Fundamentals of rare-earth flotation surface chemistry: Hydroxamate adsorption on bastnasite

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Background

The adsorption of surfactants on the surface of a mineral is largely controlled by the electrical nature of that mineral. Typically, if the mechanism of collector adsorption is of a physical nature, a cationic collector will be attracted to a negatively charged particle and vice versa. In the case of chemical adsorption, a collector with the same charge will be attracted to a particle with the same charge, for example, an anionic collector adsorbed on a negatively charged particle.

Research aim

The aim of this research was to investigate the mechanism of hydroxamate (HXM) collector adsorption, physical or chemical, on a pure bastnasite mineral – $(\text{Ce}, \text{La})\text{FCO}_3$ – using measurements of zeta potential and adsorption density.

Materials and methods

To illustrate the effect of the HXM collector on the zeta potential of bastnasite, 0.1-g/L samples of bastnasite were conditioned in solutions containing 0 M, 10^{-4} M and 10^{-3} M hydroxamate for 24 hours. Measurements of zeta potential were performed using a Microtrac Stabino instrument.

The amount of hydroxamate adsorbed on bastnasite as a function of temperature – 25 and 80°C – and hydroxamate

concentration – 5×10^{-4} to 5×10^{-3} M – was measured using the solution depletion method with a Shimadzu UV160 UV-Vis spectrophotometer.

Results

Electrokinetic measurements for bastnasite in the presence of the anionic HXM collector show that the isoelectric point (IEP_{pH}) shifted in the acidic direction as the concentration of hydroxamate increased.

Adsorption density measurements show adsorption of hydroxamate at equilibrium pH values of 7.1 for 25°C and 6.8 for 80°C. At these pH values, the zeta potential of bastnasite was negative.

Conclusions

As the amount of anionic collector in solution increased, the zeta potential of bastnasite decreased (Fig. 1). Adsorption density results indicate that the equilibrium pH where hydroxamate adsorption occurred was also the pH where the zeta potential of bastnasite was negative.

The combination of these results supports the postulation that the adsorption of hydroxamate on bastnasite occurs through a chemisorption mechanism.

Figure 1 — Effect of hydroxamate concentration on the zeta potential of bastnasite.