18.12 **A new method for utilizing oil shale ash: Preparation of silica nanoparticles**

Haifeng Zou, Guimei Gao, Shucai Gan, Xuechun Xu

Jilin University, Changchun, China

A by-product of oil shale processing is ash, which is considered to be a hazardous material. There is a need for an ash handling strategy regarding disposal and/or beneficial reuse. Oil shale ash (OSA) is mixture of inorganic and organic components. The inorganic or mineral component of many OSA materials is composed mainly of silicon dioxide (SiO_2) and alumina (Al_2O_3). Here, we propose as an alternative to disposal the use of OSA as a feedstock for production of a high-grade silica product. In this work, spherical silica nanoparticles were synthesized using OSA. The preparation method requires a series of processing steps. First, the calcined OSA (100 g) is mixed with 30 wt.% sulfuric acid solution (500 g) at 100°C for 2 h. The slurry is then filtered and washed with double distilled water until all acid is removed. The pretreated OSA is then mixed with a 30 wt.% sodium hydroxide solution (400 g) to dissolve the silica, producing a sodium silicate solution. The sodium silicate formed is then filtered and washed with boiling distilled water. The filtrate and washing solution are then heated to reduce the total mass to 550 g yielding an approximately 8 wt.% sodium silicate solution. Synthesis of silica nanoparticles begins with the addition of a surfactant water solution (30 g) to the OSA-derived sodium silicate solution followed by sonication. Following this step a 0.5 mol L^{-1} sulfuric acid solution is added gradually to the solution in order to form gel. The resulting gel mixture is then aged for 8 h, filtered and washed. The filtration cake is then distilled with butanol and calcined at 550°C for 2 h to remove the surfactant yielding silica nanoparticles. Our experimental results show that good dispersion and uniform silica particles (average diameter ~10 nm) are obtained. Moreover, the silica nanoparticles prepared have high purity (99.90%) and a large specific surface area (~700 m^2 g^{-1}). This procedure allows for low cost production of silica nanoparticles for practical applications and provides a new way to mitigate the problem of OSA disposal.