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"Kachre se kanchan tak" A Novel idea of Maha-Metro Rail Corporation (Pune Metro Rail Project) that has reclaimed the dumpsite legacy waste and reused the received soil in backfilling to conserve the virgin soil resource

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ABSTRACT

Land is scarce commodity in urban context. It is estimated that more than 10,000 hectares of urban land is locked in Indian dumpsites. Pune Metro Rail Project has been allocated one of such dumping site (Kothurd) to construct the depot for serving the East-West Corridor. The land area of Kothurd dumping site spreads over 12.2 hectares and predominantly filled with Municipal Solid waste heaped in 10 to 12 meters height, home for pigs, stray dogs and rodents. This area is also surrounded by the residential /commercial complex posing an environmental hazard to nearby residents. This article presents that how Maha-Metro, Pune Metro Rail Project has reclaimed a three decades-old garbage dumpsite with in-house effort and converted into state of art depot and unencumbered all nearby residents from ill effects of dumping site. Reclamation of kothurd dumpsite having huge quantities of decades-old garbage (aged waste or legacy waste) in an environmentally sound manner was a challenge. Maha Metro Pune Metro Rail Project took this challenge and formulated strategy for reclamation of this dumpsite. The emphasis was to conserve the virgin soil resource and to maximum reuse of earth soil to meet the backfilling requirement at various ongoing Metro Construction sites. Environment Management Division (EMD) of Pune Metro Rail Project has conducted some primary studies to understand the waste composition, organic content etc. and visited Mulund dumping site on 30.4.2019 to understand the aged/legacy waste reclamation process prescribed under Municipal Solid Waste Management Rules 2016. Primary studies on compositional analysis reveals that legacy waste consist 14 % biodegradable material, 39% recyclable (RDF- Paper card board, textile rags, plastic, rubber etc.). 8% recyclable (Non-RDF- glass metal etc.) and 39% Inert Construction & Demolition material. However, organic analysis of the waste reveals that waste was fully degraded and converted into soil like compost through natural process. The heavy metal analysis of legacy waste indicates that all the parameters are within the permissible limit (Schedule II, SWM Rules 2016) and could be effectively reused in gardening, landscaping, green belt development and median plantations. Further, the possibility of using the received soil in back filling was also explored and a lab test was carried out to understand the quality of soil. The result reveals that soil is meeting the quality criteria of IS standards can be effectively reused in backfilling at various ongoing Metro construction sites.

Keywords *-Kachra Depot, Open Dumps, Aged/legacy Waste, Environmental Hazard, Backfilling*

1. INTRODUCTION

After three decades of use, the Kothurd open dumps have grown larger, higher and became huge point sources of pollution. The heaps of garbage produced methane, a greenhouse gas that causes 21 times more global warming than carbon dioxide. Methane often auto-ignites, causing fires, generating smoke and emissions thereby severe air pollution, decreased the quality of life of nearby residents and the local community. A pictorial and Google view of Kothrud kachara dumping site can be seen below snaps.

Figure 1: View of garbage heap at Kothurd Dumping Site

The objective of present study was intended to assess the feasibility of: 1) Quality of sieved soil that can be reused in earth fill/backfilling. 2) Quality of soil that can be reused as a manure in gardening, landscaping, green belt development and transplantation of trees.

The primary studies conducted by Environmental Expert of Environment Management Division (EMD), Pune Metro Rail Projects reveals that soil received from various sieving process confirms the quality parameters and can be effectively reused in backfilling at various ongoing Metro construction sites. The soil also confirms the quality criteria of compost as prescribed in Schedule II of MSW Management Rules, 2016, and could be effectively reused in gardening, landscaping, green belt development and median plantations.

2. MATERIALS AND METHODS

In the course of this work, the reuse potential of soil of Kothurd dumping site was investigated. The scope of this investigation contained the steps of excavation, sampling and some preliminary field and laboratory analysis.

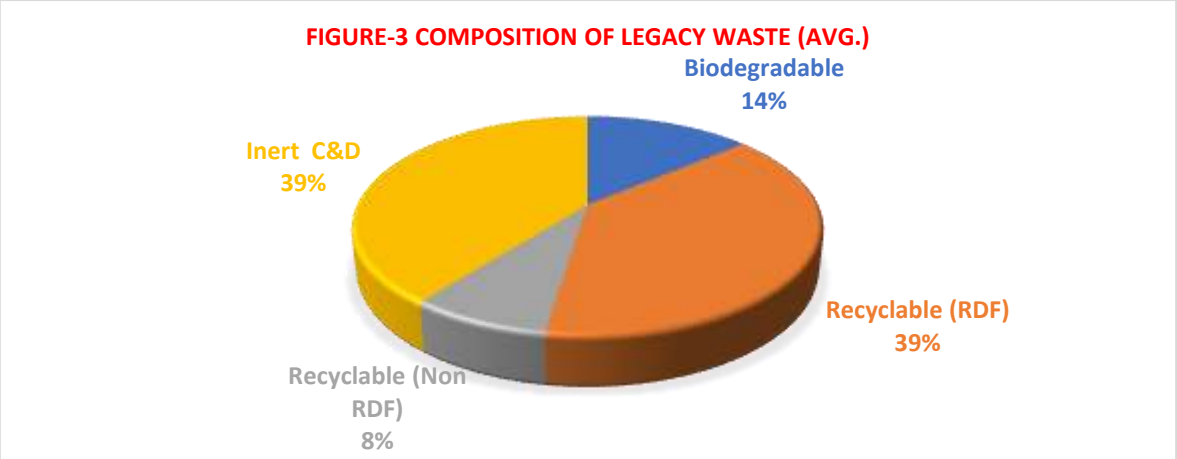
Site Description and Sampling Details

The material used in the current study picked from the Kothurd dumpsite located at Pune. The samples were collected between 2nd and 3nd week of April 2019 from the location as shown in **Figure 2**. Samples were taken from a depth of 3–5m from dumpsites as presented in **Figure 1**. All the collected samples were sealed in separated pre-cleaned polythene bags and sent to NABL/MOEF accredited lab for analysis.

Figure 2: Location of Kothrud Dumping Site

Compositional Analysis

After picking, samples from the dumping site a compositional analysis were carried out. The results reveals that legacy waste consist 14 % biodegradable material, 39% recyclable (RDF- Paper card board, textile rags, plastic, rubber etc.). 8% recyclable (Non-RDF-glass metal etc.) and 39% Inert Construction & Demolition material. The physical composition of the legacy waste is presented in **Figure-3**.

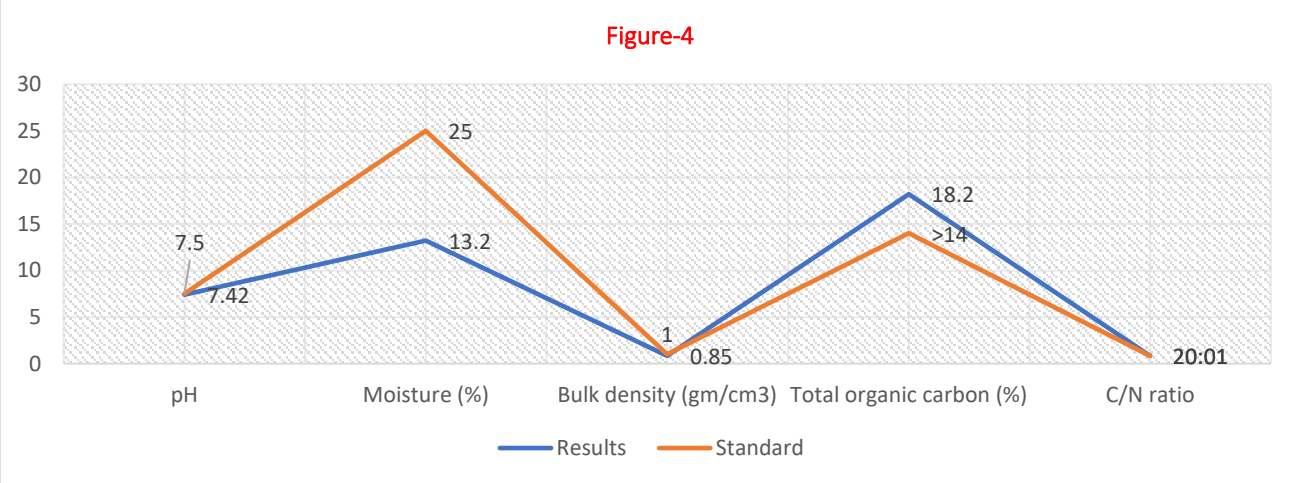


Chemical Analysis

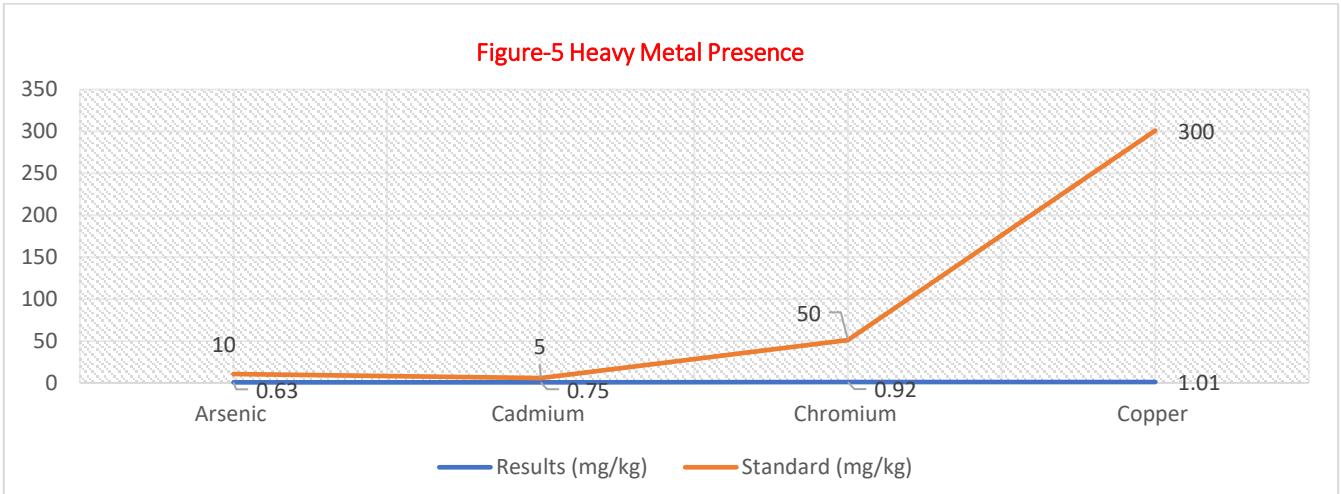
The lab tests was carried out to determine the pH, moisture content, bulk density, total organic carbon, heavy metal etc. The received values are presented in below **Table-1** and **Figure-4**

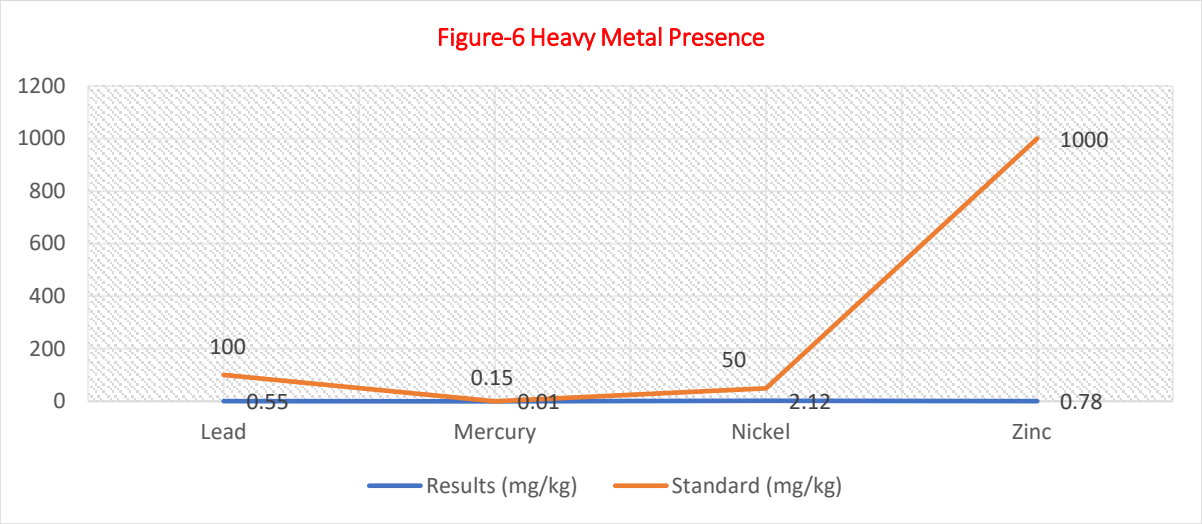
Table 1: Test Result of Legacy Waste Collected from Site

S.No.	Parameters	Results	Unit	Limit as per MSW Compost
1.	pH	7.42	-	6.5-7.5
2.	Moisture Content by weight Max.	13.2	%	25
3.	Bulk Density	0.85	gm/cm^3	1
4.	Total Organic Carbon by weight Min.	18.4	%	>14
5.	Total Nitrogen by weight Min.	0.92	%	>0.8
6.	Total Phosphate by weight Min	0.55	%	>0.4
7.	Total Potassium by weight Min	0.78	%	>0.4
8.	C/N ratio	20	-	20:1



The collected sample were also analysed for heavy metals content. The received results are presented below **Figure 5, 6**.





The results presented in above table -1, Figure 4, 5, 6 confirms the FCO 2009 compost specification and can be effectively reused in gardening, landscaping, green belt development and median plantations as manure.

Further, Sieved soil was analysed in lab in accordance with MoRTH 5th Revision, Section 305 specification and result reveals that quality of material is suitable for using as an embankment soil/ back filling at various ongoing Metro construction sites. The results of the Soil analysis are presented in **Table -2**

Table 2: Test Result of Soil collected from site

S.No.	Parameters	Results	MoRTH Speci.	Technical Reference
	pH	7.5- 7.9	-	California Test 422- April -200, IS 2720 (Part 26)-1987(RA-2016) IS 2720 (Part 27)-1977 (RA-2015), S 2720 (Part 22)-1972(RA-2010)
	Chloride % by Mass	0.036	-	
	Sulphate as SO_3 % by Mass	0.074	0.5 %	
	Organic Impurities % by Mass	3.06	-	

Based on the study findings Maha-Metro through its contractors has started mechanical segregation/sieving of the legacy waste. Following method were applied to segregate/sieve the soil and other material.

Use of vibratory machine: At the beginning, vibratory machine of screen size 750 mm x 1500 mm with a sieve size of 10 mm was used which successfully sieved the Bio Earth/ soil. However, the material like plastics, rubber, leather and C&D waste left on the screen need to be cleaned manually hence this could not be a feasible option to deal such large quantity of legacy waste.

Use of Bed/Pit type of machine: Based on the experience of vibratory machine use, second Bed/Pit type machine was engaged and JCB was deployed for pouring of garbage into the sieve and sieved material was collected in a pit. This machine had a rated capacity of 30 cubic meters per hour but could only provide efficiency of 8-10 cubic meters per hour. This is due to 60% soil presence in sieved material. The pit also required frequent cleaning for which the machine needed to be shut down hence this option of sieving was also abandoned. The process of sieving by both of the machines are shown in **Figure 7** and **8**.

Fig 7: Vibratory machine

Fig 8: Pit type machine

Fig 9: Mechanical Segregation/sieving

After due deliberation a conveyor type of screening machine was arranged. The rated capacity of the machine was 40 cubic meters/hours. This machine has an advantage over other machines are that the screened material is brought out through the conveyor and did not pose any handling risk hence this machine was opted for sieving of entire legacy waste. The process of sieving/segregation by the opted machines are shown in **Figure 9**.

Fig 10: Picking of Valuable Material by Rag pickers

During screening/Sieving phase, scavengers were also invited to collect anything of value to them. The picking of valuable material by rag pickers is shown in **Figure 10**

3. CONCLUSION

Following are the conclusions drawn after performing lab tests on aged MSW.

- 50-53% of the sieved material from kothurd dumpsite appears to be soil-like material
- Sulphate as SO_3 were found within permissible limit like other soil.
- Heavy metal i.e. Arsenic, Chromium, zinc, Lead, Mercury and Nickel content in soil are within permissible limit.
- Total Organic Carbon, Nitrogen, Phosphate, Potassium and CN ratio meets the Solid waste compost criteria.

Based on above findings it was concluded that the soil received from dumpsite meets the embankment soil/ back filling soil criteria and could be effectively reused in backfilling. Further, the received soil also meet the compost criteria and can be suitably reused as manure in gardening, landscaping, green belt development, median plantations and Trees transplantation sites.
Maha-Metro, pune Metro Rail Project has utilized this opportunity and reused the maximum soil in backfilling at various ongoing Metro construction sites apart from using it as a manure at various trees transplantation sites. This has not only preserved the virgin soil resource but also extended relief to local community in terms of dumpsite ill effects and finally the place which was a home for rats, flies, bacteria, mosquitoes having potential to cause human diseases is being converted into state of art depot with target of platinum rating green buildings.

4. REFERENCES

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[3] Central Public Health and Environmental Engineering Organisation (CPHEEO) Advisory on Landfill Reclamation.

