

## Effect of pH conditions on goethite behavior in the presence/absence of different dispersants

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### ABSTRACT

Dispersion and settling behavior of goethite has been studied and effect of pH values on surface properties of goethite particles with /without dispersants has been discussed. A prerequisite for the successful selective flocculation is the stabilization of the system which is achieved by the good dispersion of particles. The effect of pH, sodium silicate (Na<sub>2</sub>SiO<sub>3</sub>), sodium hexametaphosphate (Na<sub>6</sub>P<sub>6</sub>O<sub>18</sub>) and sodium pyrophosphate (Na<sub>4</sub>P<sub>2</sub>O<sub>7</sub>), on the surface charges of goethite was studied.

**Materials:** Natural goethite from Omarska mine (Bosnia and Herzegovina) was handpicked. It has following chemical composition (in mass %): Fe 57.16, SiO<sub>2</sub> 4.44, Al<sub>2</sub>O<sub>3</sub> 0.59, Mn 1.18 and LOI 10.86; and density of 3,940 (g/cm<sup>3</sup>). All reagents used were of analytical grade, and they were prepared as solutions in distilled water. The sodium hexametaphosphate (SHMP), sodium pyrophosphate (SPP) and sodium silicate (SS) manufactured by Lach-Ner, s.r.o. (Czech Republic), were used as dispersants. As pH modifier, 0.1M NaOH and 0.1M HCl were used.

**Methods:** Settling-dispersion experiments, Zeta potential measurements.

### RESULTS AND DISCUSSION

#### 1. SETTLING BEHAVIOR OF GOETHITE AT DIFFERENT pH

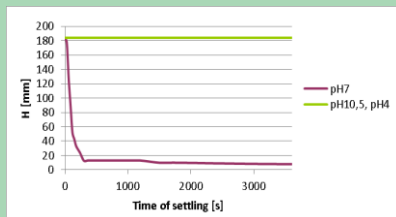


Figure 1. Natural settling of goethite at different pH values

Goethite particles do not precipitate at either pH 4 or pH 10, because of increasing of surface charge causing the repulsive forces. At condition of neutral pH, the dispersion is unstable, because there are no reflective forces present among the particles and precipitation occurs (IEP at pH=6.7).

The test results of settling behavior of goethite are in good agreement with the results of measurements of zeta potential. At pH 7 fast settling of goethite particles occurred. In acidic and alkaline medium, which is farther from the IEP, the dispersion is stable and no deposition occurs.

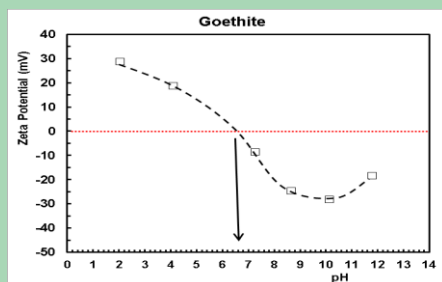


Figure 2. The zeta potential of goethite with the IEPs at pH=6.7 values

#### Literature:

- [1] Drzymala, J. *Mineral processing, Foundations of theory and practice of mineralurgy*, Wroclaw University of Technology, **2007**, 449-462
- [2] Ma, M. The dispersive effect of sodium silicate on kaolinite particles in process water: Implications for iron-ore processing, *Clays and Clay Minerals* 2011, 59,3,233-239

#### 2. DISSERSION STUDIES

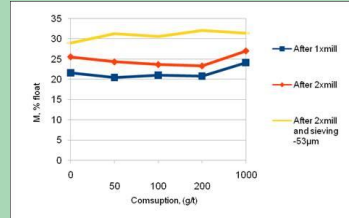


Fig.3. Goethite with SHMP

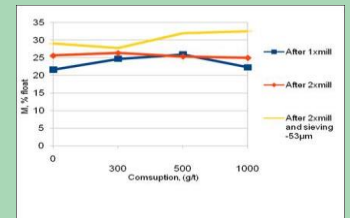


Fig.4. Goethite with Sodium silicate

#### 3. ZETA POTENTIAL STUDY

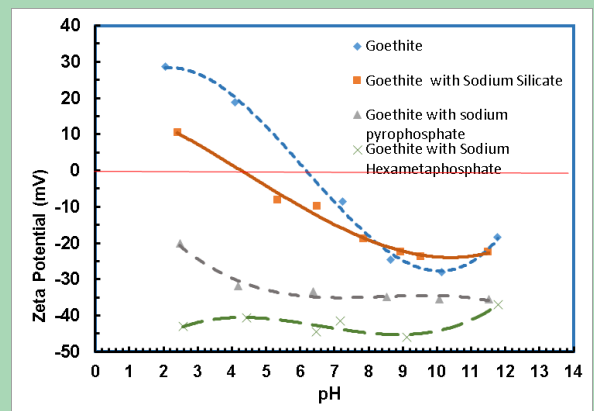


Figure 5. Zeta potential of the goethite in absence/presence of different dispersants

The IEP for goethite in this investigation, pH=6.7, is similar to the values that can be found in the literature. With the use of sodium silicate the IEP of goethite moves to pH 4.95. An IEP could not be detected when the poly-phosphates were used and the surface charge is negative from pH 2 to pH 12.

#### CONCLUSION

The results have shown that the dispersion stability of the investigated goethite sample is affected by the pH modification and the presence of dispersants.

The settling - dispersion tests at pH=7 show that all of the used dispersants cause the stable dispersion of the goethite. At pH 7 fast settling of goethite particles occurred in absence of dispersants, while in the presence of dispersants deposition is completely absent. All of the used dispersants disperse well goethite at pH7.

The settling - dispersion test results are well correlated with zeta potential measurements.

It can be assumed that the interaction of silicate with goethite is predominantly electrostatic because there is no significant effect on the surface charge of goethite in the alkaline medium.

The presence of the poly-phosphates causes significant increase of negative zeta potential magnitudes also in the alkaline medium indicated forming weak or chemical bonds with goethite surfaces.

The maximized magnitude of zeta potential of goethite in presence of SHMP at a pH 9-10 suggested higher dispersive stability.

