be checked scrutinized for the fulfillment of contractor obligation under the contract and shall be paid after verification and approval of the authority.

8. Daily received garbage from respective DMC and other agencies and KMC must be written on the board present in the office and monthly DMC,s report also be written on another board which is also present in the office. The contractor will also submit monthly report regarding the total of tonnage of waste coming from each DMC, other agencies.

9. The KMC shall be at liberty to direct the contractor to remove forthwith any person provided by the contractor at the work, who in opinion of KMC misconduct himself, or is in competent or negligent in proper performance of his duties or whose presence on site is otherwise considered by KMC to be undesirable, and such person shall not again allowed upon the work without the consent of KMC. Any person removed from the work shall be replaced as soon as possible.
10. The contractor shall at all times take all reasonable precaution to prevent any lawful, riotous or disorderly conduct by or amongst employee and for the preservation of peace and protection of person and property in neighborhood of the work

11. The contractor shall not recruit or attempt to recruit his staff and labor amongst person in service or employee.

12. Contractor shall provide of list of their employees.

13. Contractor shall keep all the equipment and other facilities handed over to him by the KMC in good conditions.

14. In case of failure to complete new cell in 03 month of fresh contract penalty of Rs. 50000 (fifty thousands) imposed per day, which shall be deducted from contractor bills.

15. Contractor shall not make alteration in vehicle or machinery with out written approval of the department concerned.

16. The vehicle will be parked at designated landfill work shop area on contractor responsibility.

17. No staff vehicle will be used for any work other than assigned in the contract.

18. Contractor shall provide within one month of contract one 1000 CC Car which will be property of KMC after completion of contract.

19. Contractor shall provide all employee proper clothing which is suitable for work

20. Contractor shall ensure that this staff are courteous with general public

21. Contractor must adhere to health and safety work laws of GOP.

22. The contractor must provide corporate address mailing address telephone no fax no of the contractor main office / companies be intimated to the employer in writing.

23. In case of weighbridge defect the contractor will be paid on average of last 30 days basis but only for a period of one month. The weighbridge must be repaired within one month of period.

24. In case of robbery or theft from the site, contractor will be responsible and if the stolen property will be of KMC then he will pay money according to market rate without any hesitation.

25. The contractor has to abide by t eh national law standards and EPA guideline if any to perform the required work.

26. The contractor will follow the KMC / Govt... Of Sindh rules pertaining to the said project.

27. For the purpose of identification and security contractor shall issue identity card jackets caps etc to its entire employee who may be detailed to work within area under contract. If any employee of the contractor is found with out these items a penalty of Rs. 5000 rupees will be fine per person as penalty imposed and deducted from month bills of the contractor.

DEVELOPMENTS OF ENGINEERED SANITARY LANDFILL SITE FOR MUNICIPAL SOLID WASTE FOR GONDPASS LANDFILL SITE

Eligibility & Minimum Qualification Criteria

The evidence / documents for the following minimum qualification / eligibility criteria will be checked during opening process of tender evaluation & if anyone is missing then the tender will be summarily rejected at the moment by the tender opening committee.

PART-A: Eligibility Criteria

- Having Experience in Specific Field.
- EPA Certificate Valid. (Handling for Hazardous & Non-Hazardous Waste)
- NTN Certificate
- Valid Profession TAX

PART-B:
Minimum Qualification Criteria

i). Bid Security, as mentioned in the NIT & Bidding Documents, should be furnished.

ii). All rates quoted including the total amount of the bid shall be in figures & words (both).

iii). All corrections / overwriting shall be clearly re-written with initials & duly stamped by the bidder.

iv). The bid shall be properly signed, named & stamped by the authorized person of the firm and authorization letter for signatory shall be enclosed with the tender by the authorized person, if other than the signatory of the firm.

v). Bidders Business experience in Last 05 years of same Work (Specially the experience of land fill site Fukooka Simierovic Method) .

vi). The bidder will provide the complete profile of Mechanical Engineer having five 05 years experience in this relevant / specific field.

KARACHI METROPOLITAN CORPORATION

MUNICIPAL SERVICES DEPARTMENT

(CONTRACT MANAGEMENT)

TENDER DOCUMENTS

SUPPLY OF FENTHION 2% GRANULES PREVENT THE EXPANSION IN DENGUE VIRUS IN KARACHI CITY TO PROTECT THE LIVES OF PEOPLE.

Estimated Cost:-	**Offer Rate**	**Tender Cost:**	**Rs. 3,000/-**
Time Limit:-	**12 Months**	**Penalty**	**Rs. 1000/-**
To be Opened on:-	**07-12-2015**	**Validity of Tender:**	**90 Days**

Chief Engineer (CM)
Municipal Services, KMC

Tender Issued:

No: KMC/MS/CM/14/15-16

Issue to M/s. _____ **P.O / Challan No. _____**

_____ **Dated _____**

_____ **Bank: _____**

Signature & Stamp of Issuing Authority

KARACHI METROPOLITAN CORPORATION

OFFICE OF THE CHIEF ENGINEER (CONTRACT MANAGEMENT)

MUNICIPAL SERVICES DEPARTMENT

Room # 409, 4th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi

No. CE (CM)/MS/KMC/316/15 **Dated:02 -11-2015**

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1.	KMC/MS/CM/ 13/15-16	Providing and Fixing Tires & Tubes for Fire Vehicles and Allied Vehicles for Fire Brigade Department, MS, KMC.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
2.	KMC/MS/CM/ 14/15-16	Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant supply.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
3.	KMC/MS/CM/ 15/15-16	Rate Running Contract of the work of Repair and Maintenance of Mechanical Sweepers, Tractor MF-240 and Tractor MF-385 (MPD) MS, KMC for the year of 2015-16. (Re-invite).	Offer Rate	Rs.8,00,000/-	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
4.	KMC/MS/CM/ 16/15-16	Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II).	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
5.	KMC/MS/CM/ 17/15-16	Remote Controlled Trailer Mounted Lighting Towers 04 Nos. for disasters & Fire Fighting Purpose for Fire Brigade Department.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
6.	KMC/MS/CM/ 18/15-16	Modification of Grab Crane increase of Boom with Hydraulically operated etc.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
7.	KMC/MS/CM/ 19/15-16	Refurbishment of Wheel Loader Model Lie Gong-856.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
8.	KMC/MS/CM/ 20/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

9.	KMC/MS/CM/ 21/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

TERMS & CONDITIONS

1. Tender schedule shall be as follows:

SCHEDULE	DATE & TIME	VENUE
1. Receiving of Application & Issuance of Tender	**From 12-11-2015** To **04-12-2015** During Office Hours	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
		Office of Director (Planning), F&A Department, 6th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
		Office of Deputy Director (Accounts), Administrator Secretariat, Karachi 1st Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
2. Dropping of Tender	**07-12-2015** at **2:00 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
3. Opening of Tender	**07-12-2015** at **2:30 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.

2. The tender documents will be issued to the firms on submission of application in their original letter head alongwith original paid challan in the prescribed account of KMC for tender cost as mentioned above. This challan can be obtained from the office of tender sale as mentioned in this NIT.
3. The tender in sealed cover superscripted with the name of work should be dropped in the tender box kept in the committee room of the office of Sr. Director (Municipal Services) KMC.
4. In case the date of opening declared as a public holiday by the Government, or Non working day due to force Majeure the next official working day shall be deemed to be the date for submission and opening of tenders at the same time.
5. **Substantially Responsive Bid:-**

   Only those bids, which comply with the each eligibility & minimum qualification criteria attached with the tender documents shall be declared substantially responsive bids and will be eligible for further evaluation, otherwise the same will be declared as non responsive / rejected.
6. Bid Security of bid amount in the form of a pay order or bank guarantee from any schedule bank should be enclosed with the tender which will be retained till finalization of the case.
7. Canvassing in connection with tenders is strictly prohibited and tenders submitted by the contractors who report canvassing will liable for rejection.
8. KMC may reject all or any bids or proposals at any time prior to the acceptance of a bid or proposals, subject to the relevant provisions of SPP Rules 2010.

Sd/=
Chief Engineer (CM) MS, KMC

BIDDING DATA

A	Name of Procuring Agency:	Karachi Metropolitan Corporation (KMC)
B	Brief Description of Work:	**Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.**
C	Procuring Agency Address:	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
D	Estimated Cost:	Offer Rate
E	Amount of Bid Security:	Offer Rate
F	Period of Bid validity (Days):	90 Days
G	Security Deposit (i/c Bid Security):	(10 % of Quoted Amount)
H	Percentage, if any, to be deducted from bills:	(5% to be deducted from Running Bills)
I	Deadline for submission of bid along with time:	04-12-2015 (During Office Hours)
J	Venue, Time and date of Bid Opening:	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
K	Liquidity Damages:	
I	Deposit Receipt No. Date & Amount:	

KARACHI METROPOLITAN CORPORATION

Bank Deposit Challan

MUNCIPAL SERVICES DEAPRTMENT, KMC

The Manger,
Habib Bank Ltd,
KMC Branch

BANK CODE	0	1

BANK ACCOUNT NO.	2	6	0	4	-	5	7		

DATE

BRANCH CODE	0	0	1	5

BANK ACCOUNT CODE	5	7

BANK BRANCH Please receive the amount as noted below for credit to the account of KMC mentioned above and as specified here below:-

Depositor's Name & Address	Particulars (To be filled up by Department)	☐ Cheque / Pay Order / Demand Draft			Amount
		Name of Bank	No.	Date	Rs.
M/s	Deposit of tender Cost Fee for the work of Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people. Tender Enquiry # **KMC/MS/CM/14/15-16** To be opened on 07-12-2015				
		☐ Cash Rs.			
				Total	

Rupees in Words _____

Note: It is valid if to be deposited on or before the last date of sale of tender as mentioned in the NIT or its corrigendum, if any. If the same are furnished on the given date of sale in the office of the tender issuing authority, the tender will be issued.

Bank Stamp

Signature Bank Cashier

Signature of Depositor

Signature with stamp
Accountant/Assistant Accounts Officer
Drawing & Disbursing Officer

Signature Bank Officer

CHALLAN NO.

PRICE SCHEDULE

SUBJECT: - SUPPLY OF FENTHION 2% GRANULES PREVENT THE EXPANSION IN DENGUE VIRUS IN KARACHI CITY TO PROTECT THE LIVES OF PEOPLE

Sr. #	Description	Qty	Unit	Rate in Figure	Rate in Word	Amount
1	2	3	4	6	7	8
1	SUPPLY OF FENTHION 2% GRANUTES PER BAG FOR A WEIGHT OF 25Kgs. Per Bag	1800	Bag			
					Amount	
Total amount of Word :-						

Checked & Verified by
Director (MPH), MS, KMC.

I/We quoted the price schedule and bound ourselves to comply all terms and conditions of this contract with all existing rules and regulations of KMC and I have attached an Bid Security in shape of Pay Order / Bank Guarantee No. _____

(Pay Order / Bank Guarantee)

Dated_____ issued from _____

Amounting Rs._____ in favour of Karachi Metropolitan Corporation (KMC).

We / I read the standard Bidding Documents (Volume-I) available in SPPRA / KMC WEB site and agreed to abide all of them and also provide all these documents with our signature as & when directed.

Signature of Bidder with Stamp

Eligibility & Minimum Qualification Criteria

The evidence / documents for the following minimum qualification / eligibility criteria will be checked during opening process of tender prior to technical & financial evaluation & if anyone is missing then the tender will be summarily rejected at the moment by the tender opening committee.

PART-A: Eligibility Criteria

- Having experience in relevant supply
- NTN Certificate
- Valid GST Registration
- Valid Profession TAX

PART-B:
Minimum Qualification Criteria

i. Bid Security, as mentioned in the NIT & Bidding Documents, is furnished.

ii. All rates quoted including the total amount of the bid shall be in figures & words (both).

iii. All corrections / overwriting shall be clearly re-written with initials & duly stamped by the bidder.

iv. The bid shall be properly signed, named & stamped by the authorized person of the firm and authorization letter for signatory shall be enclosed with the tender by the authorized person, if other than the signatory of the firm.

KARACHI METROPOLITAN CORPORATION

MUNICIPAL SERVICES DEPARTMENT

(CONTRACT MANAGEMENT)

TENDER DOCUMENTS

MODIFICATION OF GRAB CRANE INCREASE OF BOOM WITH HYDRAULICALLY OPERATED ETC

Estimated Cost:-	**Offer Rate**	**Tender Cost:**	**Rs. 3,000/-**
Time Limit:-	**12 Months**	**Penalty**	**Rs. 1000/-**
To be Opened on:-	**07-12-2015**	**Validity of Tender:**	**90 Days**

Chief Engineer (CM)
Municipal Services, KMC

Tender Issued:

No: KMC/MS/CM/18/15-16

Issue to M/s. _____

_____

_____

P.O / Challan No. _____

Dated _____

Bank: _____

Signature & Stamp of Issuing Authority

KARACHI METROPOLITAN CORPORATION

OFFICE OF THE CHIEF ENGINEER (CONTRACT MANAGEMENT)

MUNICIPAL SERVICES DEPARTMENT

Room # 409, 4th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi

No. CE (CM)/MS/KMC/316/15 **Dated:02 -11-2015**

NOTICE INVITING TENDER

Tender in sealed covers are invited for the following work from reputable firms, having experience of similar nature work:

Sr.#	Tender Reference No.	Name of Scheme	Estimated Cost	Bid Security in shape of Pay Order or Bank Guarantee in favour of KMC	Tender Cost In shape of paid Challan in favour of KMC (Non-Refundable)	Eligibility Criteria
1	2	3	4	5	6	7
1.	KMC/MS/CM/ 13/15-16	Providing and Fixing Tires & Tubes for Fire Vehicles and Allied Vehicles for Fire Brigade Department, MS, KMC.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
2.	KMC/MS/CM/ 14/15-16	Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant supply.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
3.	KMC/MS/CM/ 15/15-16	Rate Running Contract of the work of Repair and Maintenance of Mechanical Sweepers, Tractor MF-240 and Tractor MF-385 (MPD) MS, KMC for the year of 2015-16. (Re-invite).	Offer Rate	Rs.8,00,000/-	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
4.	KMC/MS/CM/ 16/15-16	Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II).	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
5.	KMC/MS/CM/ 17/15-16	Remote Controlled Trailer Mounted Lighting Towers 04 Nos. for disasters & Fire Fighting Purpose for Fire Brigade Department.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
6.	KMC/MS/CM/ 18/15-16	Modification of Grab Crane increase of Boom with Hydraulically operated etc.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
7.	KMC/MS/CM/ 19/15-16	Refurbishment of Wheel Loader Model Lie Gong-856.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
8.	KMC/MS/CM/ 20/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

9.	KMC/MS/CM/ 21/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

TERMS & CONDITIONS

1. Tender schedule shall be as follows:

SCHEDULE	DATE & TIME	VENUE
1. Receiving of Application & Issuance of Tender	**From 12-11-2015** To **04-12-2015** During Office Hours	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
		Office of Director (Planning), F&A Department, 6th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
		Office of Deputy Director (Accounts), Administrator Secretariat, Karachi 1st Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
2. Dropping of Tender	**07-12-2015** at **2:00 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
3. Opening of Tender	**07-12-2015** at **2:30 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.

2. The tender documents will be issued to the firms on submission of application in their original letter head alongwith original paid challan in the prescribed account of KMC for tender cost as mentioned above. This challan can be obtained from the office of tender sale as mentioned in this NIT.
3. The tender in sealed cover superscripted with the name of work should be dropped in the tender box kept in the committee room of the office of Sr. Director (Municipal Services) KMC.
4. In case the date of opening declared as a public holiday by the Government, or Non working day due to force Majeure the next official working day shall be deemed to be the date for submission and opening of tenders at the same time.
5. **Substantially Responsive Bid:-**

   Only those bids, which comply with the each eligibility & minimum qualification criteria attached with the tender documents shall be declared substantially responsive bids and will be eligible for further evaluation, otherwise the same will be declared as non responsive / rejected.
6. Bid Security of bid amount in the form of a pay order or bank guarantee from any schedule bank should be enclosed with the tender which will be retained till finalization of the case.
7. Canvassing in connection with tenders is strictly prohibited and tenders submitted by the contractors who report canvassing will liable for rejection.
8. KMC may reject all or any bids or proposals at any time prior to the acceptance of a bid or proposals, subject to the relevant provisions of SPP Rules 2010.

Sd/=
Chief Engineer (CM) MS, KMC

BIDDING DATA

A	Name of Procuring Agency:	Karachi Metropolitan Corporation (KMC)
B	Brief Description of Work:	**MODIFICATION OF GRAB CRANE INCREASE OF BOOM WITH HYDRAULICALLY OPERATED ETC**
C	Procuring Agency Address:	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
D	Estimated Cost:	Offer Rate
E	Amount of Bid Security:	Offer Rate
F	Period of Bid validity (Days):	90 Days
G	Security Deposit (i/c Bid Security):	(10 % of Quoted Amount)
H	Percentage, if any, to be deducted from bills:	(5% to be deducted from Running Bills)
I	Deadline for submission of bid along with time:	04-12-2015 (During Office Hours)
J	Venue, Time and date of Bid Opening:	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
K	Liquidity Damages:	
I	Deposit Receipt No. Date & Amount:	

KARACHI METROPOLITAN CORPORATION

Bank Deposit Challan

MUNCIPAL SERVICES DEAPRTMENT, KMC

The Manger,
Habib Bank Ltd,
KMC Branch

BANK CODE 0 1 | **BANK ACCOUNT NO.** 2 6 0 4 - 5 7 | **DATE**

BRANCH CODE 0 0 1 5 | **BANK ACCOUNT CODE** 5 7

BANK BRANCH Please receive the amount as noted below for credit to the account of KMC mentioned above and as specified here below:-

Depositor's Name & Address	Particulars (To be filled up by Department)	☐ Cheque / Pay Order / Demand Draft			Amount
		Name of Bank	No.	Date	Rs.
M/s	Deposit of tender Cost Fee for the work of Modification of Grab Crane increase of Boom with Hydraulically operated etc. Tender Enquiry # **KMC/MS/CM/18/15-16** To be opened on 07-12-2015				
		☐ **Cash Rs.**			
				Total	

Rupees in Words _____

Note: It is valid if to be deposited on or before the last date of sale of tender as mentioned in the NIT or its corrigendum, if any. If the same are furnished on the given date of sale in the office of the tender issuing authority, the tender will be issued.

Bank Stamp

Signature Bank Cashier

Signature of Depositor

Signature with stamp
Accountant/Assistant Accounts Officer
Drawing & Disbursing Officer

Signature Bank Officer

CHALLAN NO.

PRICE SCHEDULE

SUBJECT: - MODIFICATION OF GRAB CRANE INCREASE OF BOOM WITH HYDRAULICALLY OPERATED ETC.

Sr. #	Description	Quantity	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6
1.	Removal of Old 28 ft Boom & Redesigning of 40 ft Booms extend 12'x10'x10'x8' with rest plates, wire hooks, pulleys, Joints pins locks, setting pins made of high quality Teflon.	02 Units			
2.	Booms / grips / jacks / Winch hydraulically controlled.	02 Units			
3.	Hydraulic System to operate through hydraulic pump coupled with PTO / Drive Belt & hydraulic Motors & Complete good quality hydraulic piping.	02 Units			
4.	Manual and Hydraulic safeties & limit switches all along system.	02 Units			
5.	Modification of under carriage Knuckles with complete fittings.	02 Units			
6.	Complete Engine Overhauling with replacement of parts, Turbo Repair, Fuel Injection Pump & Automiser Set Repair, Clutch Plate, Pressure Plate & Fly wheel Set Repair, Self Starter & Generator Repair	02 Units			
7.	Complete suspension overhauling with replacement of parts, Front Leaf Spring & Repair Leaf Spring set load Enhancement with centre bolts & U Clips.	02 Units			
8.	Complete Electrical Wiring repair & replacement of Components	02 Units			
9.	Complete Denting Painting & Under Coating writing & Logos of KMC.	02 Units			
				Total	
Total amount of Word :-					

Checked & Verified by
Project Engineer (MPD), MS, KMC.

I/We quoted the price schedule and bound ourselves to comply all terms and conditions of this contract with all existing rules and regulations of KMC and I have attached an Bid Security in shape of Pay Order / Bank Guarantee No. _____

(Pay Order / Bank Guarantee)

Dated_____ issued from _____

Amounting Rs._____ in favour of Karachi Metropolitan Corporation (KMC).

We / I read the standard Bidding Documents (Volume-I) available in SPPRA / KMC WEB site and agreed to abide all of them and also provide all these documents with our signature as & when directed.

Signature of Bidder with Stamp

MODIFICATION OF GRAB CRANE INCREASE OF BOOM WITH HYDRAULICALLY OPERATED ETC.

Eligibility & Minimum Qualification Criteria

The evidence / documents for the following minimum qualification / eligibility criteria will be checked during opening process of tender prior to technical & financial evaluation & if anyone is missing then the tender will be summarily rejected at the moment by the tender opening committee.

PART-A: Eligibility Criteria

- Having experience in Relevant field
- NTN Certificate
- Valid Professional TAX

PART-B:
Minimum Qualification Criteria

i. Bid Security, as mentioned in the NIT & Bidding Documents, is furnished.

ii. All rates quoted including the total amount of the bid shall be in figures & words (both).

iii. All corrections / overwriting shall be clearly re-written with initials & duly stamped by the bidder.

iv. The bid shall be properly signed, named & stamped by the authorized person of the firm and authorization letter for signatory shall be enclosed with the tender by the authorized person, if other than the signatory of the firm.

v. Bidders business experience in last 03 year of similar nature.

vi. Satisfactory Commutative Work Experience

KARACHI METROPOLITAN CORPORATION

MUNICIPAL SERVICES DEPARTMENT

(CONTRACT MANAGEMENT)

TENDER DOCUMENTS

REFURBISHMENT OF WHEEL LOADER MODEL LIE GONG – 856

Estimated Cost:-	**Offer Rate**	**Tender Cost:**	**Rs. 3,000/-**
Time Limit:-	**12 Months**	**Penalty**	**Rs. 1000/-**
To be Opened on:-	**07-12-2015**	**Validity of Tender:**	**90 Days**

Chief Engineer (CM)
Municipal Services, KMC

Tender Issued:

No: KMC/MS/CM/19/15-16

Issue to M/s. _____

_____

_____

P.O / Challan No. _____

Dated _____

Bank: _____

Signature & Stamp of Issuing Authority

KARACHI METROPOLITAN CORPORATION

OFFICE OF THE CHIEF ENGINEER (CONTRACT MANAGEMENT)

MUNICIPAL SERVICES DEPARTMENT

Room # 409, 4th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi

No. CE (CM)/MS/KMC/316/15 **Dated:02 -11-2015**

NOTICE INVITING TENDER

Tender in sealed covers are invited for the following work from reputable firms, having experience of similar nature work:

Sr.#	Tender Reference No.	Name of Scheme	Estimated Cost	Bid Security in shape of Pay Order or Bank Guarantee in favour of KMC	Tender Cost In shape of paid Challan in favour of KMC (Non-Refundable)	Eligibility Criteria
1	2	3	4	5	6	7
1.	KMC/MS/CM/ 13/15-16	Providing and Fixing Tires & Tubes for Fire Vehicles and Allied Vehicles for Fire Brigade Department, MS, KMC.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
2.	KMC/MS/CM/ 14/15-16	Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant supply.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
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4.	KMC/MS/CM/ 16/15-16	Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II).	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
5.	KMC/MS/CM/ 17/15-16	Remote Controlled Trailer Mounted Lighting Towers 04 Nos. for disasters & Fire Fighting Purpose for Fire Brigade Department.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
6.	KMC/MS/CM/ 18/15-16	Modification of Grab Crane increase of Boom with Hydraulically operated etc.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
7.	KMC/MS/CM/ 19/15-16	Refurbishment of Wheel Loader Model Lie Gong-856.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
8.	KMC/MS/CM/ 20/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

9.	KMC/MS/CM/ 21/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

TERMS & CONDITIONS

1. Tender schedule shall be as follows:

SCHEDULE	DATE & TIME	VENUE
1. Receiving of Application & Issuance of Tender	**From 12-11-2015** To **04-12-2015** During Office Hours	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
		Office of Director (Planning), F&A Department, 6th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
		Office of Deputy Director (Accounts), Administrator Secretariat, Karachi 1st Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
2. Dropping of Tender	**07-12-2015** at **2:00 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
3. Opening of Tender	**07-12-2015** at **2:30 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.

2. The tender documents will be issued to the firms on submission of application in their original letter head alongwith original paid challan in the prescribed account of KMC for tender cost as mentioned above. This challan can be obtained from the office of tender sale as mentioned in this NIT.
3. The tender in sealed cover superscripted with the name of work should be dropped in the tender box kept in the committee room of the office of Sr. Director (Municipal Services) KMC.
4. In case the date of opening declared as a public holiday by the Government, or Non working day due to force Majeure the next official working day shall be deemed to be the date for submission and opening of tenders at the same time.
5. **Substantially Responsive Bid:-**

   Only those bids, which comply with the each eligibility & minimum qualification criteria attached with the tender documents shall be declared substantially responsive bids and will be eligible for further evaluation, otherwise the same will be declared as non responsive / rejected.
6. Bid Security of bid amount in the form of a pay order or bank guarantee from any schedule bank should be enclosed with the tender which will be retained till finalization of the case.
7. Canvassing in connection with tenders is strictly prohibited and tenders submitted by the contractors who report canvassing will liable for rejection.
8. KMC may reject all or any bids or proposals at any time prior to the acceptance of a bid or proposals, subject to the relevant provisions of SPP Rules 2010.

Sd/=

Chief Engineer (CM) MS, KMC

BIDDING DATA

A	Name of Procuring Agency:	Karachi Metropolitan Corporation (KMC)
B	Brief Description of Work:	**REFURBISHMENT OF WHEEL LOADER MODEL LIE GONG-856**
C	Procuring Agency Address:	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
D	Estimated Cost:	Offer Rate
E	Amount of Bid Security:	Offer Rate
F	Period of Bid validity (Days):	90 Days
G	Security Deposit (i/c Bid Security):	(10 % of Quoted Amount)
H	Percentage, if any, to be deducted from bills:	(5% to be deducted from Running Bills)
I	Deadline for submission of bid along with time:	04-12-2015 (During Office Hours)
J	Venue, Time and date of Bid Opening:	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
K	Liquidity Damages:	
I	Deposit Receipt No. Date & Amount:	

KARACHI METROPOLITAN CORPORATION

Bank Deposit Challan

MUNCIPAL SERVICES DEAPRTMENT, KMC

The Manger,
Habib Bank Ltd,
KMC Branch

BANK CODE	0	1

BANK ACCOUNT NO.	2	6	0	4	-	5	7		

DATE

BRANCH CODE	0	0	1	5

BANK ACCOUNT CODE	5	7

BANK BRANCH Please receive the amount as noted below for credit to the account of KMC mentioned above and as specified here below:-

Depositor's Name & Address	Particulars (To be filled up by Department)	☐ Cheque / Pay Order / Demand Draft			Amount
		Name of Bank	No.	Date	Rs.
M/s	Deposit of tender Cost Fee for the work of Refurbishment of Wheel Loader Model Lie Gong 856. Tender Enquiry # **KMC/MS/CM/19/15-16** To be opened on 07-12-2015				
		☐ **Cash Rs.**			
				Total	

Rupees in Words _____

Note: It is valid if to be deposited on or before the last date of sale of tender as mentioned in the NIT or its corrigendum, if any. If the same are furnished on the given date of sale in the office of the tender issuing authority, the tender will be issued.

Bank Stamp

Signature Bank Cashier

Signature of Depositor

Signature with stamp
Accountant/Assistant Accounts Officer
Drawing & Disbursing Officer

Signature Bank Officer

CHALLAN NO.

PRICE SCHEDULE

SUBJECT: - REFURBISHMENT OF WHEEL LOADER MODEL LIE GONG-856

Sr. #	Description	Quantity	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6
1.	Complete Engine Overhauling with replacement of parts, Fuel Injection Pump & Automiser Set Repair, Self Starter & Generator Repair	02 Jobs			
2.	New Tires Change Size 23-5-25	08 Nos			
3.	Complete Electrical Wiring repair & replacement of Components	02 Jobs			
4.	Solenoid Valve	10 Nos			
5.	Control Unit Card	02 Sets			
6.	Complete Overhauling of Transmission.	02 Jobs			
7.	Complete Overhauling of Breaks	02 Jobs			
8.	Complete Overhauling of differential system	02 Jobs			
9.	Complete Overhauling of Hydraulic System	02 Jobs			
10.	Head Light Set	02 Set			
11.	Break Light	02 Set			
12.	Batteries	02 Set			
13.	Cabin Glasses	02 Set			
14.	Rear View Mirror	02 Set			
15.	Complete Denting Painting & Under Coating writing & Logos of KMC.	02 Jobs			
				Total	
Total amount of Word :-					

Checked & Verified by
Project Engineer (MPD), MS, KMC

I/We quoted the price schedule and bound ourselves to comply all terms and conditions of this contract with all existing rules and regulations of KMC and I have attached an Bid Security in shape of Pay Order / Bank Guarantee No. _____

(Pay Order / Bank Guarantee)

Dated_____ issued from _____

Amounting Rs._____ in favour of Karachi Metropolitan Corporation (KMC).

We / I read the standard Bidding Documents (Volume-I) available in SPPRA / KMC WEB site and agreed to abide all of them and also provide all these documents with our signature as & when directed.

Signature of Bidder with Stamp

REFURBISHMENT OF WHEEL LOADER MODEL LIE GONG – 856

Eligibility & Minimum Qualification Criteria

The evidence / documents for the following minimum qualification / eligibility criteria will be checked during opening process of tender prior to technical & financial evaluation & if anyone is missing then the tender will be summarily rejected at the moment by the tender opening committee.

PART-A: Eligibility Criteria

- Having experience in Relevant field
- NTN Certificate
- Valid Professional TAX

PART-B:
Minimum Qualification Criteria

i. Bid Security, as mentioned in the NIT & Bidding Documents, is furnished.

ii. All rates quoted including the total amount of the bid shall be in figures & words (both).

iii. All corrections / overwriting shall be clearly re-written with initials & duly stamped by the bidder.

iv. The bid shall be properly signed, named & stamped by the authorized person of the firm and authorization letter for signatory shall be enclosed with the tender by the authorized person, if other than the signatory of the firm.

v. Bidders business experience in last 03 year of similar nature

vi. Satisfactory Commutative Work Experience

KARACHI METROPOLITAN CORPORATION

MUNICIPAL SERVICES DEPARTMENT

(CONTRACT MANAGEMENT)

TENDER DOCUMENTS

REMOTE CONTROLLED TRAILER MOUNTED LIGHTING TOWER 04 NOS FOR DISASTERS & FIRE FIGHTING PURPOSE FOR FIRE BRIGADE DEPARTMENT.

Estimated Cost:-	**Offer Rate**	**Tender Cost:**	**Rs. 3,000/-**
Time Limit:-	**12 Months**	**Penalty**	**Rs. 1000/-**
To be Opened on:-	**07-12-2015**	**Validity of Tender:**	**90 Days**

Chief Engineer (CM)
Municipal Services, KMC

Tender Issued:

No: KMC/MS/CM/17/15-16

Issue to M/s. _____

_____

_____

P.O / Challan No. _____

Dated _____

Bank: _____

Signature & Stamp of Issuing Authority

KARACHI METROPOLITAN CORPORATION

OFFICE OF THE CHIEF ENGINEER (CONTRACT MANAGEMENT)

MUNICIPAL SERVICES DEPARTMENT

Room # 409, 4th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi

No. CE (CM)/MS/KMC/316/15 **Dated:02 -11-2015**

NOTICE INVITING TENDER

Tender in sealed covers are invited for the following work from reputable firms, having experience of similar nature work:

Sr.#	Tender Reference No.	Name of Scheme	Estimated Cost	Bid Security in shape of Pay Order or Bank Guarantee in favour of KMC	Tender Cost In shape of paid Challan in favour of KMC (Non-Refundable)	Eligibility Criteria
1	2	3	4	5	6	7
1.	KMC/MS/CM/ 13/15-16	Providing and Fixing Tires & Tubes for Fire Vehicles and Allied Vehicles for Fire Brigade Department, MS, KMC.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
2.	KMC/MS/CM/ 14/15-16	Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant supply.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
3.	KMC/MS/CM/ 15/15-16	Rate Running Contract of the work of Repair and Maintenance of Mechanical Sweepers, Tractor MF-240 and Tractor MF-385 (MPD) MS, KMC for the year of 2015-16. (Re-invite).	Offer Rate	Rs.8,00,000/-	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
4.	KMC/MS/CM/ 16/15-16	Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II).	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
5.	KMC/MS/CM/ 17/15-16	Remote Controlled Trailer Mounted Lighting Towers 04 Nos. for disasters & Fire Fighting Purpose for Fire Brigade Department for Fire Brigade Department.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
6.	KMC/MS/CM/ 18/15-16	Modification of Grab Crane increase of Boom with Hydraulically operated etc.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
7.	KMC/MS/CM/ 19/15-16	Refurbishment of Wheel Loader Model Lie Gong-856.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
8.	KMC/MS/CM/ 20/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

9.	KMC/MS/CM/ 21/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

TERMS & CONDITIONS

1. Tender schedule shall be as follows:

SCHEDULE	DATE & TIME	VENUE
1. Receiving of Application & Issuance of Tender	**From 12-11-2015** To **04-12-2015** During Office Hours	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
		Office of Director (Planning), F&A Department, 6th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
		Office of Deputy Director (Accounts), Administrator Secretariat, Karachi 1st Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
2. Dropping of Tender	**07-12-2015** at **2:00 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
3. Opening of Tender	**07-12-2015** at **2:30 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.

2. The tender documents will be issued to the firms on submission of application in their original letter head alongwith original paid challan in the prescribed account of KMC for tender cost as mentioned above. This challan can be obtained from the office of tender sale as mentioned in this NIT.
3. The tender in sealed cover superscripted with the name of work should be dropped in the tender box kept in the committee room of the office of Sr. Director (Municipal Services) KMC.
4. In case the date of opening declared as a public holiday by the Government, or Non working day due to force Majeure the next official working day shall be deemed to be the date for submission and opening of tenders at the same time.
5. **Substantially Responsive Bid:-**

   Only those bids, which comply with the each eligibility & minimum qualification criteria attached with the tender documents shall be declared substantially responsive bids and will be eligible for further evaluation, otherwise the same will be declared as non responsive / rejected.
6. Bid Security of bid amount in the form of a pay order or bank guarantee from any schedule bank should be enclosed with the tender which will be retained till finalization of the case.
7. Canvassing in connection with tenders is strictly prohibited and tenders submitted by the contractors who report canvassing will liable for rejection.
8. KMC may reject all or any bids or proposals at any time prior to the acceptance of a bid or proposals, subject to the relevant provisions of SPP Rules 2010.

Sd/=

Chief Engineer (CM) MS, KMC

BIDDING DATA

A	Name of Procuring Agency:	Karachi Metropolitan Corporation (KMC)
B	Brief Description of Work:	**REMOTE CONTROLLED TRAILER MOUNTED LIGHTING TOWERS 04 NOS. FOR DISASTERS & FIRE FIGHTING PURPOSE FOR FIRE BRIGADE DEPARTMENT FOR FIRE BRIGADE DEPARTMENT**
C	Procuring Agency Address:	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
D	Estimated Cost:	Offer Rate
E	Amount of Bid Security:	Offer Rate
F	Period of Bid validity (Days):	90 Days
G	Security Deposit (i/c Bid Security):	(10 % of Quoted Amount)
H	Percentage, if any, to be deducted from bills:	(5% to be deducted from Running Bills)
I	Deadline for submission of bid along with time:	04-12-2015 (During Office Hours)
J	Venue, Time and date of Bid Opening:	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
K	Liquidity Damages:	
I	Deposit Receipt No. Date & Amount:	

KARACHI METROPOLITAN CORPORATION

Bank Deposit Challan

MUNCIPAL SERVICES DEAPRTMENT, KMC

The Manger,
Habib Bank Ltd,
KMC Branch

BANK CODE	0	1

BANK ACCOUNT NO.	2	6	0	4	-	5	7		

DATE

BRANCH CODE	0	0	1	5

BANK ACCOUNT CODE	5	7

BANK BRANCH Please receive the amount as noted below for credit to the account of KMC mentioned above and as specified here below:-

Depositor's Name & Address	Particulars (To be filled up by Department)	☐ Cheque / Pay Order / Demand Draft			Amount
		Name of Bank	No.	Date	Rs.
M/s	Deposit of tender Cost Fee for the work of Remote Controlled Trailer Mounted Lighting Towers 04 Nos. for disasters & Fire Fighting Purpose for Fire Brigade Department for Fire Brigade Department. Tender Enquiry # **KMC/MS/CM/17/15-16** To be opened on 07-12-2015.				
		☐ **Cash Rs.**			
				Total	

Rupees in Words _____

Note: It is valid if to be deposited on or before the last date of sale of tender as mentioned in the NIT or its corrigendum, if any. If the same are furnished on the given date of sale in the office of the tender issuing authority, the tender will be issued.

Bank Stamp

Signature Bank Cashier

Signature of Depositor

Signature with stamp
Accountant/Assistant Accounts Officer
Drawing & Disbursing Officer

Signature Bank Officer

CHALLAN NO.

PRICE SCHEDULE

SUBJECT: - REMOTE CONTROLLED TRAILER MOUNTED LIGHTING TOWERS 04 NOS. FOR DISASTERS & FIRE FIGHTING PURPOSE FOR FIRE BRIGADE DEPARTMENT FOR FIRE BRIGADE DEPARTMENT

Sr. #	Description	Quantity	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6
1	Complete Fabrication of Chassis with extendable booms 3 x 10' with all its Accessories, Max Height 16 Ft from Chassis Base and Tow Pod Complete Fabrication of Tow Trailer along with tires, 2 x 2 Tires with Rims 14 R, 04 Nos Ground Jacks with Auto Balancing system with Range Of Penetration Upto 100 Meter Lighting Tower with Remote Control Handling And Operation System).Dimensions (4' X 5' X 5'+- 15%) With Complete Shock Proofing Through Hydraulic Filled Jacks And Springs With Directional Manual Breaking System.	04 Nos			
2	Complete Imported Electrical System with all its accessories along with 2 x 12 Batteries, 4 x LED Search Light, 4 x Parking Lights (Hazard Lights), 4 x Blinkers. A. All operation though Ground Controlled system and Ground / Wireless remote control operation. Wireless Remote Controlled Transmitter and Receiver along with complete Electrical fittings with remote controlled lights B. Angle 360 degrees wireless remote controlled.	04 Nos			
3	Complete Hydraulic De-Unit 220 V with 2 HP Motor	04 Nos			
4	Complete Electrical Control Panel Wireless Remote Control Range 100	04 Nos			

Sr. #	Description	Quantity	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6
	Meters.				
5	Complete Electrical Shock Proofing	04 Nos			
6	Power Unit 3 Cycle Engine 20 HP	04 Nos			
7	Generator 6 KVA 1500 RPM	04 Nos			
8	Arduino Control	12 Nos			
9	Xbee Control with Shield	8 Nos			
10	Electronic Joy Stick	8 Nos			
11	Rely 24 Volts Control Valve	72 Nos			
12	Supply Converter 24 V to 5 V	04 Nos			
13	Complete Electrical Wiring Heat Proofing	04 Nos			
14	Emergency Stop Switch	04 Nos			
15	Wireless Remote Control With Solenoid Switching For Lighting Tower & Insullation of Software	04 Nos			
16	Hydraulic Piping Complete With Directional Controls Valves.	04 Nos			
17	Complete Bake Painting	04 Nos			
				Total	
Total amount of Word :-					

Checked & Verified by
Project Engineer (MPD), MS, KMC

I/We quoted the price schedule and bound ourselves to comply all terms and conditions of this contract with all existing rules and regulations of KMC and I have attached an Bid Security in shape of Pay Order / Bank Guarantee No. _____

(Pay Order / Bank Guarantee)

Dated_____ issued from _____

Amounting Rs._____ in favour of Karachi Metropolitan Corporation (KMC).

We / I read the standard Bidding Documents (Volume-I) available in SPPRA / KMC WEB site and agreed to abide all of them and also provide all these documents with our signature as & when directed.

Signature of Bidder with Stamp

REMOTE CONTROLLED TRAILER MOUNTED LIGHTING TOWERS 04 NOS. FOR DISASTERS & FIRE FIGHTING PURPOSE FOR FIRE BRIGADE DEPARTMENT FOR FIRE BRIGADE DEPARTMENT

Eligibility & Minimum Qualification Criteria

The evidence / documents for the following minimum qualification / eligibility criteria will be checked during opening process of tender prior to technical & financial evaluation & if anyone is missing then the tender will be summarily rejected at the moment by the tender opening committee.

PART-A: Eligibility Criteria

- Having experience in Relevant field
- NTN Certificate
- Valid Professional TAX

PART-B:
Minimum Qualification Criteria

i. Bid Security, as mentioned in the NIT & Bidding Documents, is furnished.

ii. All rates quoted including the total amount of the bid shall be in figures & words (both).

iii. All corrections / overwriting shall be clearly re-written with initials & duly stamped by the bidder.

iv. The bid shall be properly signed, named & stamped by the authorized person of the firm and authorization letter for signatory shall be enclosed with the tender by the authorized person, if other than the signatory of the firm.

v. Bidders business experience in last 03 year of similar nature (Fire Vehicle maintenance foreign) made. Up to Rs.40.0 Million & Above

vi. Satisfactory Commutative Work Experience

- Repair / Maintenance / Improvement of Fire Tenders 03 years of similar nature fabrication of rescue vehicles. Up to Rs.40.00 Million and above.

vii. Registration with SESSI, Civil Defense, E.O.B.I

viii. Prove of availability of wirelessly remote controlled fire atomizer and Repair & Maintenance facility of similar nature work.

ix. Proof of satisfactory Fabrication / Construction of Hydraulically Operated Platform Similar Nature Works locally.

KARACHI METROPOLITAN CORPORATION

MUNICIPAL SERVICES DEPARTMENT

(CONTRACT MANAGEMENT)

TENDER DOCUMENTS

SPECIALIZED TRAILER MOUNTED MONITOR LIFT (GROUND CONTROLLED) 04 NOS FOR RAPID INTERVENTION INTO NARROW LINES IN OLD CITY AREA FOR FIRE FIGHTING PURPOSE FOR FIRE BRIGADE DEPARTMENT KMC (PHASE-II)

Estimated Cost:-	**Offer Rate**	**Tender Cost:**	**Rs. 3,000/-**
Time Limit:-	**12 Months**	**Penalty**	**Rs. 1000/-**
To be Opened on:-	**07-12-2015**	**Validity of Tender:**	**90 Days**

Chief Engineer (CM)
Municipal Services, KMC

Tender Issued:

No: KMC/MS/CM/16/15-16

Issue to M/s. _____ **P.O / Challan No. _____**

_____ **Dated _____**

_____ **Bank: _____**

Signature & Stamp of Issuing Authority

KARACHI METROPOLITAN CORPORATION

OFFICE OF THE CHIEF ENGINEER (CONTRACT MANAGEMENT)

MUNICIPAL SERVICES DEPARTMENT

Room # 409, 4th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi

No. CE (CM)/MS/KMC/316/15 **Dated:02 -11-2015**

NOTICE INVITING TENDER

Tender in sealed covers are invited for the following work from reputable firms, having experience of similar nature work:

Sr.#	Tender Reference No.	Name of Scheme	Estimated Cost	Bid Security in shape of Pay Order or Bank Guarantee in favour of KMC	Tender Cost In shape of paid Challan in favour of KMC (Non-Refundable)	Eligibility Criteria
1	2	3	4	5	6	7
1.	KMC/MS/CM/ 13/15-16	Providing and Fixing Tires & Tubes for Fire Vehicles and Allied Vehicles for Fire Brigade Department, MS, KMC.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
2.	KMC/MS/CM/ 14/15-16	Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant supply.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
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4.	KMC/MS/CM/ 16/15-16	Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II).	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
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7.	KMC/MS/CM/ 19/15-16	Refurbishment of Wheel Loader Model Lie Gong-856.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
8.	KMC/MS/CM/ 20/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate**

						• **Valid Professional Tax.**
9.	KMC/MS/CM/ 21/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

TERMS & CONDITIONS

1. Tender schedule shall be as follows:

SCHEDULE	DATE & TIME	VENUE
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		Office of Director (Planning), F&A Department, 6th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
		Office of Deputy Director (Accounts), Administrator Secretariat, Karachi 1st Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
2. Dropping of Tender	**07-12-2015** at **2:00 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
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Sd/=
Chief Engineer (CM) MS, KMC

BIDDING DATA

A	Name of Procuring Agency:	Karachi Metropolitan Corporation (KMC)
B	Brief Description of Work:	**SPECIALIZED TRAILER MOUNTED MONITOR LIFT (GROUND CONTROLLED) 02 NOS. FOR RAPID INTERVENTION INTO NARROW LINES IN OLD CITY AREA FOR FIRE FIGHTING PURPOSE FOR FIRE BRIGADE DEPARTMENT KMC. (PHASE-II)**
C	Procuring Agency Address:	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
D	Estimated Cost:	Offer Rate
E	Amount of Bid Security:	Offer Rate
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H	Percentage, if any, to be deducted from bills:	(5% to be deducted from Running Bills)
I	Deadline for submission of bid along with time:	04-12-2015 (During Office Hours)
J	Venue, Time and date of Bid Opening:	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
K	Liquidity Damages:	
I	Deposit Receipt No. Date & Amount:	

KARACHI METROPOLITAN CORPORATION

Bank Deposit Challan

MUNCIPAL SERVICES DEAPRTMENT, KMC

The Manger,
Habib Bank Ltd,
KMC Branch

BANK CODE	0	1

BANK ACCOUNT NO.	2	6	0	4	-	5	7		

DATE

BRANCH CODE	0	0	1	5

BANK ACCOUNT CODE	5	7

BANK BRANCH Please receive the amount as noted below for credit to the account of KMC mentioned above and as specified here below:-

Depositor's Name & Address	Particulars (To be filled up by Department)	☐ Cheque / Pay Order / Demand Draft			Amount
		Name of Bank	No.	Date	Rs.
M/s	Deposit of tender Cost Fee for the work of Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II). Tender Enquiry # **KMC/MS/CM/16/15-16** To be opened on 07-12-2015				
		☐ **Cash Rs.**			
				Total	

Rupees in Words _____

Note: It is valid if to be deposited on or before the last date of sale of tender as mentioned in the NIT or its corrigendum, if any. If the same are furnished on the given date of sale in the office of the tender issuing authority, the tender will be issued.

Bank Stamp

Signature Bank Cashier

Signature of Depositor

Signature with stamp
Accountant/Assistant Accounts Officer
Drawing & Disbursing Officer

Signature Bank Officer

CHALLAN NO.

PRICE SCHEDULE

SUBJECT: - **SPECIALIZED TRAILER MOUNTED MONITOR LIFT (GROUND CONTROLLED) 04 NOS FOR RAPID INTERVENTION INTO NARROW LINES IN OLD CITY AREA FOR FIRE FIGHTING PURPOSE FOR FIRE BRIGADE DEPARTMENT KMC (PHASE-II)**

Sr. #	Description	Quantity	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6
1	Complete Fabrication of Chassis with extendable booms 3 x 10' with all its Accessories, Max Height 30 Ft from Chassis Base and Tow Pod Complete Fabrication of Tow Trailer along with tires, 2 x 2 Tires with Rims 14 R, 04 Nos Out Riggers (with Balancing system)..	02 Jobs			
2.	Complete Imported Electrical System with all its accessories along with 2 x 12 Batteries, 2 x Search Light, Search Light, 4 x Parking Lights (Hazard Lights), 4 x Blinkers. The Servo Motor Control System is based on PLC & HML remote Control Technology with Wireless Operation within 100 meters range. A. All operation though Ground Controlled system with screen and Ground / Wireless remote control operation. Wireless Remote Controlled Transmitter and Receiver along with complete Electrical fittings with remote controlled lights, B. Spray angle 360 degrees with shoot and spray system wireless remote controlled. C. 01 Camera with Night Vision Operation Wireless Remote Controlled and thorough Device Monitoring.	02 Jobs			

Sr. #	Description	Quantity	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6
3.	Complete Hydraulic System Lift Knuckle (Elbow and Rest Type) for angular penetration along with fire monitor with automatic ground levelling and balancing system, 360 degree Ground controlled camera and fire monitor (wirelessly remote controlled operation), Left/ Right/ Up and downward motion, joy stick (Compact Electronically Inter Controlled) with wireless remote and manual backup, all intercepted angles must have Rotational Motion and with Emergency Stop Switches, Complete Solenoid Switches with emergency stop button. i. HPMF Automizer Remote Controlled Spray & Jet Fire Monitor ii. Simultaneous Power Unit (Complete in all respects). iii. Large Oil Reservoir. iv. LCD Monitor. v. Six Jack Pair with extendable Lead (for Rescue Operation). vi. Remote Ground Control. vii. Power Unit 4 Cycle Gas Engine 20 HP.	02 Jobs			
4	Complete Bake Painting	02 Jobs			
5	Fabrication / Providing / Installation of Water System along with Complete 2 ½" Pressure line along the Lift up till Fire Monitor, 4 x couplings and Joints, Storage Compartments x 2 with Locking system.	02 Jobs			
				Total	
Total amount of Word :-					

Checked & Verified by
Project Engineer (FB), MS, KMC.

I/We quoted the price schedule and bound ourselves to comply all terms and conditions of this contract with all existing rules and regulations of KMC and I have attached an Bid Security in shape of Pay Order / Bank Guarantee No. _____

(Pay Order / Bank Guarantee)

Dated_____ issued from _____

Amounting Rs._____ in favour of Karachi Metropolitan Corporation (KMC).

We / I read the standard Bidding Documents (Volume-I) available in SPPRA / KMC WEB site and agreed to abide all of them and also provide all these documents with our signature as & when directed.

Signature of Bidder with Stamp

SPECIALIZED TRAILER MOUNTED MONITOR LIFT (GROUND CONTROLLED) 04 NOS FOR RAPID INTERVENTION INTO NARROW LINES IN OLD CITY AREA FOR FIRE FIGHTING PURPOSE FOR FIRE BRIGADE DEPARTMENT KMC (PHASE-II)

Eligibility & Minimum Qualification Criteria

The evidence / documents for the following minimum qualification / eligibility criteria will be checked during opening process of tender prior to technical & financial evaluation & if anyone is missing then the tender will be summarily rejected at the moment by the tender opening committee.

PART-A: Eligibility Criteria

- Having experience in Relevant field
- NTN Certificate
- Valid Professional TAX

PART-B:
Minimum Qualification Criteria

i. Bid Security, as mentioned in the NIT & Bidding Documents, is furnished.

ii. All rates quoted including the total amount of the bid shall be in figures & words (both).

iii. All corrections / overwriting shall be clearly re-written with initials & duly stamped by the bidder.

iv. The bid shall be properly signed, named & stamped by the authorized person of the firm and authorization letter for signatory shall be enclosed with the tender by the authorized person, if other than the signatory of the firm.

v. Bidders business experience in last 03 year of similar nature (Fire Vehicle maintenance foreign) made. Up to Rs.40.0 Million & Above

vi. Satisfactory Commutative Work Experience

- Repair / Maintenance / Improvement of Fire Tenders 03 years of similar nature fabrication of rescue vehicles. Up to Rs.40.00 Million and above.

vii. Registration with SESSI, Civil Defense, E.O.B.I

viii. Prove of availability of wirelessly remote controlled fire atomizer and Repair & Maintenance facility of similar nature work.

ix. Proof of satisfactory Fabrication / Construction of Hydraulically Operated Platform Similar Nature Works locally.

KARACHI METROPOLITAN CORPORATION

MUNICIPAL SERVICES DEPARTMENT

(CONTRACT MANAGEMENT)

TENDER DOCUMENTS

PROVIDING AND FIXING TIRES & TUBES FOR FIRE VEHICLES AND ALLIED VEHICLES FOR FIRE BRIGADE DEPARTMENT, MS, KMC.

Estimated Cost:-	**Offer Rate**	**Tender Cost:**	**Rs. 3,000/-**
Time Limit:-	**12 Months**	**Penalty**	**Rs. 1000/-**
To be Opened on:-	**07-12-2015**	**Validity of Tender:**	**90 Days**

Chief Engineer (CM)
Municipal Services, KMC

Tender Issued:

No: KMC/MS/CM/13/15-16

Issue to M/s. _____ **P.O / Challan No. _____**

_____ **Dated _____**

_____ **Bank: _____**

Signature & Stamp of Issuing Authority

KARACHI METROPOLITAN CORPORATION

OFFICE OF THE CHIEF ENGINEER (CONTRACT MANAGEMENT)

MUNICIPAL SERVICES DEPARTMENT

Room # 409, 4th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi

No. CE (CM)/MS/KMC/316/15 **Dated:02 -11-2015**

NOTICE INVITING TENDER

Tender in sealed covers are invited for the following work from reputable firms, having experience of similar nature work:

Sr.#	Tender Reference No.	Name of Scheme	Estimated Cost	Bid Security in shape of Pay Order or Bank Guarantee in favour of KMC	Tender Cost In shape of paid Challan in favour of KMC (Non-Refundable)	Eligibility Criteria
1	2	3	4	5	6	7
1.	KMC/MS/CM/ 13/15-16	Providing and Fixing Tires & Tubes for Fire Vehicles and Allied Vehicles for Fire Brigade Department, MS, KMC.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
2.	KMC/MS/CM/ 14/15-16	Supply of Fenthion 2% Granules prevent the expansion in dengue virus in Karachi city to protect the lives of people.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant supply.** • **NTN Certificate** • **Valid GST Registration.** • **Valid Professional Tax.**
3.	KMC/MS/CM/ 15/15-16	Rate Running Contract of the work of Repair and Maintenance of Mechanical Sweepers, Tractor MF-240 and Tractor MF-385 (MPD) MS, KMC for the year of 2015-16. (Re-invite).	Offer Rate	Rs.8,00,000/-	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
4.	KMC/MS/CM/ 16/15-16	Specialized Trailer Mounted Monitor Lift (Ground Controlled) 02 Nos. for rapid intervention into narrow lines in Old City Area for Fire Fighting Purpose for Fire Brigade Department KMC. (Phase-II).	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
5.	KMC/MS/CM/ 17/15-16	Remote Controlled Trailer Mounted Lighting Towers 04 Nos. for disasters & Fire Fighting Purpose for Fire Brigade Department.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
6.	KMC/MS/CM/ 18/15-16	Modification of Grab Crane increase of Boom with Hydraulically operated etc.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
7.	KMC/MS/CM/ 19/15-16	Refurbishment of Wheel Loader Model Lie Gong-856.	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in relevant field.** • **NTN Certificate** • **Valid Professional Tax.**
8.	KMC/MS/CM/ 20/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Jam Chakro Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

9.	KMC/MS/CM/ 21/15-16	Developments of Engineered Sanitary Landfill Site for Municipal Solid Waste for Gondpass Landfill Site	Offer Rate	2% of Bid Amount	Rs. 3,000/-	• **Having experience in specific field** • **EPA Certificate valid.** • **NTN Certificate** • **Valid Professional Tax.**

TERMS & CONDITIONS

1. Tender schedule shall be as follows:

SCHEDULE	DATE & TIME	VENUE
1. Receiving of Application & Issuance of Tender	**From 12-11-2015** To **04-12-2015** During Office Hours	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
		Office of Director (Planning), F&A Department, 6th Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
		Office of Deputy Director (Accounts), Administrator Secretariat, Karachi 1st Floor, Civic Centre, Gulshan-e-Iqbal, Karachi.
2. Dropping of Tender	**07-12-2015** at **2:00 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
3. Opening of Tender	**07-12-2015** at **2:30 pm**	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.

2. The tender documents will be issued to the firms on submission of application in their original letter head alongwith original paid challan in the prescribed account of KMC for tender cost as mentioned above. This challan can be obtained from the office of tender sale as mentioned in this NIT.
3. The tender in sealed cover superscripted with the name of work should be dropped in the tender box kept in the committee room of the office of Sr. Director (Municipal Services) KMC.
4. In case the date of opening declared as a public holiday by the Government, or Non working day due to force Majeure the next official working day shall be deemed to be the date for submission and opening of tenders at the same time.
5. **Substantially Responsive Bid:-**

   Only those bids, which comply with the each eligibility & minimum qualification criteria attached with the tender documents shall be declared substantially responsive bids and will be eligible for further evaluation, otherwise the same will be declared as non responsive / rejected.
6. Bid Security of bid amount in the form of a pay order or bank guarantee from any schedule bank should be enclosed with the tender which will be retained till finalization of the case.
7. Canvassing in connection with tenders is strictly prohibited and tenders submitted by the contractors who report canvassing will liable for rejection.
8. KMC may reject all or any bids or proposals at any time prior to the acceptance of a bid or proposals, subject to the relevant provisions of SPP Rules 2010.

Sd/=
Chief Engineer (CM) MS, KMC

BIDDING DATA

A	Name of Procuring Agency:	Karachi Metropolitan Corporation (KMC)
B	Brief Description of Work:	**PROVIDING AND FIXING TIRES & TUBES FOR FIRE VEHICLES AND ALLIED VEHICLES FOR FIRE BRIGADE DEPARTMENT, MS, KMC.**
C	Procuring Agency Address:	Office of Chief Engineer (Contract Management), Municipal Services Hall No. 409, 4th Floor, Civic Center, Gulshan-e-Iqbal, Karachi.
D	Estimated Cost:	Offer Rate
E	Amount of Bid Security:	Offer Rate
F	Period of Bid validity (Days):	90 Days
G	Security Deposit (i/c Bid Security):	(10 % of Quoted Amount)
H	Percentage, if any, to be deducted from bills:	(5% to be deducted from Running Bills)
I	Deadline for submission of bid along with time:	04-12-2015 (During Office Hours)
J	Venue, Time and date of Bid Opening:	Office of Sr. Director (Municipal Services), Hall No. 3, Adjacent 134 Help Line, Ground Floor, KBCA Building, Civic Centre, Gulshan-e-Iqbal, Karachi.
K	Liquidity Damages:	
I	Deposit Receipt No. Date & Amount:	

KARACHI METROPOLITAN CORPORATION

Bank Deposit Challan

MUNCIPAL SERVICES DEAPRTMENT, KMC

The Manger,
Habib Bank Ltd,
KMC Branch

BANK CODE	0	1

BANK ACCOUNT NO.	2	6	0	4	-	5	7		

DATE

BRANCH CODE	0	0	1	5

BANK ACCOUNT CODE	5	7

BANK BRANCH Please receive the amount as noted below for credit to the account of KMC mentioned above and as specified here below:-

Depositor's Name & Address	Particulars (To be filled up by Department)	☐ Cheque / Pay Order / Demand Draft			Amount
		Name of Bank	No.	Date	Rs.
M/s	Deposit of tender Cost Fee for the work of PROVIDING AND FIXING TIRES & TUBES FOR FIRE VEHICLES AND ALLIED VEHICLES FOR FIRE BRIGADE DEPARTMENT, MS, KMC. Tender Enquiry # **KMC/MS/CM/13/15-16** To be opened on 07-12-2015				
		☐ **Cash Rs.**			
				Total	

Rupees in Words _____

Note: It is valid if to be deposited on or before the last date of sale of tender as mentioned in the NIT or its corrigendum, if any. If the same are furnished on the given date of sale in the office of the tender issuing authority, the tender will be issued.

Bank Stamp

Signature Bank Cashier

Signature of Depositor

Signature with stamp
Accountant/Assistant Accounts Officer
Drawing & Disbursing Officer

Signature Bank Officer

CHALLAN NO.

PRICE SCHEDULE

SUBJECT: - PROVIDING AND FIXING TIRES & TUBES FOR FIRE VEHICLES AND ALLIED VEHICLES FOR FIRE BRIGADE DEPARTMENT, MS, KMC.

Sr. #	Description	Qty	Unit	Tire Size	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6	7	8
A.	**Central Fire Station**						
1	ISUZU SNORKEL	10	Nos	10.00-20 (General Make)			
2	VEMA SNORKEL 02	10	Nos	11.00-22 R 5 (Japan Make)			
3	HINO FOAM UNIT	6	Nos	10.00-20 (General Make)			
4	ISUZU RESCUE	6	Nos	10.00-20 (General Make)			
5	HINO RESCUE 03	6	Nos	10.00-20 (General Make)			
6	MERCEDES RESCUE	10	Nos	10.00-20 (General Make)			
7	VOLVO BREAKDOWN	6	Nos	12.00-20(General Make)			
8	ISUZU BREAKDOWN	4	Nos	10.00-20 (General Make)			
9	COMMAND VEHICLE	6	Nos	6-50-14 (General Make)			
10	HINO GV 47	10	Nos	10.00-20 (General Make)			
11	ISUZU T 02	6	Nos	11.00-22 R 5 (Japan Make)			
12	IVECO FT 32	6	Nos	11.00-22 R 5 (Japan Make)			
13	HINO FT 02	6	Nos	10.00-20 (General Make)			
14	HINO FT 03	6	Nos	10.00-20 (General Make)			
15	GL-7680 (High Roof)	4	Nos	450-12			
16	GL-6199 (High Roof)	4	Nos	450-12			

Sr. #	Description	Qty	Unit	Tire Size	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6	7	8
B	**SADDAR FIRE STATION**						
17	IVECO FT 08	6	Nos	11.00-22 R 5 (Japan Make)			
18	HINO FT 06	6	Nos	10.00-20 (General Make)			
19	GS-3076 (Carry)	4	Nos	450-12			
C	***NAZIMABAD FIRE STATION***						
20	HINO FT 01	6	Nos	10.00-20 (General Make)			
21	IVECO FT 17	6	Nos	11.00-22 R 5 (Japan Make)			
22	IVECO FT 26	6	Nos	11.00-22 R 5 (Japan Make)			
23	GL-5246 (Mazda)	4	Nos	650-14			
D	***LYARI FIRE STATION***						
24	IVECO FT 10	6	Nos	11.00-22 R 5 (Japan Make)			
25	IVECO FT 16	6	Nos	11.00-22 R 5 (Japan Make)			
26	HINO FT 403	6	Nos	10.00-20 (General Make)			
E	***SITE FIRE STATION***						
27	IVECO FT 03	6	Nos	11.00-22 R 5 (Japan Make)			
28	IVECO FT 24	6	Nos	11.00-22 R 5 (Japan Make)			
29	IVECO FT 34	6	Nos	11.00-22 R 5 (Japan Make)			
30	HINO FT 502	6	Nos	10.00-20 (General Make)			
31	HINO WATER BOUZER 03	22	Nos	11.00-20(General Make)			
32	GL-5102 (Mazda)	4	Nos	650-14			
F	***KORANGI FIRE STATION***						
33	IVECO FT 12	6	Nos	11.00-22 R 5 (Japan Make)			

Sr. #	Description	Qty	Unit	Tire Size	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6	7	8
34	IVECO FT 15	6	Nos	11.00-22 R 5 (Japan Make)			
35	HINO FT 46	6	Nos	10.00-20 (General Make)			
36	HINO FT 604	6	Nos	10.00-20 (General Make)			
37	HINO WATER BOUZER 02	22	Nos	11.00-20 (General Make)			
38	GL-2244 (High Roof)	4	Nos	450-12			
G	**LANDHI FIRE STATION**						
39	IVECO FT 22	6	Nos	11.00-22 R 5 (Japan Make)			
40	IVECO FT 39	6	Nos	11.00-22 R 5 (Japan Make)			
41	HINO FT 04	6	Nos	10.00-20 (General Make)			
42	HINO WATER BOUZER 04	22	Nos	11.00-20 (General Make)			
43	GL-5227 (High Roof)	4	Nos	450-12			
44	GL-7089 (High Roof)	4	Nos	450-12			
H	***GULISTAN MUSTAFA FIRE STAITON***						
45	IVECO FT 09	6	Nos	11.00-22 R 5 (Japan Make)			
46	HINO FT 05	6	Nos	10.00-20 (General Make)			
47	HINO FT 005	6	Nos	10.00-20 (General Make)			
48	HINO WATER BOUZER 01	22	Nos	11.00-20 (General Make)			
49	ISUZU T 01	10	Nos	11.00-22 R 5 (Japan Make)			
50	GL-6220 (High Roof)	4	Nos	450-12			
I	***ORANGI FIRE STATION***						
51	IVECO FT 31	6	Nos	11.00-22 R 5 (Japan Make)			

Sr. #	Description	Qty	Unit	Tire Size	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6	7	8
52	IVECO FT 35	6	Nos	11.00-22 R 5 (Japan Make)			
53	GL-5189 (Mazda)	4	Nos	650-14			
J	***SHAH FAISAL FIRE STATION***						
54	IVECO FT 20	6	Nos	11.00-22 R 5 (Japan Make)			
55	IVEOC FT 36	6	Nos	11.00-22 R 5 (Japan Make)			
56	IVEOC FT 37	6	Nos	11.00-22 R 5 (Japan Make)			
57	GL-5021 (High Roof)	4	Nos	450-12			
K	**MANZOOR COLONY FIRE STATION**						
58	IVECO FT 01	6	Nos	11.00-22 R 5 (Japan Make)			
59	GS-9061 (Hi-Lux)	4	Nos	650-14			
L	**NEW KARACHI FIRE STATION**						
60	IVECO FT 06	6	Nos	11.00-22 R 5 (Japan Make)			
61	IVECO FT 14	6	Nos	11.00-22 R 5 (Japan Make)			
62	HINO FT 1202	6	Nos	10.00-20 (General Make)			
63	GS-3060 (Carry)	4	Nos	450-12			
M	**BALDIA TOWN FIRE STATION**						
64	IVECO FT 18	6	Nos	11.00-22 R 5 (Japan Make)			
65	KFB-104 (Hi-Lux)	4	Nos	650-14			
N	**ERC FIRE STATION**						
66	HINO FT 1602	6	Nos	7-50-16 (General Make)			
67	HINO SMALL WATER BOUZER 1402	6	Nos	11.00-20 (General Make)			
68	GL-6219 (High Roof)	4	Nos	450-12			
O	**NEW TRUCK STAND**						

Sr. #	Description	Qty	Unit	Tire Size	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6	7	8
69	IVECO FT 02	6	Nos	11.00-22 R 5 (Japan Make)			
P	**BOULTON MARKET**						
70	HINO FT 1002	6	Nos	7-50-16 (General Make)			
71	GL-3273 (Potohar)	4	Nos	600			
Q	**GULISTAN JOHAR FIRE STATION**						
72	IVECO FT 19	6	Nos	11.00-22 R 5 (Japan Make)			
73	IVECO FT 27	6	Nos	11.00-22 R 5 (Japan Make)			
74	GL-7674 (High Roof)	4	Nos	450-12			
R	**CATTLE COLONY FIRE STATION**						
75	IVECO FT 25	6	Nos	11.00-22 R 5 (Japan Make)			
S	**CIVIC CENTER FIRE STATION**						
76	IVECO FT 23	6	Nos	11.00-22 R 5 (Japan Make)			
77	GL-8604 (Carry)	4	Nos	450-12			
78	GL-5190 (Mazda)	4	Nos	450-12			
T	**MALIR FIRE STATION**						
79	IVECO FT 28	6	Nos	11.00-22 R 5 (Japan Make)			
80	IVECO FT 38	6	Nos	11.00-22 R 5 (Japan Make)			
81	IVECO FT 40	6	Nos	11.00-22 R 5 (Japan Make)			
82	HINO FT 11	6	Nos	7-50-16 (General Make)			
83	GL-3005 (Potohar)	4	Nos	700			
U	**GULSHAN-E-IQBAL FIRE STATION**						
84	IVECO FT 29	6	Nos	11.00-22 R 5 (Japan Make)			
85	161-316 (High Roof)	4	Nos	450-12			

Sr. #	Description	Qty	Unit	Tire Size	Rate in Figure	Rate in Word	Amount
1	2	3	4	5	6	7	8
V	**GULSHAN-E-MAYMAR FIRE STATION**						
86	IVECO FT 33	6	Nos	11.00-22 R 5 (Japan Make)			
87	HINO RESCUE 04	6	Nos	10.00-20 (General Make)			
88	HINO RESCUE 05	6	Nos	10.00-20 (General Make)			
89	HINO RESCUE 06	6	Nos	10.00-20 (General Make)			
90	GL-7674 (High Roof)	4	Nos	450-12			
Total amount of Word :-							

Checked & Verified by
Project Engineer (FB) MS, KMC.

I/We quoted the price schedule and bound ourselves to comply all terms and conditions of this contract with all existing rules and regulations of KMC and I have attached an Bid Security in shape of Pay Order / Bank Guarantee No. _____

(Pay Order / Bank Guarantee)

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Amounting Rs._____ in favour of Karachi Metropolitan Corporation (KMC).

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v. Satisfactory Commutative Work Experience