Influence of Electrolytes and pH on the Solubility of 2-Keto-L-gulonic Acid in Aqueous Solutions

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Industrial biotechnological processes often suffer from high production costs and high energy consumption. This is mainly due to the downstream processing in which the desired products have to be separated from of the complex diluted aqueous solutions. In the EU Horizon 2020 project “PRODIAS – Processing Diluted Aqueous Systems” novel energy- and cost-efficient methods for the downstream processing of bio-based products are developed. One of the processes studied in this project is the biotechnological production process of 2-keto-L-gulonic acid (KGA). The KGA production is an intermediate step in the production of L-ascorbic acid (Vitamin C). In the process, KGA is initially obtained highly diluted in an aqueous solution which also contains a large variety of other components including electrolytes. Crystallization offers a possibility to recover and simultaneously purify the KGA. Depending on the pH and the ion concentrations in the solution, KGA crystallizes in its protonated form or as organic salt, e.g. sodium KGA. Regarding the conceptual design of the crystallization process, the knowledge of both the crystallizing species and their solubility are important. In this work, the solid-liquid equilibrium of KGA in aqueous solutions containing sodium and chloride ions was studied experimentally at varying temperatures, pH values, and ion concentrations. Both the liquid and the solid phases were analyzed. A thermodynamic model that describes the activity coefficients in the electrolyte solution using the Pitzer approach was developed including the adjustment of specific interaction parameters. The model shows excellent agreement with the experimental results and is a useful tool for the conceptual process design.