

## BACKFILLING AND WASTE MANAGEMENT IN ESTONIAN OIL SHALE INDUSTRY

Dr Jyri-Rivaldo PASTARUS, Eesti Põlevkivi Ltd. Jõhvi Tarmo Tohver(a), Eesti Põlevkivi Ltd. Jõhvi Erik Vali(b)

Tallinn University of Technology, Department of Mining, Associate Prof., 5 Ehitajate tee Str., 19086, Tallinn, Estonia, pastarus@cc.ttu.ee

(a) Mr

(b) Mr.

Oil shale industry of Estonia provides a significant contribution to the country's economy, but causes a large number of different problems. In spite of high economical parameters of the current underground mining (room-and-pillar) system it is characterized by high loss of oil shale in pillars, safety and environmental problems. As regards landfill of waste (Directive 1999/31/EC), due to large amounts of neutral (limestone) and hazardous waste (ash) generated by oil shale industry, it must resolve these complicated problems. Complex approach is needed.

Backfilling in mining operations is in wide use all the world. In modern backfill technologies so called past fills are preferred. Nowadays attention has been focused on the use of combustion and mining by-products as filling materials (Directive 2006/21/EC). Use of ash and limestone in mining industry is treated as a part of mining technology, not as a waste disposal. It will have great impact on mining practice in Estonian oil shale mines.

As it is well known, combustion of 1 t oil shale gives 0.84 - 0.89 t of CO<sub>2</sub> and 0.43 - 0.44 t of hazardous ash. By underground mining the amount of limestone equals oil shale production. Amount of backfill materials is enough for modernization of mining technology. Mineral sequestration is an option for solving CO<sub>2</sub> and hazardous ash problems. The use of oil shale ash, neutralized with CO<sub>2</sub> and limestone as backfilling materials, decreases CO<sub>2</sub> emissions and landfill dangerous wastes. Generally, underground utilization of oil shale combustion and mining by-products reduces the volume and area required for surface disposal.

A number of options were elaborated for different mining methods (room-and-pillar, shortwall, and longwall mining) and different ways of backfilling. Some of backfill mixtures were tested in the laboratory of Civil Engineering of Tallinn University of Technology. They gave excellent results. The effects of backfilling are significant: minimization of surface movement, improvement of safety, facilitation of mining operations, and increase of extraction ratio. From the other side, backfilling has been considered as an inevitable part of mining technology. For working out new technologies for Estonian oil shale mines it is necessary to perform supplementary investigations of in situ conditions. It is also important to give economic analysis.

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