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# Synthesis of magnetite from iron-rich mine water using sodium carbonate

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## Abstract

In recent decades, much research has been paying attention on the treatment and desalination of acid mine drainage (AMD) with minimal focus on the recovery of minerals from the resultant residues. Solid sludge produced after the treatment process is highly mineralised and technologies are required for the processing of the final sludge for possible industrial application. Conventionally, magnetite is synthesized using iron-rich, industrial grade chemical reagents making magnetite expensive to produce. This has urged the need to come-up with pragmatic and sustainable technologies of recovering magnetite from waste materials. This has led to the development of the present study which aimed at pre-treating AMD in such a way that magnetite could be generated from the recovered sludge. Synthesis of magnetite nanoparticles was evaluated at varying temperature gradients. The principal mechanism governing the metals recovery was selective precipitation. This was achieved by manipulating the pH and aeration rate of the reaction mixture. Experimental results revealed that optimum conditions that are suitable for the recovery of magnetite nanoparticles from AMD were 2:1 mol ratio of Fe(II)/Fe(III), pH = 10 and temperature ranging from 25 to 100 °C. The purity of synthesized magnetite was 24 (Wt.%) for Al-removed magnetite and 28 (Wt.%) for magnetite synthesized with no Al-removal. Particle size analysis indicated the presence of magnetite nanoparticles having diameters of 0.5 nm. SEM-EDS and mapping revealed the presence of Fe and O on the matrices of synthesized material hence confirming that the recovered material is magnetite. This study successfully proved that magnetite nanoparticles can be synthesized from iron-rich mine drainage.