

4.1 **Solid Wastes of Oil Shale Processing, Environmental Challenges of Disposal and Use**

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Oil shale (OS) resources are widely used for energy generation and oil production in many countries. Due to high mineral content, processing of OS always results in vast (60-88%) quantities of solid wastes having widely varying composition. There are both economical and ecological needs to convert the enormous quantities of OS ash into a resource. The aim of the current investigation is the evaluation of the chemical and physical characteristics of waste material for safe industrial application and environmentally friendly disposal. Important main ingredients in OS wastes are usually Si, Al, Fe, Ca and Mg oxides. The content of Si and Al varied in OS fly ash fractions obtained from different units of ash removal systems whereas the ratio of Al to Si remained almost the same. For industrial applications the existing commonly used ASTM classification for coal fly ash utilization systems (class F and C ash) was applied as a specification prototype for each of the OS ash fractions. A special treatment strategy for industrial applications of OS ash fractions was found to be promising. Hydrothermal alkaline activation of OS fly ash was also studied using SEM/EDX, XRD and ²⁹Si and ²⁷Al high-resolution MAS-NMR spectra. The silicon in the original fly ashes was completely converted into Calcium-alumino-silicate hydrates, mainly into 1.1 nm tobermorite structures. The local structure of synthesized tobermorite samples implies long silicate chains with small number of bridging sites. The results obtained show that the oil shale fly ash can be used for production of geopolymers, e.g., Al-substituted tobermorites. Bulk chemical analysis was performed for OS ash and spent shale samples taken from the thermal power plants, retorting facilities, and disposal. The concentrations of trace metals were consistent with ICP and X-ray data. Assessment of mobility of pollutants in ash and spent shale matrices was based on results of the laboratory batch leaching tests and in situ verifications, performed at the disposal site. The continuous release of toxic trace metals, radionuclides and organic compounds from ash and spent shale to the water phase was found in laboratory tests. Thus, the strategy of any method for utilization of OS wastes should include pretreatment of material to eliminate hazardous ingredients or decrease their mobility.