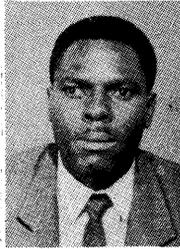


WASTE MANAGEMENT FOR MINE SOLID WASTE



PRESENTED AT:
THE INTERNATIONAL SYMPOSIUM ON MINE DRAINAGE AND ENVIRONMENTAL PROTECTION
FROM WASTE DISPOSAL

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ABSTRACT

Major solid mine wastes in zambia are mining waste rock, tailings, slag and small amounts of toxic hazardous chemical wastes. Zambian mining operations commenced in the early 1900 and it is obvious that the disposal of solid wastes then, did not consider effects on the environment in terms of pollution as well as environmental degradation. This can be attested to the location of the various dump sites and emission points in relation to human populations and sensitive environments like rivers, animal habitats etc. in mining areas both on the Copperbelt and Kabwe to mention two major mining operations. It is of critical importance to assess the impact that existing wastes dumps and the ones being created, have on the environment with a view to come up with new technologies and better ways of tailings disposal and management. Planning and design of these dump sites must incorporate for the rehabilitation of the site, pollution control measures after mining operations have stopped. Regulatory measures must be drawn up which will prevent and control pollution, environmental degradation, and encourage rehabilitation of tailings dumps. Economic incentives and other insurance packages must be set up which will help the mining industry to deal with problems of tailings dumps.

KEY TERMS: Tailings disposal, environment, pollution, environmental degradation, dump sites, new technologies, rehabilitation.

1.0 INTRODUCTION

The sight of mine waste dumps is evident as one enters the mining towns of Kabwe and those on the Copperbelt. Some of these dumps are over 80 years old and dormant while others are still active dumping sites. These sites are located either within or outside population centers.

The Mining regulations (dumps) promulgated in the early 1970's have their emphasis on safety and the integrity of mining operations. Mine waste disposal methods (tailings dams) have affected the environment in which they are situated in many ways: dam failures have damaged not only property, life loss, pollution, and environmental degradation. This paper attempts to highlight the adverse environmental hazards, and possible further environmental degradation that the mine solid wastes have on their areas of location and the measures that can be Instituted for mitigation. The emphasis will be put on tailings dumps although generalities will be made where necessary. Developments in mine waste management are also being discussed, and in this light, mention is made of the role played by legislation like the mining (dumps) Regulations of 1972 and the Environmental Protection and Pollution Control Act No. 12, of 1990.

2.0 TAILINGS DISPOSAL DUMPS

Early tailings dumps, like in many mining operations in the world, included discharging of tailings into rivers or streams and disposal on the land.

To understand the magnitude and the problem of tailings disposal it's important to look at the waste management situation in general.

Currently, Zambia produces an estimated 38 million tonnes of solid wastes per annum. Mining wastes account for 90% of this figure and these are mainly tailings. It must be pointed out that Agricultural wastes are not included in this estimate due to lack of reliable information.

Municipal and industrial wastes account for 2 - 3 million tonnes per annum. Most of it is disposed of in about 60 non-scientific municipal disposal sites (crude dumping). By the way, this does not include waste which is clandestinely discharged. Waste disposal dumps cover vast tracts of land estimated at over 32km². The actual affected area (catchment) is over 60 km² of potentially productive land. Mine tailings are pumped to the dumps in slurry form of concentrations 30 - 40 % solids. ZCCM has created a number of tailings dumps in various sites where concentrators operate or have ceased operations. These tailings dumps are constructed and managed in accordance with the provisions of the mining (dumps) regulations which came into force in 1972.

These regulations have developed to their present status especially after the dam failure at Mufulira Mine which unfortunately led to the Mufulira Mine disaster of 1970.

The main thrust of the Mining dump regulations is to ensure the safety and integrity of the mining operations. In this respect the position of dumps in relation to underground mining is strictly controlled.

Many environmental impacts and issues of mine dumps have received secondary importance in the past and these impacts were rated only as nuisances.

New and better designed tailings dams incorporating new technologies and better waste managements are being adopted and implemented such as implementation of better engineer central tailings dams as opposed to scattered small mismanaged ones. These developments could be attributed to three main reasons, among other things:

- (A) A growing realization that good environmental management is responsible management, and that this would in the long run, prove cost-effective and make good economic sense, through;
 - i. Improved safety of material and human resources.
 - ii. Reduced Cost and savings from possible claims and compensations resulting from pollution and other environmental damages,
- (B) The growing environmental awareness in the Country leading to new developments in environmental law or legislation like the enactment of the Environmental protection and Pollution Control Act No. 12 of 1990.
- (C) The growing international pressure from major project financiers like the World Bank, which insist on EIAs for projects requiring their financial support, and to be able to comply with the local existing environmental standards.

The main control on mining dumps currently is through the permit system by the mine safety Department (MSD) of the ministry of mines. Under mining Regulations (mining dumps) of 1972, the permit system includes;

- i. Dumping site approval which require an independent opinion of a competent person on the design and construction of the dam.
- ii. Statutory periodic inspection and reporting by a competent

person on the operation and management of the dam.

- iii. Regular inspections by inspectors from the MSD looking at the dam stability and other aspects which will compromise its stability and threaten the safety of property and humanlife.
- iv. Proper dam drainage and the proper working of the installed drainage system.
- v. Proper working and control of water level in the dam during the different operational stages and seasons.
- vi. Pollution monitoring of the incoming slurry especially for pH, dissolved heavy metals etc. and the quality of the effluent from the dam into the local streams or rivers.
- vii. Dam erosion control measures such as maintenance of drainage pipes and the revegetation of the slopes.

3.0 ENVIRONMENTAL IMPACTS OF TAILINGS DUMPS

The major environmental impacts of tailings dumps apart from visual effects on the landscape are:

- a) Surface water pollution arising from the discharge of waste water contaminated with solids, heavy metals, mill reagents, sulphur compounds etc.
- b) Air pollution arising from nuisance dust particles being blown by wind if the dump site is not vegetated.
- c) Large tracts of land becoming barren as a result of annihilation of biodiversity by the dump due to its adverse effects on the local ecology.
- d) Underground water pollution if the dump is located in a geotechnically unsuitable site. Leachate from the dump has potential to pollute underground water sources.

3.1 WATER POLLUTION

- 3.1.1 The most investigated case of pollution arising from the tailings dumps is that of water pollution in the Kafue river. This has risen in most cases as a result of spillage of tailings from the dam into the streams leading into the Kafue river e.g the January 1981 Chambishi Mine tailings spillage which resulted in the death of several livestock from chronic copper-poisoning down stream of the spill. The Mwambashi river which finally joins the Kafue river was heavily contaminated with levels of copper in the liver samples of some of the dead animals exceeding the 30 - 70 ppm limit, reaching up to 910 ppm in one case.
- 3.1.2 Mine acid drainage results not only in low pH that favours dissolution of heavy metals but could also promote biological actions of certain bacteria on residue sulphide ore in the tailings. This could lead to water pollution of streams receiving the leachate.
- 3.1.3 Dam erosion during the rain season especially, result in millions of tonnes of solids going into the local streams and finally into the Kafue river, silting and inundating the river banks. Nchanga division is the best example for such siltation. This poses a threat to aquatic life, the river course, and economic life of wetlands like the Lukanga swamps.
- 3.1.4 Another major water pollution threat arises from inactive tailings dumps, which do not receive any maintenance or monitoring and are in need of rehabilitation.

3.2 AIR POLLUTION

Dust Pollution is not severe at most tailings sites mostly due to revegetation efforts although it is a problem during the dry season when prevailing winds blow across the dumps.

3.3 ENVIRONMENTAL DEGRADATION

Environmental degradation can lead to severe ecological and economic effects on sensitive habitats. To illustrate;

3.3.1 Vast tracts of productive land is surrendered to tailings and other mine wastes because of the very high generation capacity of mine operations. A good number of the tailings dumps are sited in valleys whose agricultural potential will never be realised.

3.3.2 Loss of trees leads to deforestation.

3.3.3 The destruction of the local habitats has an adverse effects on biodiversity.

3.3.4 Negative social-economic impacts on the local people result from the above effects.

4.0 SOLUTIONS AND CONTROL MEASURES

The following are suggested possible remedial measures:

4.1 Waste reduction measures like recycling, form the most important aspect of any waste management system. Some progress worth mentioning is the open-pit back-filling at Nchanga and the newly-introduced underground mining technology of "cut and fill" in Luanshya which could significantly reduce the amount of wastes for disposal.

4.2 The utilization of mine solid wastes in the building industry, and road construction, should be researched on and marketed aggressively.

4.3 Use of Environmental Impact Assessments in the permit system for mine solid waste dumps, so that negative Impacts can be identified and mitigation measures drawn and implemented at an early stage during the design stage.

4.4 Post-closure maintenance and rehabilitation measures for the waste disposal sites must be included at the planning and design stage.

4.5 A requirement for an Environmental liability insurance cover should be included in the provisions of our environmental law to ensure

availability of funds for prompt corrective action, clean-up and rehabilitation in case of an environmental damage.

- 4.6 Setting up of an effective emergency response system to ensure prompt rescue and corrective measures to save lives and property in case of failure or accident. This emergency response plan must be tested periodically by simulation to measure its effectiveness or for practice.

9. REFERENCES:

1. Environmental Protection and Pollution Control Act of 1990 of the Republic of Zambia.
2. Hazardous Wastes Policies and Strategies. A training manual technical Report series number 10, UNEP.
3. P.C Lucia et al Summary of research on case histories of flow failures of mine tailings impoundments EPA/600/9-91/030 July, 1991.
4. Mining (dumps) Regulations of 1972 (GRZ).
5. Republic of South Africa, Veterinary Research Institute Report OP4/3/IBL 1981.
6. SADC workshop on Mining and the Environment, Lusaka. December, 1992
7. Zambia's National Report to UNCED, GRZ 1992.