

Mine Waste Management Methods – improving material recycling and decreasing waste – KaiHaMe project

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Background

- Management of mining wastes is one of the primary challenges of sustainable mining.
- Only a small part of excavated metal ores can usually be utilized and the rest of the material is disposed as a mineral waste.
- The uncontrolled drainage from waste disposal sites may deteriorate downstream water bodies and cause harm to aquatic biota and human health.
- The KaiHaMe project develops tools for the utilization and management of mining wastes and for the prediction of their discharge quality

Mining Waste Management Methods (KaiHaMe)

- Main themes:
 - Optimization of mine waste characterization and utilization, identification of raw material potential of wastes
 - Long term stability and storage of wastes
- Duration: 1.5.2015–31.12.2017 (2 y 8 m)
- GTK Industrial Environments and Recycling Unit Kuopio and GTK Mineral Processing and Materials Research, Outokumpu and Espoo
- FQM Kevitsa Mining Oy = Boliden Kevitsa (since June 2016), Kemira Oyj, Endomines Oy
- 580 k€, ERDF funding (60 %)



Objectives

- To decrease negative impacts of mining waste disposal and to promote sustainable mining by enhancing material eco-efficiency throughout the life-cycle of mining operation
- To increase raw material value of excavated ores
- To decrease the amount of disposed hazardous waste
- To enhance the prediction of long-term impacts of wastes
- To strengthen the network of mining competence in Eastern Finland



Approaches

- To develop an operational model for the optimal use of wastes to enhance material eco-efficiency (WP1). The model will combine raw material aspects and environmental characterization of wastes.
- To review data on modelling tools applied in the prediction of waste effluent quality and make a suggestion of respectable methods (WP2)
- To study how to optimize the use and environmental properties of wastes through beneficiation (WP3).
- To seek new options for the use of non-inert waste rocks at mine sites (WP3).
- To disseminate generated knowledge through workshops, publications and Wiki (WP4).

Benefits of the KaiHaMe project

Improved operational preconditions for sustainable mining

Increased material ecoefficiency and decreased use of other natural resources

Improved management of mining wastes

Decreased negative impacts of mining waste disposal



Project structure

WP1 Operational model for optimization of mining wastes

WP2 Long term stability of mining wastes and prediction of seepage water quality

WP3 Increased utilization and raw material potential through processing of mining wastes

WP4 Dissemination and communications



Operational model for optimization of mining wastes

- Operational model to be developed will combine data/knowledge from beneficiations tests and pilot processing with environmental characterization
 - To identify raw material potential of wastes
 - Valuable metals, valuable minerals, utilization potential
 - To assess environmental risks related to wastes as early as possible
 - Presence and occurrence/form of harmful elements, their mobilization potential, AMD potential of wastes



Model for optimization of tailings properties and characterization

- To provide mining operators comprehensive characterization of the ore and wastes in one go
 - Adaptation of the beneficiation process to gain more value of the ore and to decrease amounts and environmental risks of wastes
 - Characterization of environmental properties of wastes for waste management and to evaluate costs
- Basis for the model
 - Legislative requirements for characterization; standards, guidance
 - GTK resources and facilities – current procedures
 - Evaluation of subcontracting needs
 - Mining operators' expectations



Long term stability of mining wastes and prediction of seepage water quality

- Review of available methods for the prediction of effluent quality and their usability in Nordic conditions
- A proposal of suitable modelling tools
 - Testing the selected tools with data from various mine sites in Finland (seepage water and waste characteristics)
 - Closed/abandoned mine sites & operating mine sites
 - Base metal mines & industrial mineral mines
 - Previously collected data complemented with data collected in KaiHaMe
 - Comprehensive characterization of wastes and seepage waters



Increased utilization and raw material potential through processing of mining wastes

- To promote multipurpose use of mining wastes
 - by developing evaluation of raw material potential of wastes,
 - by modifying wastes into more usable form,
 - by finding new usage options for wastes, and
 - by evaluating environmental performance of modified wastes
- Task 1: Enhanced processing of tailings containing harmful elements
- Task 2: Increased potential of the use of waste rocks in earth construction of a mine site

Enhanced processing of tailings containing harmful elements

- To assess economic ways to process/modify wastes one step further
- To decrease contents of harmful elements in wastes
 - To increase utilization potential of tailings, and
 - To decrease the amounts of hazardous wastes
- Beneficiation tests carried out on As-containing tailings
 - 3 different ore types (Kopsa, Kuikka-2)
 - Grinding tests, flotation tests, testing of different chemicals
 - Objective: to decrease As levels in the wastes
 - Detailed mineralogical and geochemical characterization of the tailings and process waters carried out

Enhanced processing of tailings containing harmful elements

- Filled-in-lysimeter tests applied to evaluate environmental performance of the modified tailings
 - Possible use in cover structures on other tailings materials
 - Comparison of original As-rich tailings with modified, As-poor tailings
 - Empty control lysimeter
 - Water sampling from the lysimeters carried out



Increased potential of the use of waste rocks in earth construction of the mine site

- Filled-in-lysimeter tests are carried out to evaluate leaching of harmful elements from waste rocks
 - Influence of grain size
 - Use as a cover material on top of other waste rock
 - Three different waste rocks tested
 - Hitura serpentine & mica gneiss
 - Kevitsa olivine pyroxenite
 - Empty control lysimeter



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Increased potential of the use of waste rocks in earth construction of the mine site

- **Hitura:**
 - Mobility of harmful elements in mica schist and serpentinite; consequences of "disturbing" old waste rock piles?
 - Utilization of the Ni-containing serpentinite as a cover in the closure of the mica schist pile
- **Kevitsa:**
 - Mobility of harmful elements from aggregate; potential for using the aggregate also outside the mine site?





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