

Hazardous Waste Management in the West Rand District Municipality, Gauteng, South Africa: A Review

Bongekile Ginindza and Edison Muzenda

Abstract—Hazardous and medical waste types are often generated in the West Rand District Municipality (WRDM). The WRDM is made up of four Local Municipalities (LMs) which are Randfontein, Mogale City, Westonaria and Merafong City. Hazardous waste can cause significant health and environmental impacts when managed inadequately. It contains organic and inorganic elements with inherent physical, chemical and biological or toxicological characteristics. All the WRDM landfill sites (Luipaardsvlei, Roipoort, Lebanon and Uitvaalfontein) do not cater for hazardous waste as all wastes are classified and permitted as generally the same. Hazardous waste requires special handling, treatment and disposal and thus spotters and gate controllers on the landfill site screen for hazardous waste. There is no hazardous or medical waste disposal site in the WRDM therefore, hazardous waste generated by WRDM is disposed off at an incinerating plant near Roodepoort in Johannesburg.

Index Terms—Hazardous waste, Incinerator, Inorganic, Medical waste, Organic, Spotters, Toxicological.

I. INTRODUCTION

Hazardous WASTE is any waste that contains organic or inorganic elements or compounds with inherent physical, chemical or toxicological characteristics and having detrimental effects on human and environment health. In terms of the minimum requirements of the Department of Water Affairs and Forestry (DWAF), hazardous wastes are grouped into four hazard ratings. High hazardous waste requires the strictest control and urgent attention. Its contents are said to be significantly toxic and persist in the environment and accumulate in biological tissues. Moderate hazardous waste possesses highly dangerous characteristics and contains significant concentration of high/moderate toxic constituents. Low hazardous waste has dangerous characteristics or with significant concentrations of available toxic constituents. Potential hazardous waste has characteristic toxicity, which are either in a form that will remain insoluble or are of

significant concentrations [2]. Hazard ratings are summarised in Table 1.

TABLE I: HAZARDOUS WASTE RATINGS

HAZARDOUS WASTE RATINGS	
HAZARD RATING 1	High Hazard
HAZARD RATING 2	Moderate Hazard
HAZARD RATING 3	Low Hazard
HAZARD RATING 4	Potential Hazard

Health care risk waste (HCRW) or medical waste presents a great hazard to the environment and to those who come into contact with the waste. It is waste generated in health care facilities i.e., hospitals, clinics including pathogenic or biological infectious waste, sharps objects and hazardous waste mainly originating from laboratories containing toxic substances [3].

II. HAZARDOUS WASTE MANAGEMENT

The disposal of medical and hazardous waste in WRDM's four local municipalities (Mogale City, Merafong City, Westonaria and Randfontein) is done by accredited service providers. These include among others; Phambili Waste, Buhle Medical Waste, Sanumed, Envirocil (also disposes animal carcasses), Waste-tech and Lancet Laboratories. There is no hazardous or medical waste disposal site in the WRDM thus, medical wastes generated by the local public and private medical facilities are disposed off at the incinerating plant in Roodepoort, Johannesburg as shown in Fig. 1. Sanumed Waste has three incinerating facilities in the Gauteng Province. Majority of medical practitioners, clinics and hospitals do separate their medical waste from the general waste. Medical waste includes sharp objects, ampules, soiled dressings, syringes, needles, etc. However, a few places where the practice of separating medical waste from general waste was not done were identified. The waste is disposed in 240L bins which are collected by the respective service providers. Companies such as Sanumed also provide medical waste containers. In instances where the municipality collects the waste, this is taken to the central clinic where an accredited service provider collects them for disposal outside the WRDM. The frequency of waste collection depends on the amount of waste generated as they range from daily collection in hospitals to weekly collection for other medical practitioners.

Bongekile Ginindza is with the Department of Chemical Engineering, Faculty of Engineering and the Built Environment, University of Johannesburg, Doornfontein, Johannesburg 2028,

Edison Muzenda is a Professor of Chemical and Petroleum Engineering and Head of Department of Chemical, Materials and Metallurgical Engineering, College of Engineering and Technology, Botswana International University of Science and Technology, Private Mail Bag 16, Palapye, Botswana as well as Visiting Professor at the University of Johannesburg, department of Chemical Engineering, Faculty of Engineering and the Built Environment, Johannesburg, P O Box 17011, 2028, South Africa



Fig. 1: Hazardous waste incinerator in Rodepoort, Johannesburg [2]

Hazardous and general waste is collected by service providers in skip containers and other mass storage containers provided by the WRDM. Service providers include among others Mogale City LM, Multi-waste, Skip Waste, Waste-tech, Reclaim Metals, Chamdor Waste, Rainbow Waste and Oil Kol. No information was provided for other hazardous and toxic waste generators, such as hair and beauty salons. WRDM landfill spotters currently do not identify and separate all hazardous and toxic waste coming into the landfill due to highly mixed waste streams. Thus, it is highly possible that other hazardous material such as aerosol cans, batteries, paint, household chemicals also end up in landfills. WRDM landfills (Luipaardsvlei, Roipoort, Lebanon and Uitvaalfontein) cater for general waste excluding hazardous, medical/pharmaceutical and toxic waste [2].

III. HAZARDOUS WASTE STREAM ANALYSIS

Hazardous waste stream include house hold waste, oil based paints, paint thinners, paraffin, wood preservatives, pesticides, household cleaners, used motor oil as shown in Fig. 2 as well as antifreezes, batteries, discarded tyres, used oil, electronic waste, wet batteries, construction and demolition waste, municipal waste water treatment sludge and slaughterhouse waste. Industrial hazardous waste include metal cutting from processing or cannery waste [3].



Fig. 2: Hazardous motor oils and paint cans collected for recovery [4]

There is a tyre cutter at the Luipaardsvlei landfill site in Mogale City LM where waste tyres are cut as shown in Fig. 3 before they are landfilled in order to reduce their size and save landfill space. Some re-claimers on site burn the tyres thereby recovering metals from this exercise. This is a hazardous act due to the presence of flammable and explosive gases at the landfill site.



Fig. 3: Tyre cutting @ Luipaardsvlei landfill site

IV. E-WASTE RECYCLING

Hazardous components in electronic waste (e-waste) complicate the recycling/dismantling and disposal processes in the waste management sector. It requires a full understanding of the components of the materials dealt with. Strict measures should always be put in place in dismantling e-waste equipments to avoid further environmental impacts due to improper waste management and lack of education and training on waste management [5]. E-waste is often found in general landfill site as they are also disposed in waste bags. There are currently no e-waste drop off centers and separation at source initiatives, awareness and education for household electronic appliance users in the WRDM. Fig. 4 shows e-wastes such as computers, microwaves, TV's, cell phones for recycling [6].



Fig. 4: Electronic waste mixed with hazardous waste [4]

Some electronic waste pose high levels of risk to human health and the environment such as arsenic and mercury from waste lamps i.e. fluorescent lamp, thermometers, and dental amalgams shown in Fig.5. These types of waste cannot be destroyed and therefore must be immobilized and permanently encapsulated. These are costly processes, which illustrate the importance of changing product composition, industrial processes or the source of raw material [7].



Fig. 5: E-waste spent lamps [7]

V. MEDICAL WASTE SITUATION ANALYSES

WRDM is currently not able to properly treat much of the medical waste, especially when not separated, it enters municipal waste stream where it is mixed with general waste. It is often found in waste bags, disposed by some medical practitioners thereby decreasing the likelihood of spotters to identify the medical waste from the waste stream. This can lead to injury and infection for waste pickers, contamination of other waste fractions, recovery and re-sale of sharps objects without sterilization and pollution of water including drinking water. Medical waste presents a risk to the health of people and can cause infectious diseases and pollution if not handled properly. Medical waste or health care waste consist of infectious waste at 25% of the total health care waste among which are sharp objects and body part wastes which constitutes 1% each, chemical or pharmaceutical waste at 3%, radioactive waste and broken thermometers containing mercury at 1% of the total health care risk waste. Infectious waste, especially sharp objects such as discarded syringes poses risk to anyone who comes into contact with it especially in cases where they are re-used.

VI. HAZADOUS WASTE LEGISLATIVE

WRDM municipality has a mandate to adhere to the hazardous waste legislative framework, which are the Hazardous substance Act, Health Act and the National Environmental Management Act. These acts are associated with addressing the gap of hazardous waste management that provide and promote the health status of people as well as prevent prevailing conditions detrimental to health. It also provides for legal disposal of empty containers with flammable containers being disposed separately [8].

VII. AIR POLLUTION

Poorly managed landfill sites contribute to air pollution through hazardous substances such as benzene, methane, naphthalene, tetrachloroethylene and trichloroethylene. These gases decompose and create volatile gases and if they become concentrated in pockets, they can be explosive. Bad odours are common during wet summer months when landfill sites are kept moist. High temperatures facilitate decomposition of waste and production of odours. Communities located close to landfill sites can be impacted on by air pollution and landfill gases. These substances cause burning of the eyes, sore throats

and headaches. It also attracts rats, snakes, flies and other insects which spread to surrounding communities. Other potential consequences for poorly managed hazardous waste include air pollution by dust release particularly from mine deposits as well as health care risk from waste incinerators [9].

VIII. CONCLUSION

This paper has identified gap analysis that needs assessment in the hazardous waste management and treatment for the West Rand District Municipality. The paper has also shown that there are serious detrimental consequences on the environment and to the health of people if hazardous waste is improperly managed.

ACKNOWLEDGMENT

The authors acknowledge the support provided by the WRDM's waste management Managers and the University of Johannesburg.

REFERENCES

- [1] KwaZulu Natal – Hazardous Waste Management Plan, Final Status Quo Report, 2013.
- [2] IWMP Integrated Waste management Plan Report, West Rand District Municipality, 2010.
- [3] National Waste Management Strategy. Department of environmental affairs, 2011.
- [4] Waste and Chemicals Management, Guidelines for the hospitality industry, 2012.
- [5] Municipal waste management - good practices, 2011.
- [6] Development of a General Waste Minimisation Plan for Gauteng, Status Quo and Waste Minimisation Options Report, 2008.
- [7] Guidelines for Waste Management Strategies. Moving from Challenges to Opportunities, 2013.
- [8] Integrated Waste Management Plan. Westonaria Local Municipality, 2005.
- [9] Gauteng State of Environmental Report. Using indicators to track environmental change, 2004.



Bongekile Ginindza is a Masters of Technology in Chemical Engineering final year student at the University of Johannesburg. Her research focuses on Integrated Waste Management.. She holds a Bachelor of Technology Degree in Chemical (Environmental) Engineering from the University of South Africa. She has 8 years working experience in manufacturing industries. Her research interests are broadly in solid waste treatment, air quality control, quality management, energy recovery, wastewater and water treatment.



Edison Muzenda is a Full Professor of Chemical and Petroleum Engineering, and Head of Chemical, Materials and Metallurgical Engineering Department at Botswana International University of Science and Technology. He is also a Visiting Professor in the Department of Chemical Engineering, Faculty of Engineering and Built Environment, University of Johannesburg. He was previously a Full Professor of Chemical Engineering, the Research and Postgraduate Coordinator as well as Head of the Environmental and Process Systems Engineering and Bioenergy Research Groups at the University of Johannesburg. Professor Muzenda holds a PhD in Chemical Engineering from the University of Birmingham, United Kingdom. He has more than 16 years' experience in academia which he gained at various institutions including the National University of Science and Technology, Zimbabwe, University of Birmingham, University of Witwatersrand, and most

importantly the University of Johannesburg. Through his academic preparation and career, He has held several management and leadership positions such as member of the student representative council, research group leader, university committees' member, staff qualification coordinator as well as research and postgraduate coordinator. Edison's teaching interests and expertise are in unit operations, multi-stage separation processes, environmental engineering, chemical engineering thermodynamics, professional engineering skills, research methodology as well as process economics, management and optimization. He is a recipient of several awards and scholarships for academic excellence. His research interests are in green energy engineering, integrated waste management, volatile organic compounds abatement and as well as phase equilibrium measurement and computation. He has contributed to more than 280 international peer reviewed and refereed scientific articles in the form of journals, conferences books and book chapters. He has supervised more than 30 postgraduate students and over 250 Honours and BTech research students. He serves as reviewer for a number of reputable international conferences and journals. Edison is a member of several academic and scientific organizations including the Institute of Chemical Engineers, UK and South African Institute of Chemical Engineers. He is an Editor for a number of Scientific Journals and Conferences. He has organized and chaired several international conferences. He currently serves as an associate Editor of the South African Journal of Chemical Engineering. His current research activities are mainly focused on WASTE to ENERGY projects particularly biowaste to energy for vehicular application in collaboration with SANEDI and City of Johannesburg PIKITUP as well as waste tyre and plastics utilization for fuels and valuable chemicals in collaboration with Recycling and Economic Development Initiative of South Africa (REDISA). He has been in the top 3 and 10 research output contributors in the faculty of Engineering and the Built Environment and the University of Johannesburg respectively since 2010. In 2013, Prof Muzenda was the top and number 2 research output contributor in the Faculty of Engineering and Built Environment, and University of Johannesburg respectively. Edison is a member of the South African Government Ministerial Advisory Council on Energy and Steering Committee of City of Johannesburg – University of Johannesburg Biogas Digester Project.