Detailed Process Description

For

Remediation of Existing Legacy Dumps in Goa

1. General:

The state of Goa admeasures 3,702 square Km of which more that one third of the land is afforested area. Goa has a coastline of about 110 Km. The availability of land for the use of waste management is scarce and acquisition of land for this specific purpose is very difficult.

The State Government, understanding the various problems faced in identifying lands for setting up of waste management facilities took a conscious decision of utilizing legacy dump areas to set up its waste management's facilities.

In the first phase two main sites were identified for setting up state of art integrated solid waste management facilities. The first site identified was in Saligao/North Goa and the second site was at Cacora in South Goa.

2. Description of the legacy waste Dumps

SN	Description	North Goa	South Goa
1.	Location of Dump Site	Saligao/Calangute	Cacora
2.	Area Details	Survey No.: 47/1 (Part)	Survey No.: 167/168
3.	Area of Dump site	29,000 m2	11,961 m2
4.	Estimated Volume of waste.	80,437 m3	~ 30,000 m3

Photographs of Dump sites

Img. 1: Saligao/Calangute dump site

Img. 2: Cacora Dump Site

3. Detailed Process:

The State Government constituted an Expert Committee to assist in the construction of the integrated solid waste management facilities (SWMF) under the Chairmanship of Padmashree Dr. Sharad Kale. The constitution of the committee is as under:

1.	**Dr. Sharad Kale**	Head, Technology Transfer & Collaboration Division, Bhabha Atomic Research Centre, Mumbai	Chairman
2.	**Dr. Munish K. Chandel**	Associate Professor, Centre For Environment Science & Engineering, IIT, Mumbai	Member
3.	**Dr. Shrikant Mutnuri**	Associate Professor, BITS Goa Campus	Member
4.	**Dr. A. N. Vaidhya**	Senior Principal Scientist, Solid & Hazardous Waste Management Division, CSIR-NEERI, Nagpur	Member
5.	**Dr. Mahendra Patil**	Principal Scientist, Solid & Hazardous Waste Management Division, CSIR-NEERI, Nagpur	Member

OFFICIAL MEMBERS

7.	**Shri. Sandip K. Prabhu Chodnekar**	General Manager (Engineering-II), Goa State Infrastructure Development Corporation	Member Secretary

8.	**Shri. Sanjeev Joglekar**	Environmental Engineer, Goa State Pollution Control Board	Member
9.	**Shri. Dominic Fernandes**	Officer on Special Duty Solid Waste Management Department of Science & Technology	Member

Img. 3: Expert Committee conducting tests at Saligao/Calangute dump site

The proposed remediation process was vetted by the Committee and its suggestions were incorporated. Preliminary trial runs for remediation were conducted at site, by using a mobile Multi Deck Vibratory Screen and Conveyor Mechanism, wherein the waste was screened using 120 mm, 40 mm and 15 mm Screens. Various tests were conducted at NABL / MoEF&CC accredited labs to test the composition of the compost and finalise the method of final disposal of the compost. The over fractions primarily comprised plastic, clothes and inorganic

Refuse Derived Fuel (RDF) fractions and the under fractions were earth material.

The conclusions of the Expert Committee Meeting were as under:

1. The existing dumped waste primarily comprises of plastics and earth material. This waste was screened at the dump location only.
2. A mobile multi deck vibratory screen was used to separate the various fractions, which was tested and analysed.
3. The separated fractions can be stored at one location at the site. The compost can be either provided to the social forestry or can be put to suitable use based on the characteristics of the compost as decided by the Dept. of Science, Technology & Environment/Goa State Pollution Control Board.
4. Regarding the monsoon cover, the expert committee approved both, geo-membrane bentonite liner or Polyethylene as optional methods to cover the dump prior to the monsoon period. As per DST&E's approval, a Bentonite Liner has been considered.

Remediation Methodology of existing Municipal Solid Waste:

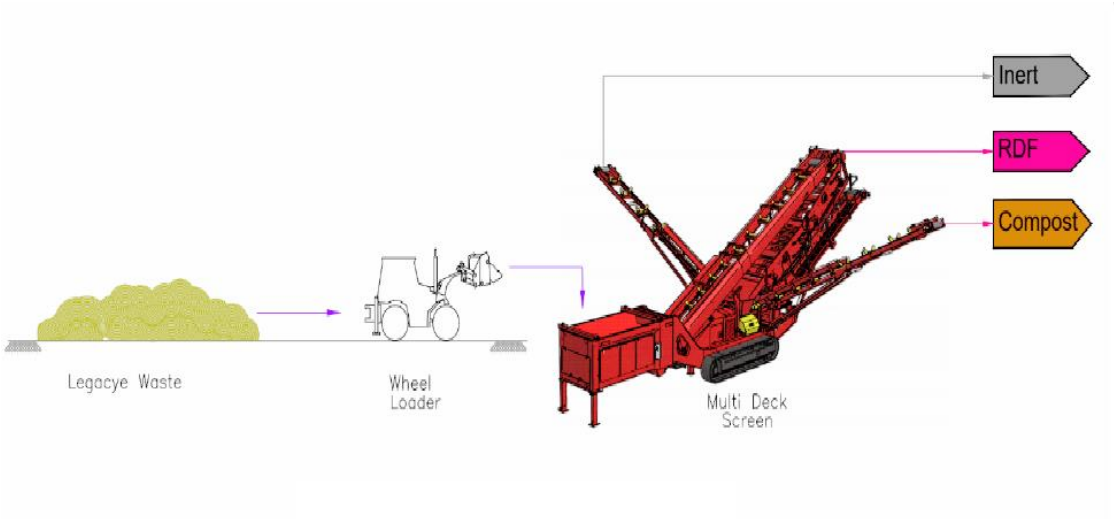
Img-4: Mobile Screen screening the existing Dump at Site

The existing Solid Waste was remediated by mobile "Multi Deck Vibratory Screen and Conveyor Mechanism". It has multiple Screen Decks having Opening as 120 mm, 40 mm and 15 mm. The existing waste was loaded into the Machine by a Wheel Loader / Crawler Dozer. The waste was then screened and separated into the four fractions as described below:

1.	Over fraction of 120 mm Screen	mainly comprising rags, textile and clothes etc
2.	Under fraction of 120 / 40 mm Screen	mainly non-recyclable plastic
3.	Over fraction of 40/15 mm Screen	mainly stones & gravel
4.	Under fraction of 15 mm Screen	mainly inert earth material and soil conditioner / compost

The screen was operated during the non-monsoon period. It was ensured that fresh waste was not dumped in the areas where waste was being remediated.

Both Items 1 & 2 are primarily Refuse Derived Fuel (RDF) and was sent to the Cement Companies for co-processing and Items 3 & 4 was used as a Soil Conditioner / Compost for non-food agricultural trees / social forestry usage. The sample of compost was analysed and test reports are annexed.



Img 5: Process Flow Diagram for remediation of legacy waste

COMPOST: 25% to 30%	RDF: 50% to 60%	Inerts 10% to 15%
Compost utilized within the MSW facility	High calorific material (plastic, paper, cloth etc.) Alternative fuel (to be sent to cement factories for co-incineration etc.)	Inert heavy material, sand, stones, grit etc used to reclaim the low lying area within the plant site.

4. Pre- monsoon Cover of the existing Dumped Waste:

The balance waste was pushed and shaped at one side of the site. It was compacted and covered by a Geo-membrane Bentonite Liner (Specifications enclosed as **Annexure-3**), which prevented any water ingress in to the same. All along the dumped waste, temporary roads were created for proper access and garland drains were made to allow the rain water to be diverted to the main storm water drain.

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Test Report

ISSUED TO:
Hindustan Waste Treatment Pvt Ltd
Phoenix Estate, 2nd Floor, S-18,
Eastern Bypass Road, Gogal
Margaon-403601
Goa INDIA
Ph:
KIND.ATTN. : .

Report Number : 29170/15/VLL/000/02
Issue Date : 2016-03-16
Your Ref : WO NO:INT/VLL/100TPD MSW PROJECT NORTH GOA/15
and Date : 2016-02-15

Sample Particulars: COMPOST

Sample Received date : 2016-02-24 Sample Registration Date : 2016-02-26
Analysis Starting date : 2016-02-27 Analysis Completion date : 2016-03-11
Quantity:1No Packed in Polyethylene Cover.
Sample ID:COMPOST,15 MM SCREEN OVER FRACTION.
Test Required:As,Cd,Cr,Cu,Pb,Hg,Ni,Zn,C/N ratio,PH,Moisture,Bulk density,Total organic Carbon,Total nitrogen,Total Potassium as K2O,Total Phosphorous as P2O5,Colour,Odour,Conductivity and Sieve(4mm) Analysis
SAMPLE TESTED AS RECEIVED BASIS LAB REF NO:SF/NAG/0238130

TEST RESULTS

Sl. No	Test Parameters	Unit of Measurement	Result
1	Odour	.	No foul odour
2	Colour	.	Brown
3	Moisture	%	6.80
4	Bulk Density	gm/cc	0.9930
5	Total organic Carbon	%	21.99
6	Total Nitrogen as N	%	0.41
7	Chromium as Cr	mg/Kg	275.79
8	Nickel as Ni	mg/Kg	15.34
9	Lead as Pb	mg/Kg	60.04
10	Cadmium as Cd	mg/Kg	2.60
11	Mercury as Hg	mg/Kg	<1.0
12	Total phosphorous as P2O5	%	0.57
13	Potassium as K2O	%	0.47
14	PH(5% Solution)	.	8.37
15	C/N ratio	.	53.63
16	Passing through 4.0 MM	%	3.45
17	Copper as Cu	mg/Kg	47.73
18	Arsenic as As	mg/Kg	51.31
19	Zinc as Zn	mg/Kg	89.80
20	Conductivity(5% Solution)	dsm-1	3.23

Method of Testing : As per AOAC 17th Edition and Fertilizer(control)order 1985 and ASTM E828
Instrument Used:ICP-AES.

Remarks : This is a revised report, supersedes previous test report bearing no. 29170/15/VLL/000/02, dated 2016-02-15 with copy numbers 426530, 870027, 870028. This revised report is issued as per customer request for address correction .

Srinivasa Rao Ghanta
Sr.Manager Analytical

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Test Report

ISSUED TO:
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Page 1 of 1

Sample Particulars: COMPOST

Sample Received date : 2016-02-24 Sample Registration Date : 2016-02-26
Analysis Starting date : 2016-02-27 Analysis Completion date : 2016-03-11
Quantity:1No Packed in Polyethylene Cover.
Sample ID:COMPOST,15 MM SCREEN UNDER FRACTION.
Test Required:As,Cd,Cr,Cu,Pb,Hg,Ni,Zn,C/N ratio,PH,Moisture,Bulk density,Total organic Carbon,Total nitrogen,Total Potassium as K2O,Total Phosphorous as P2O5,Colour,Odour,Conductivity and Sieve(4mm) Analysis.
SAMPLE TESTED AS RECEIVED BASIS LAB REF NO:SF/NAG/8238120.

TEST RESULTS

Sl. No	Test Parameters	Unit of Measurement	Result
1	Odour	-	No foul odour
2	Colour	-	Blackish brown
3	Moisture	%	11.15
4	Bulk Density	gm/cc	0.8825
5	Total organic Carbon	%	9.24
6	Total Nitrogen as N	%	0.37
7	Chromium as Cr	mg/Kg	274.05
8	Nickel as Ni	mg/Kg	19.58
9	Lead as Pb	mg/Kg	25.94
10	Cadmium as Cd	mg/Kg	2.24
11	Mercury as Hg	mg/Kg	<1.0
12	Total phosphorous as P2O5	%	0.44
13	Potassium as K2O	%	0.64
14	PH(5% Solution)	-	8.33
15	C/N ratio	-	24.97
16	Passing through 4.0 MM	%	65.70
17	Copper as Cu	mg/Kg	87.16
18	Arsenic as As	mg/Kg	36.29
19	Zinc as Zn	mg/Kg	149.37
20	Conductivity(5% Solution)	dsm-1	1.34

Method of Testing : As per AOAC 17th Edition and Fertilizer(control)order 1985 and ASTM E828.
Instrument Used ICP-AES.

Remarks : This is a revised report, supersedes previous test report bearing no. 29170/15/VLL/000/01, dated 2016-02-15 with copy numbers 426529, 870005, 870026. This revised report is issued as per customer request for address correction.

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Sr.Manager Analytical

Photos of Legacy Waste Site in Calangute/ Saligao, North Goa

Img. 6: Old legacy Waste at Calangute/ Saligao

***Img. 7*: Remediated site and SWTF at Calangute/ Saligao**

Photo of Legacy waste site at Cacora, South Goa.

Img. 8: **Legacy waste site at Cacora**

Further GWMC has undertaken remediation of following sites as received from DMA and is following the same remediation process as adopted at Saligao & Cacora dump sites

Sr. No.	Name of the Local Body	Location of dump	Status of Work
1	Corporation of the City of Panaji	Campal- Attachment Point No. 290	Completed
2	Corporation of the City of Panaji	Behind SBI, EDC, Patto- attachment Point No. 287	Completed
3	Corporation of the City of Panaji	Near Divja Circle, Panaji- Attachment Point No. 288	Completed
4	Margao Municipal Council	Sonsoddo dump site, Margao	Work in progress
5	Mormugao Municipal Council	Headland Sada dump site, Mormugao	Remediation Completed, RDF disposal in progress
6	Mapusa Municipal Council	Assagao Dump site, Mapusa	Remediation Completed
7	Cuncolim Municipal Council	Dumpsite at Cuncolim IDC	Remediation Completed, RDF disposal in progress
8	Canacona Municipal Council	Dumpsite at Garbage Treatment Plant at Dumane Shristhal	Work in progress
9	Corporation of the City of Panaji	Curca- Attachment Point No. 289	To be commenced
10	Bicholim Municipal Council	Adjacent to the garbage Treatment Plant, Lakherem in Sy. No.109/0.	Work in progress
11	Pernem Municipal Council	At garbage Treatment Plant of Pernem Municipal Council	Remediation Completed