



**INTERNATIONAL SYMPOSIUM ON
DAMS IN A GLOBAL ENVIRONMENTAL CHALLENGES**

Bali, Indonesia, June 1ST – 6TH, 2014



**Geotechnical Performance Evaluation of Sediment Dam
A Case Study on Fiona Dam at PT Vale Indonesia Tbk**

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ABSTRACT:

This paper is intended to evaluate geotechnical performance of Fiona Dam as a sediment dam in terms of stability against seismicity since water filling stage until operational period. The dam is located in the area of the mining operations of PT Vale Indonesia Tbk at Sorowako, East Luwu Regency, South Sulawesi Province, Indonesia, constructed to impound solids of waste material (disposal) and also act as filter function before the mine effluent released to the downstream waterbody. In this review, the analyses are referring to the detailed engineering design, survey & monitoring serial data, seismicity calculation, and previous geotechnical site investigation report through simulation and data analysis approaches.

Keywords: Sediment dam, solids of waste material, seismicity, peak ground acceleration (PGA), geotechnical slope stability.



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**Assessment of static and seismic stability of
Kumtor's gold mine tailings dam
in Kyrgyz Republic**

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ABSTRACT:

Kumtor gold mine is situated in the Kyrgyz Republic in Central Tien Shan Mountains at an altitude 4000 meters in permafrost area. Construction and exploitation of the tailings dam was started in 1995. In 1999 the displacement of the dam to downstream side was detected. The dam height was 20 meters. Analysis of monitoring data showed that displacement took place in ice rich loamy layer in the foundation on 4 meters depth. To stop the displacement the decision was made to excavate loamy layer beyond downstream and change it by construction shear key made of macro fragmental soil. The depth of shear key was 5 meters. In the following the monitoring data showed that tailings dam continue to move on underlying soils. The additional geological investigation was done. It showed that more solid soils were located on the depth from 10 to 12 meters. Numerical modeling of the dam was made in FLAC codes. The methodology of displacement stoppage was the same. Rheological parameters of the soils in numerical model calibrated on the basis of back analysis. Forecast calculations were made to 2016 when the dam height would be 42.7 meters. Also the assessment of seismic stability was made with consideration of layered foundation. Calculation in FLAC codes showed the influence of soils condition. Peak ground acceleration was increased. Worked out measures to stop the tailings dam displacement was accomplished in the period from 2006 to 2010. The new monitoring data of displacement confirm the efficient of the taken actions.



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Comparison of tailings dams dynamic response in case of central and downstream method of construction

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ABSTRACT:

The tailings dams are complex engineering structures, composed of: initial (starter) dam, sand dam, deposit pond, drainage system, water conveyors for cleared water conduction and structures for protection in case of incoming external water. The tailings dams along with the enormous volume of sediment's lake are structures with highest potential hazard for the surrounding. A numerous tailings dams had a break or suffered enormous displacements during past earthquakes. Namely, the first main reason for tailings dam break is overflow, while the second is the action of earthquakes, causing tailings dams break at around 17% of the total number of breaks.

The aim of this research is to contribute on the understanding of tailings dams behavior on action of strong earthquakes, by comparison analysis of the seismic response of the tailings dam constructed by different construction method.

In this paper are presented results and conclusions from the comparison analysis (tailings dams alternatives with central and downstream method of construction) of the dynamic response of tailings dam no. 4 of lead and zinc mine Sasa, located in the north-east part of Republic of Macedonia. This region, as part of the Western Balkan, is seismic active area with maximal intensity of VIII-th degree for the expected earthquake for return period $T = 1,000 \div 10,000$ years, magnitude $M \approx 6.5$, and peak ground acceleration $PGA \approx 0.35$ g in case of Maximum Credible Earthquake. The analyzed tailings dam, currently at design stage, is planned with dam crest width of 5.0 m, downstream slope of 2.7 and height of 79.0 m measured from the tailings dam crest to the downstream toe.

Keywords: tailings dams, dynamic analysis.



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**Optimization of Tailings and Water Management Schemes
in Taft and Dareh Alou Copper Mines**

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ABSTRACT

The National Iranian Copper Industries Company is placing significant investment in expanding its existing mining complexes, as well as developing new mines. "Tailings and Water Management" is regarded as a crucial aspect of these development projects. Regarding the dry climate and severe shortages in water resources in Iran, maximizing the water recovery from the tailings outflow from the concentrator plant, has been a major objective in the related engineering designs. In this paper, Tailings and Water Management of two of the more recent mine development projects in the very dry region of Central Iran are reviewed. Three major components of the "Tailings and water Management" studies including tailings "Dewatering", "Transport" and "Storage" and different combinations of the available options are investigated. Technical and economic aspects of these components and their role in the overall "Feasibility Studies" of these projects are discussed. In view of the water scarcity in the regions, raw water resourcing and transfer costs are also taken into account. Both mines have mineable ore capacities of about 140 Million tons. Concentrator plants with nominal capacities of 7 Mtpa (900 ton per hour), are designed to operate for 20 years of mine life. The study shows that despite similarities in the mine and concentrator plant capacities, Capital Costs of the optimized Tailings and Water Management Schemes may differ significantly, mostly due to the topographic and environmental restrictions in each region.

Keywords: *Water, Tailings, Feasibility, Copper, Stacking, Filtration, Beach Slope*



INTERNATIONAL SYMPOSIUM ON DAMS IN A GLOBAL ENVIRONMENTAL CHALLENGES

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MANUAL FOR DESIGN, CONSTRUCTION AND OPERATION OF TAILINGS DAMS IN IRAN

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ABSTRACT:

Comparing to regular water reservoir dams, tailings dams potentially have more environmental impacts. After some incidents in tailings dams in recent years in the country, and considering the insufficiency of technical documents and national regulations for these dams, the ministry of power which is the governmental organization; responsible for water recourses, decided to prepare a national technical document to promote knowledge in this field. The intention is to guide the owners of the mines to a safer construction, operation and abandonment of tailings dams. This document is titled “Manual on design, construction, and operation of tailings dams”, and takes into consideration the current trends of design and construction of tailings dams in Iran. The manual is prepared under supervision of the committee of tailings dams of Iranian national committee on large dams (IRCOLD), and though concentrates mostly on the above ground facilities; it is expected to be a helpful document for other kinds of tailings storage facilities as well.

Major part of this guideline is based on published experiences of other countries and accepted recommendations thereof, so in this paper, after briefly introducing the structure of the document, only those parts of the manual which deal with the problems from a national viewpoint, will be introduced with some details.

Keywords: Tailings Dam, Manual, Design-Construction-Operation.



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**Tailings Storage Risk Reduction by Integrated Waste Management Mine
at Didipio Mine**

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ABSTRACT

OceanaGold's Didipio Mine Project comprises an open pit operation in the Dinauyan River valley of northern Luzon, Philippines. The site is characterised by steep topography, high rainfall and deeply weathered tropical soils (saprolite) prone to landslips on the steep valley slopes. In general these conditions create a challenging situation for safe disposal of tailings, particularly considering closure after completion of mining. The solution was developed by considering the synergies of total waste from the mine; the estimated 40 million m³ of tailings and 70 million m³ of waste rock over the projected 17 year mine life, moving the tailings dam upstream from its original planned location and allowing it to be integrated into a conservatively stable waste rock dump. "Flow-through" dump technology is being used to manage significant stream flow within the waste storage area, creating "real-estate" for waste disposal and also managing the impact of peak storm flows on the open pit which will eventually span across the valley floor with resultant risk of flooding.

The integrated waste facility design allows a high degree of confidence to meet the closure planning aims of ICOLD Bulletin 153 (draft) "Sustainable Design and Post-Closure Performance of Tailings Dams".

This paper outlines the design development of the Didipio tailings storage facility with reference to ICOLD bulletin 153, and describes experience in the first two years of construction, including initial placement of the "flow-through" dump structure.

Keywords: Integrated Mine Waste Management; Tailings Dams, Flow-Through Waste Dump



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**Design and construction of an exposed geomembrane sealing system
for the Sar Cheshmeh tailings dam raising in Iran**

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ABSTRACT

Sar Cheshmeh is a large copper mine in Iran. Its tailings dam comprises a 70m high Main Embankment with inclined clay core and outer colluvial gravel shell. ATC Williams, engaged to consider tailings management options for a production escalation involving almost 1 billion tonnes of tailings over 31 years, designed a scheme comprising a 40m high downstream raise to the Main Embankment in four stages. The critical design case included up to 20m of water ponding against the upstream face. The design of the raised embankment was constrained by the existing inclined core, as the raised core would become an upstream diaphragm with little rockfill cover to act as a surcharge during seismic loading. Iran is a highly seismically active region, and the resultant seismic factor of safety for this conventional raising approach was found to be unacceptable. Clay hence needed to be eliminated from the raise, and a geomembrane sealing system on a rockfill embankment was adopted. From a construction, performance and cost point of view, an exposed liner was preferred. Due to its superior mechanical and durability properties, a 3mm thick PVC geocomposite system, designed by Sembenelli and Carpi Tech, and supplied and installed by Carpi Tech, represented the optimal solution. The geomembrane sealing system utilises a patented face anchorage system fastening the geocomposite to a drainage layer of extruded porous concrete curbs. This paper discusses the design issues and the installation of the first two stages of the raise, completed in 2008.

Keywords: *Geomembrane, geocomposite, PVC anchor strips.*



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**Design Optimization of Bauxite Residue Dam
in Connection with Environment and Land Acquisition
in Mempawah SGA, Indonesia**

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**DESIGN OPTIMIZATION OF BAUXITE RESIDUE DAM
IN CONNECTION WITH ENVIRONMENT AND LAND ACQUISITION
IN MEMPAWAH SGA, INDONESIA**

Mining and mineral processing activities cannot be separated from tailing. In its operation, Smelter Grade Alumina processing plant will produce mud called bauxite residue. In order to accommodate the mud output, we should build dam. The development of bauxite residue dam is closely related to the environment and land acquisition. Because its form is mud, bauxite residue dam must be designed in such a way that is environmentally friendly. In addition, the design of bauxite residue dam sometime must be adjusted in the field because of the challenges in land acquisition. This paper will explain the strategies that can be taken in the design optimization of bauxite residue dam i.e. do pre-treatment by pressing and filtering the mud that would reduce the volume and the toxicity of the mud. The dam also needs to be built by staging system to overcome the challenges of land acquisition and to minimize catchment area of the dam. Because it is in a dry form, the bauxite residue can be disposed forming bench so that it will reduce the large of dam area required. The liner system also should be made to ensure there is no infiltration from the dam, so it is safe for the environment. Based on research that has been done, bauxite residue can be used as geopolymer brick with low compressive strength 53.5 kg/cm² and high compressive strength 238.9 kg/cm². It can also reduce the large of dam area required.

Keywords: bauxite residue dam, design optimization, environment, land acquisition