Abstract

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ProMine – Nano-particle products from new mineral resources in Europe
Schwertmannite – Raw material and valuable resource from mine water treatment processes
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Abstract

ProMine addresses the concerns of the European commission over the annual 11 billion Euro trade deficit in metal and mineral imports. Higher quality and added value products on the European market as well as the recovery of valuable resources from supposed waste materials could efficiently improve this situation. The development of various nano-particle materials from waste products or mining residues is one of the main objectives in ProMine.

The production of the raw material schwertmannite during the water treatment of acid mine water in the Lusatian brown coal mining area is a crucial step to recover and concentrate iron from mine water. Schwertmannite is an ironhydroxysulphate mineral, which precipitates from iron and sulphate rich acid mine water at a pH between 2.8 and 4.5 (see equation).

\[ 16 \text{Fe}^{3+} + 3.5 \text{SO}_4^{2-} + 25 \text{H}_2\text{O} \rightarrow \text{Fe}_{16}\text{O}_{16}(\text{OH})_{9}(\text{SO}_4)_{3.5} + 41 \text{H}^+ \quad (1) \]

The G.E.O.S. Ingenieurgesellschaft mbH has developed a pilot-scale technology in Nochten (open cast mine) where schwertmannite is formed during microbial treatment of acid mine water. Schwertmannite, a supposed waste product in mine water treatment, has got a high potential for the production of valuable nano-particle products for instance iron oxide pigments as focused in the ProMine project. Iron oxide pigments have got a wide range of applications in ceramics, building materials and the colour and coating industry. Usually the iron oxide pigments are produced from iron salt solutions of the chemical industry or other ferruginous residues. The microbiologically generated schwertmannite is a very pure mineral containing almost no contaminants and with a high specific surface. The processing of schwertmannite to iron oxide pigments is achieved by washing, filtration, drying, annealing and grinding of the raw material. Finally the obtained iron oxide pigments are evaluated according to general european standards.

However, schwertmannite is not only a valuable resource for iron oxide pigments but exhibits excellent characteristics for the use as water treatment material. Adding biosynthesized schwertmannite to contaminated waters, its transformation to ferric hydroxides and the associated large sorption capacity are suitable to remove heavy metal anions like AsO$_4^{3-}$ by adsorption processes from mine water.

Keywords: ProMine, schwertmannite, microbial treatment of mine water, iron oxide pigments

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