Improving waste landfilling practices in Africa: the case of Maputo

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INTRODUCTION

Maputo, the capital city of Mozambique, has a population of 1.1 million and collects about 1200 t/d of municipal solid waste. Presently, all municipal solid waste collected is disposed at the Hulene landfill, located 8 km away from the city center in a densely populated area.Mozambican legislation enacted in 2014 sets that all open dumps should be closed but given that the construction of the new sanitary landfill that will serve Maputo is yet so start, the Hulene landfill remains as the only option for the disposal of the municipal solid waste collected daily. However, inadequate landfill operation practices and heavy rain led to a major slope failure in the west face in 2018, resulting in 17 casualties. To improve the site conditions, the Ministries of Environment of Mozambique and Japan agreed on Japanese landfill technology transfer, through the implementation in part of the dumpsite of a pilot-project on landfill rehabilitation measures based on the so-called “Fukuoka Method” concept, a semi-aerobic waste landfill technology.

The Fukuoka Method is widely used in Japan and many Southeastern Asian countries for the construction of new landfills. However, cases of rehabilitation of landfills/dumpsites in developing countries are rare, especially in the academic literature; this paper aims to contribute to filling this knowledge gap.

MATERIALS AND METHODS

Target landfill site

The Hulene landfill is located in a densely populated area of Maputo (lat. -25.09 long. 32.59), covering an area of 17 ha. It is estimated to have accumulated between 1.7 to 2.5 million tons of waste since its operation started in 1973, with the west and south sides having an average height of 30 m above ground level. In addition to lack of an engineered bottom liner, as of 2018, the landfill did not have soil cover, nor leachate and gas collection and treatment systems. Regarding waste disposal practices, following unloading from collection vehicles, waste was pushed over the brink of the top slope without any compaction, creating more space on top for further waste placement while making slopes with a gradient over 45 degrees. Additionally, fires were observed on the surface of the waste at several places, caused either by waste pickers working in the landfill or by natural combustion.

Slope failure and remediation measures

After the shear failure on the west side of the landfill occurred on 19 February 2018, the Japanese technical assistance team dispatched estimated that the above-mentioned inadequate landfill operation practices as well as the potential build-up of landfill gas resulted into a low-density waste mass, whose collapse was triggered by the continuous heavy rain of previous days. As the risk of further slope failures remained, the Japanese team

proposed the implementation of improvement measures based on slope stabilization engineering works, promotion of waste decomposition through the Fukuoka Method, and appropriate landfill operation practices.

The Fukuoka Method can be explained as a system where the leachate and landfill gas are continuously removed from the waste mass through leachate collection and gas venting systems, with engineering designs that allow for ambient air to flows into the waste body naturally through the leachate collection pipes and venting pipes. The continuous natural flow of ambient air allows for aerobic decomposition within the waste mass, resulting in increased leachate quality due to suppression of acid accumulation and lower ammonia nitrogen and COD.

RESULTS AND DISCUSSION

Engineering and the Fukuoka Method related works lasted from November 2019 to July 2020 and consisted of 150 m of slope correction using terraces to guarantee slope angle of 1:3, installation of gas venting pipes, installation of leachate collection system and a simplified leachate treatment/evaporation pond. Operation practices included knowledge transfer on appropriate waste disposal using work faces and waste cells, maintenance of access roads, and adaptation of elements of the Fukuoka Method using low-cost material and or waste found in the site. The interventions and knowledge transfer resulted in improved security in the collapsed area and now serve as a basis for expansion of improvements across the whole landfill.

Figure - Landfill before (left) and 1 month after slope failure (center), and after rehabilitation (right)

CONCLUSION

Using the Hulene landfill in Maputo as a case study, this work aimed at showing how the Fukuoka Method can be applied to existing landfills to improve their security in a situation of limited resources. It is hoped that local authorities will continue to implement the appropriate landfill practices based on the Fukuoka Method not only across the Hulene Landfill, but also in other landfills and dumpsites in similar condition.

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REFERENCES

Maputo City Council, Plano Diretor da Gestao de Residuos Solidos Urbanos na Cidadee de Maputo, 2017.

Chong T., Matsufuji Y. et al., Implementation of the semi-aerobic landfill system (Fukuoka method) in developing countries: a Malaysia cost analysis, Waste Management, 2005(7) 702-711, 2005.