Title:

Retorted Oil Shale In Estonia: An Environmental Audit

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The main objective of this investigation is to present an environmental audit of retorted oil shale, which is based on physico-chemical study of the solid residues of the retort processes utilized for shale oil production in Estonia. Laboratory and field experiments were performed to characterize residual organics, sulfur species, leaching chemistry and the changes occurring during weathering. It is generally known that fresh oil shale thermal treatment wastes contain chemically active compounds, which undergo different chemical reactions when in contact with air and water. This is why everything starting from sampling, sample storage and selection of analysis methods is important to get a true picture of hazardousness of these initially reactive wastes. We have seen that using of several evaluated analysis methods will give highly over- or underestimated results for environmentally important parameters. For example, semicoke even does not comply with the waste acceptance criteria for landfills set in EU, exceeding the limit value for total organic carbon (TOC). However most of the TOC originates from elemental carbon – pyrolysis char, probably the best part of the waste. We also hope that the phenols in retorted oil shale could be referred as to the problem of the past in the very near future. Still we had to answer the question, why the phenolic pattern of leachates and contaminated surface and ground water around semicoke embankments differ sufficiently. Model experiments with major phenolic compounds found in the semicoke leachates were performed to show the chemical reactions behind the changes in the content of organics in the leachates. Oxidation of phenols and resorcinols was studied and molecular structures of alkaline auto-oxidation products of 2.5-dimethylresorcinol proved by NMR. The proposed new landfilling technology, where retorted oil shale will be mechanically compacted to reduce permeability has given good results. Unfortunately the leachable organics and sulfur are not oxidized in these conditions. The data obtained allow us to predict flows and emissions, when different waste treatment schemes are applied. We have also defined the crucial components of the material flow of the retort processes that influence the composition of retorted oil shale. We also try to answer the question whether it is possible that retorted oil shale is treated in the way that it could be classified as non-hazardous waste.

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