

## **Project for the implementation of techniques to reduce damage and consequences of mining dumps developed by the Higher Technological Institute of Fresnillo**

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## **ABSTRACT**

The methodology presented consists of procedures for improvement and quality in the environment in a more specific way to implement the necessary indications to guide the proponent a safe work environment, focused on the mining dumps in preparation for their preparation in accordance with the Regulation of Mining Security. Based on a project which is considered for the implementation of techniques that promote the reduction of damage or consequences, generating a safer environment that cannot be harmful or unsafe for personnel and people nearby or who may have access to these areas. In mining, a large amount of waste is produced that brings with it affectations and damages generated especially to the environment, personnel and people who have access.

**Keywords:** project, dumps, techniques.

## **1 INTRODUCTION**

The Pollution problems are due to mining activities, especially in smelters, are notorious in the case of dumps. In the case of the La Oroya smelter (copper, lead, and zinc), the main contaminants identified are lead, sulfur dioxide, cadmium, arsenic, and articulated material. The lead concentrations in the air monitored by the Address General of Health Environmental (DIGESA, 1999) show that these exceed the EPA and WHO standards. In the case of dumps, the waste generated in the smelting processes, as well as the water used in these processes, are deposited in said dumps, causing pollution and damage.

The Fresnillo Higher Technological Institute from the Industrial and Business Development academic body, in the mining engineering career, as well as with the participation of the ITSF young researchers club developed this project.

For its part, mining waste corresponds to the sterile material from the mining operation, and to the tailings or gravel from the treatment plants, depending on whether they come from a concentration or leaching operation, respectively.

Sterile disposal is normally carried out by unloading from the truck or loader towards a topographic unevenness (ravine) located in the vicinity of the mine entrance (underground mining) or pit (open pit mining). The work that is formed in this process is called a waste dump.

This dump must be formed in a planned and orderly manner, so that the filling of the topographic unevenness results in a stable work. Under no reason can the sterile dump be built in an area of natural runoff of water, unless works are carried out to channel it.

## **2 METHOD DESCRIPTION**

The central problem of this research is based on the chemical and physical repercussions generated by mining dumps, either due to their excessive accumulation, poor transport of the material or its leaks, propitiating conditions that are not suitable for the ecosystem, or even creating circumstances that are detrimental to the environment. the human being Good planning to locate dumps is the key to avoiding this type of inconvenience. Creating a protocol of safe operations for the transport, storage and treatment of sterile material (ganga) to avoid leaks of material, train personnel according to the activities to be carried out and create awareness campaigns about the damage that a bad procedure can cause, both the staff and the ecosystem.

Dumps are rock deposits without mineral concentrations of interest resulting from mining exposure, generally in contact with the ground, so any acid drainage reaction will seep into the ground and could damage groundwater or springs in the area.

The design of dumps must contemplate the concepts of the shortest possible distance to minimize the costs of transporting the material and the construction in stages of a geotechnically stable configuration with slopes that can withstand landslides and foreseeable extreme conditions of exposure to the environment. It is necessary to make due provisions to avoid, as far as possible, contact between neutral water and watercourses that could compromise the physical or chemical stability of the dump over time. It is necessary to ensure that the construction of dumps complies with the design specifications approved by the authority, since a large part of the causes of failure of the dumps are normally deviations during their construction due to lack of quality control during their construction.

### **3 TYPES OF DUMPS**

- valley fill

They are dumps that are totally or partially developed by filling valleys. The most important aspect in this type of dump is the prevention of water reservoirs at the head of the valleys.

- fill through valleys

This type of dump is a variant of valley filling. It is characterized in that its construction is carried out from one end of a valley to the other, crossing the drainages.

- Mid-slope fill

They are dumps built on sloping land that do not block any water course or any drainage system.

- Fill from the crest of the mountain

It is a special case of mid-slope fills, the growth of the dump is carried out from the crest lines in both directions.

- Filling in stock.

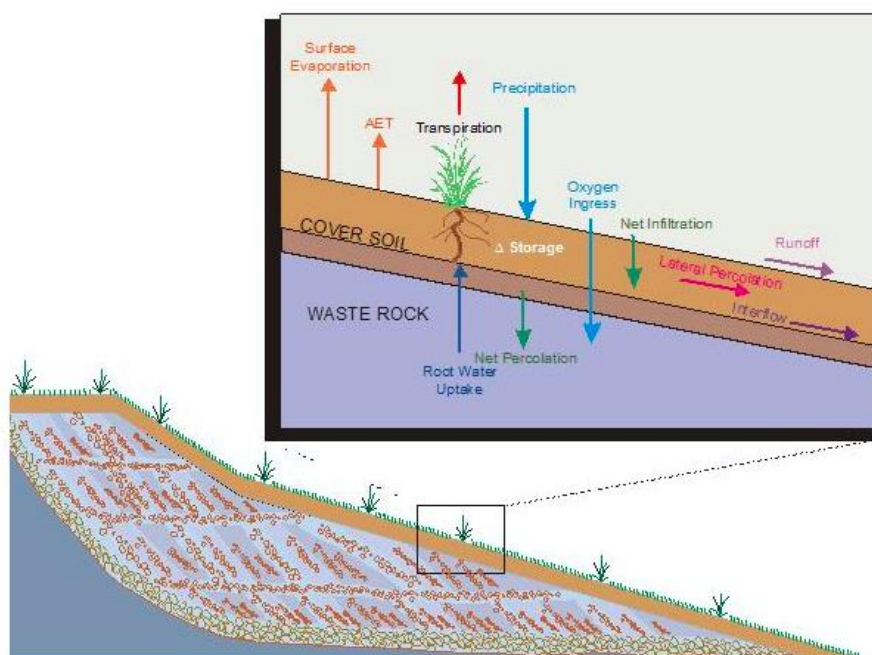
They are called piles that consist of piles of clearing material with slopes formed in all directions. (Mining, 2012)

### **4 GRAPHICS OF THE LANDFILLS**

The coverage design proposed by Gida hatari should reduce leaks to the standards indicated by the regulatory bodies. The cover system must allow vegetation on top, allowing the dump to recover a natural appearance in the ecosystem.

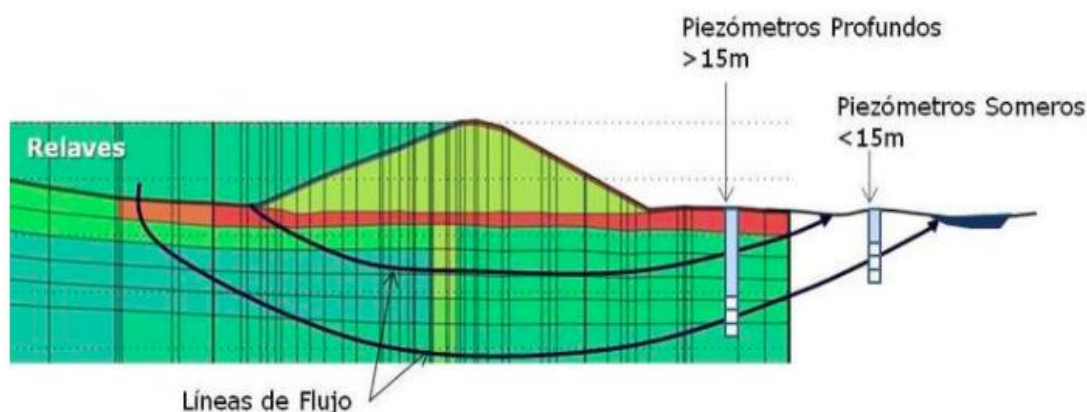
The type of vegetation, its performance regarding water availability and its root depth will be evaluated in this research. You must have a vegetation that consumes most of the precipitation water, with a layer of soil that allows its full development but that its roots do not damage the lower layers.

Other factors such as stability, erosion, and performance over time will also be considered in the evaluation of alternatives. Priority will be given to the use of materials from the area for the coverage system.



Chemical samples will be taken from the main watercourses, monitoring points, natural springs and leachate outcrops.

The collection of initial and current topography data, details of the installation of dump deposits, data of interception systems, meteorology, rainfall, flow records and water chemistry is also contemplated.



(INAP, 2006)

## failures

### 4.1 MAIN FAILURES IN DUMPS

The "Methodological Guide for the Evaluation of the Physical Stability of Remaining Mining Facilities", developed by the Pontificia Universidad Católica de Valparaíso with the support of Corfo, and

approved by the National Service of Geology and Mining (Sernageomin) in 2019, details the types of failures that the waste dumps (BEM) and the leaching debris deposits (DRL) may suffer.

As background, the report indicates that in Chile only one case of failure has been documented that "was generated in 2004 in a BEM of height between 330 and 530 meters, belonging to a copper mine located in the Andes Mountains. It occurred under static conditions without involving a seismic event, and the material mobilized by the slide reached approximately 10 million tons, which moved to an old mining pit." He adds that the instability modes that have been commonly observed in the slopes of BEMs and DRLs are generated by faults of the crest or edge type, planar, deep and flow (static liquefaction)

- Ridge or edge

Ridge or edge landslide instabilities are probably the most observed failure mode during the operational phase of a large dump, whose slopes are defined by the angle of repose of the deposited materials.

The failure commonly occurs when heavy rains or a significant increase in the degree of saturation decreases the negative pore pressures in the fine fraction of the mining waste, which causes a loss of the apparent cohesion that this type of material presents.

- Flat

They are triggered by a slip induced by the existence of a plane of weak resistance. This plane could occur during the construction phase if from the crest of the dump of fine mining waste or of low geotechnical quality, which produce zones or numerous layers parallel to the slope. They are also formed if waste is dumped on a slope covered by thick layers of snow, ice or materials degraded by the environment or by shear stress inside the dump. High pore pressures also contribute to the generation of a fault plane. In this case, the failure surface is similar to that associated with an edge instability, but deeper and involving a larger volume of material.

- Deep

They include rotational and compound faults. The former involve a mass along a circular, semicircular, or ellipsoidal/curvilinear fault surface. Creep failure is a special case of rotational failure, which considers a wide rotational shear within the mass of mining waste, without movement defined by a single failure surface. The "creep" manifests itself in the long term, with an accumulation of material at the foot of the deposit.

Rotational faults are commonly associated with homogeneous, weak, loose or fine material mine waste. In the case of cohesive materials, they can slide in a rotational manner if the construction of the dump or of the different platforms is very fast and their slopes have a high slope. This class of failures can also be generated by high pore pressures in the dumps. And occur in weak areas, such as a plane formed by fine granular materials or where waste is dumped on snow or ice.

- By static liquefaction

They are generated in a loose, contractive, saturated or almost saturated non-cohesive granular mass –due to rain and infiltration, the existence of hanging layers and/or concentrations of surface flows–, close to the state of creep, which is very close to an undrained fault.

This condition can be produced by stress paths that are not drained (rapid application of loads or external forces) or drained (increase in pore pressure).

In both cases there is a volume reduction restricted by the water. As a result, a charge transfer to the water phase is triggered, increasing pore pressures. The effective stress is suddenly reduced, inducing a decrease in shear strength to such an extent that the granular (sterile) media can flow.

The generation of a static liquefaction or "flowslide" in a DRL is linked to the following factors: height and type of deposit, natural slope of the foundation soil, angle of inclination of the slopes, percentage of moisture in the material deposited, degree of saturation, granulometry and permeability of materials. (Induambience, 2019)

Acid drainage is that physical and chemical change of the sterile rocky material with a high concentration of sulfides which, when in contact with water and air, cause abiotic oxidation, therefore the water, as it is introduced through the veins of the earth, is prone to reaching groundwater.

Water contaminated by acid drainage is harmful to health, in addition to the fact that this water generates damage to surface ecosystems, affecting the growth of natural organisms.

#### 4.2 HOW WILL WE AVOID ACID DRAINAGE IN MINE DUMPS?

Carry out an underground survey to locate the mining dump in a good area and thus avoid contact with groundwater. Once the place is well located, we are going to design the mining dump, preferably the first layers of sterile rocky material must be filled with impermeable rocky material such as slate and basalt.

This will avoid that if for some given consequence acid drainage is generated in the last layers of the dump, it will not be able to penetrate the first layers and thus submerge into the underground areas.

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### 5 RESULTS

- 1.-Evaluate the geotechnical characteristics of the foundation soil and the physical-mechanical properties of the clearing material that will make up the projected slopes.
- 2.-Evaluate the condition of the physical and chemical stability of the dump, for later project physical-chemical stabilization works.
- 3.-Design the drainage works for surface and sub-surface waters.
- 4.-Establish the technical specifications of the items that contemplate the construction works of the waste dump.
- 5.-Establish a schedule of activities for the construction.
- 6.-The objective of this study is to design and build the waste dump for the storage of material from mining.

### 6 CONCLUSIONS

Mining as an economic activity of the primary sector is of great importance in our current world, however, the damage generated to the environment and even to the personnel that operates in this industry cannot go unnoticed.

Different processes used in this industry are great sources of waste generation and damage to the environment, among the most notable such as flotation and leaching, they carry with them a large amount

of material with high contents of toxicity due to the fact that they are materials that are found on the ground, these materials that cannot be neglected are deposited in dumps, therefore, we could say that dumps are large containers of material that can be benign to human health and the environment.

A good handling and a good treatment of the sterile material brings with it a great reduction of damages and risks that can be generated especially in the dumps of the mining industry, a good location, a good design, techniques implemented even with the help of technology, are additions that can be very useful to us for the reduction of the consequences and the risks generated by the mining dumps.

### **FINAL COMMENTS**

To future researchers who do it on this topic we hope that this proposal will be to your liking and help them to get rid of doubts and that they themselves will be attracted to improve this same proposal with their own essence and achieve improvement in all areas of the mining in general.

To the Instituto Tecnológico De Fresnillo, we hope that it will serve as a support to teach their students and be used in the best way for their wisdom, since it is something that will help future engineers a lot.



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