Competitive Sorption of Inorganics impurities from Aqueous Solutions onto Boric Acid: Implications on its Crystal Growth

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INTRODUCTION

The necessity of safe operations of energy nuclear plants requires addressing the problems of control of nuclear fission reactions, for the countries where they are present. For this purpose high purity boric acid is added to the cooling water used in high pressure reactors due to boron compounds are good absorbers of thermal neutrons, owing to isotope ^{10}B. Boric acid is crystallized from brines. They are multicomponent aqueous solutions that contain inorganic species such as Na^+, Li^+, K^+, Mg^{2+}, SO_4^{2-} and Cl^-. Those impurities affect the growth rate and purity of boric acid. In this context is the great importance to study the phenomena that govern the transport of impurities and the developments of models for the description of the migration processes during the crystal growth from impure solutions.

In a former work[1] we have found that the reduction of the growth rate of boric acid by sodium sulfate could be due to that salt competes with boric acid for the adsorption sites on the crystal surface. It is adsorbed preferentially on the actives sites of the crystal surface as its concentration increases. Therefore it is utmost importance to take into account competition between species for active sites on the crystal surface to improve the quality of the boric acid. In addition in spite of Na^+, Li^+ and SO_4^{2-} species are the main impurities presents on aqueous solutions of boric acid, studies on the uptake of them onto boric acid have not been reported yet in the literature.

OBJECTIVES

The aims of this work are to investigate a) the sorption uptake of Na^+, Li^+ and SO_4^{2-} and the existence of competitive sorption processes between these ions and b) estimating the impurities sorption on the actives sites on the crystal surface of boric acid during its crystal growth.

METHODOLOGY

Reagents. Boric acid, sulfuric acid, sodium tetraborate, lithium tetraborate, sodium sulfate and lithium sulfate.

Equipment. Ionic chromatography, SEM and UV-vis Spectrophotometer.

Procedure. The sorption of boric acid and ions on the surface of boric acid is evaluated by single component and multicomponent batch experiments. The morphology of crystal surfaces of the boric acid is characterized by SEM. The concentrations of Na^+ and Li^+ ions in the solution are determined by ionic chromatography and UV-vis Spectrophotometer for SO_4^{2-}.

Sorption data is fitted by sorption models and correlated with growth rate data, from a former work, by crystal growth models[2].

RESULTS

First results concerning the uptake of Na^+, Li^+ and SO_4^{2-} on the crystal surface of boric acid will be presented.

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