

Research Association

Mining and Environment in Vietnam
Stabilization of Waste Rock Dumps from Coal Mining in Vietnam



Research Association
Mining and Environment
in Vietnam

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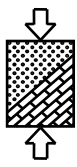


Environmental Engineering and Ecology
Bochum University



Vietnam National Coal
Mineral Industries Group
Vietnam





Problem definition and objectives

The province Quang Ninh in northern Vietnam is the most important coal producing region of the country. The state-owned group of companies VINACOMIN operates most of the open-pit coal mines in the region. The mining activities are accompanied by the construction of large waste dumps for overburden removed by blasting. At the mining sites various environmental problems as well as stability problems (erosion, slope stability) are encountered. These problems are mainly caused by the construction method of the dumps and by the local climatic conditions with very strong rainfalls during the rainy seasons.

The german-vietnamese research association RAME (Research Association Mining and Environment in Vietnam) deals in different subprojects with the aspects of the coal mining industry with influence on the environment and is developing measures to improve the environmental situation. The Institute of Geotechnical Engineering is working as partner of the



Figure 1: Erosion on waste rock dump slopes

Institute of Mining Engineering I at RWTH Aachen University on the subproject for the development of stabilization and rehabilitation concepts for waste rock dumps.

Situation

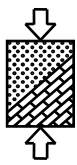
The design of waste rock dumps is currently carried out on the base of experience only, usual stability analysis are not applied. The dumps are being built as sidehill-fill by simply dumping material over the crest without any further compaction. This construction method results in massively emerging subsidence that is leading to severe damage to the slopes, because developing cracks are creating initial points



Figure 2: Cracks on the dump surface

for internal erosion processes. In the recent past repeatedly larger slope areas failed due to this processes and caused major damage.

The reduction of subsidence is a crucial for the mid- and long-term functionality of the dump. In the context of this project the state of the art of waste rock dump stabilization will be communicated to the project partners and adapted to the local conditions.



Proposed solution

After a classification of documents from the project partners, investigations will be carried out on-site to firstly find the cause of the stability, erosion and rehabilitation issues on the waste rock dumps.

In the following process, several concepts for the stabilization and rehabilitation of the dumps will be developed jointly, taking into account all aspects like cost, climatic conditions, required mass movement, environmental emissions as well as social effects. The best applicable concept for the local conditions will be chosen and tested on-site for feasibility under realistic circumstances. An adapted monitoring concept will enable to investigate the effectiveness of the measures and to compare with the traditional dumping method.

The results of these investigations will be integrated in a „Best Practice Guide“ for dump stabilization that is going to be developed as well as a software-based „Decision Support Systems“ to help the local partners to find solutions for encountered problems. These two systems can be communicated to other companies of VINACOMIN and thus improve the state of the art for dump stabilization in the hole region.

Recent work and results

Based on AutoCAD-plans provided by the vietnamese project partners, three-dimensional models of the dump were created with the mine-planning software SURPAC.

These models help to identify areas, where the stability could possibly be endangered. All over the surface of the dump, effects of large subsidence are visible, as there are wide open cracks, signs of large differential settlements and obvious changes of the surface inclination. An annual mapping of the cracks, active areas of the dump were identified and enabled to draw conclusions on the causes for the slope movements. First analyses show that the stability of the slopes is more significantly affected by erosion processes than by geotechnical slope stability failures.

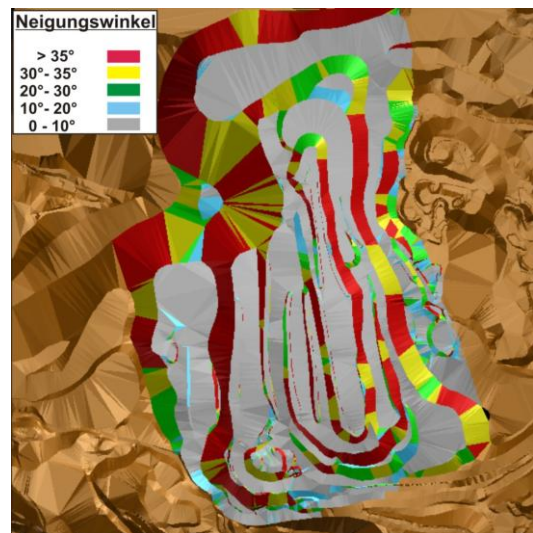
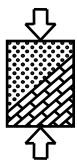


Figure 3: 3D-model of the dump



Figure 4: Trial pit for field testing

For the definition of geotechnical parameters, samples were taken for laboratory testing and field testing has been carried out on-site in several trial pits. Most of the laboratory tests were carried out by a local laboratory for soil mechanics, but it was quite difficult to find equipment for the dumped material, as the maximum particle size exceeds the limitations of standard laboratory equipment. Thus a new device will be built by the german partners for the definition of shear strength parameters.



To gather information about the existing damages caused by erosion of the slopes of new as well as older parts of the dump, an ILRIS 3D-terrestrial laserscanner is used. The scanning records are used to build a refined digital model. By comparing the records from different moments, the volume change can be quantified by calculating the differential changes between the records.

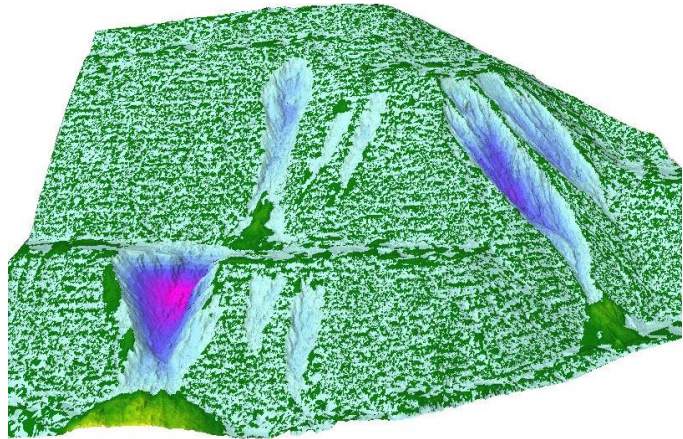


Figure 5: 3D-record of erosion

Outlook

As already mentioned above, no adequate laboratory equipment for the definition of shear parameters for the particle sizes of the waste rock material was found in the region, the Institute of Geotechnical Engineering is developing a mobile shear testing device to carry out tests on-site. The device will firstly be calibrated under laboratory conditions and used in Vietnam after preliminary field tests in Germany.

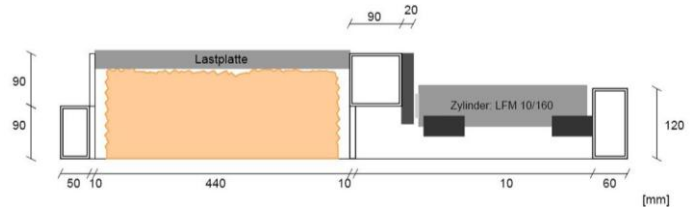


Figure 6: sketch of the mobile shear testing device

Furthermore, a large-scale compaction test is currently being carried out in the dump site to investigate the compaction effect by mining vehicles. The test will help to optimize the height of the layers, depending on the used equipment and number of vehicle passes for a dumping in layers with subsequent compaction as alternative construction method. Following these tests, a full-scale slope will be constructed with this method and equipped with surveying points to monitor the slope movement.

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