

## **Phase, morphological, and magnetic properties of iron oxide nanoparticles extracted from mill scale waste and its surface modification with CTAB surfactant**

### **ABSTRACT**

Tremendous accumulation of mill scale waste consisting of iron oxides, metal alloys, and impurities such as dust and sand contributes to the landfill pollution and endangers the environmental ecosystem. In order to recycle the mill scale waste, iron oxide was extracted by using magnetic separation technique (MST) and Curie temperature separation technique (CTST), and then high-energy ball milling (HEBM) process was carried out for various milling times at 4, 6, 9, and 12 h to obtain different average particle sizes of the iron oxide nanoparticles. Surface modification of the iron oxide nanoparticles with cetyltrimethylammonium bromide (CTAB) was carried out to study the effect of surface modification on the morphological, physical, and magnetic properties of the iron oxide nanoparticles. After the characterization, iron oxide obtained from mill scale waste consisted of hematite, magnetite, and wuestite phase with decreasing average particle size as the milling time was increased and prolonged milling time led to the phase transformation in the sample. Without surface modification, iron oxide nanoparticles were agglomerated and the surface area per volume of the iron oxide nanoparticle was reduced. The surface modification of iron oxide nanoparticle with CTAB has successfully overcome the agglomeration problem and increased the surface area per volume of the iron oxide nanoparticles. However, the magnetization values were decreased after surface modification.

**Keyword:** Mill scale waste; Magnetic separation technique; Curie temperature separation technique; Iron oxide nanoparticles