PREDICTIVE MODELLING OF ENVIRONMENTAL IMPACTS OF THE OIL SHALE INDUSTRY

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Environmental impact of the oil shale industry is one of the largest concerns regarding utilization of the resources in many countries. For example, mining of oil shale is accompanied by sulphide oxidation, followed by groundwater pollution and triggering spontaneous combustion of the waste rock heaps. If oil shale is used for power generation or by chemical industry, the ash may be classified as hazardous waste, creating the risks of water pollution.

The environmental impacts of two different oil shales occurring in Estonia - kukersite and Dictyonema argillite have been studied. Using the tools of hydrogeochemical modelling and chemical engineering, the models have been created that explain the environmental impacts. Kukersite oil shale has no potential to cause acid drainage during and after mining, the sulphate content in the drainage waters has a limiting condition of gypsum precipitation. Oxidation of the Dictyonema shale leads to the formation of acid leachate and mobilisation of the heavy metals, but is buffered by limestone in the waste rock heaps originating from the overburden of the shale. Both oil shales can cause spontaneous combustion of the waste rock heaps if improper technologies of disposal have been used. Kukersite ash and semicoke are highly alkaline, but the emissions are buffered close to the waste by simple mixing with ground water or reaction with gaseous carbon dioxide.

It is possible to use the modelling concepts for predicting environmental impacts during the planning phase of oil shale utilization of any deposit. The reactions regarding the inorganic phase are more predictable, the predictions regarding the impacts of organic matter of the processing waste are not straight forward. The models can be used for prevention of spontaneous combustion. This has been successfully done in Estonia during planning of a municipal landfill in the mine area containing oil shale. Modelling can also be used for selection of appropriate and cost effective technologies for minimisation of the water pollution, as well as to prove that the reuse of oil shale wastes in various applications is permissible.