

Solubility, Phase Equilibria, and Solid Phase Characterization of Potassium and Sodium Pyrophosphate in Aqueous Solutions over the Temperature Range 298.15–353.15 K

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Abstract: Understanding the phase equilibria and solubility behavior of potassium and sodium pyrophosphate in aqueous systems is of considerable importance for both fundamental and applied aspects of phosphate chemistry [1]. A detailed thermodynamic description of these systems is essential for accurately modeling solid–liquid equilibria and predicting the stability of different solid phases over a wide range of concentrations and temperatures [2]. Such knowledge is particularly relevant for processes involving phosphoric acid and its derivatives, where crystallization, dissolution, and complex formation may significantly affect the overall system behavior [3]. In this study, the solubility of potassium and sodium pyrophosphate was investigated over a temperature range of 298.15 to 353.15 K using equilibrium methods [4]. The results show a temperature-dependent solubility increase for both systems, attributed to enhanced ionic mobility and water activity. X-ray diffraction analysis revealed the formation of distinct phases, $K_2HPO_4 \cdot 3H_2O$ and $Na_2HPO_4 \cdot 7H_2O$, at various temperatures. This crystallization is influenced by specific solution conditions, particularly temperature and ionic strength, which determine the nature of the solid phase. These findings offer valuable insights into the comparative behavior of potassium and sodium pyrophosphate salts, contributing to better process control in the production of phosphoric acid derivatives and supporting the design of more efficient and sustainable industrial systems.

Keywords: pyrophosphate, Solubility, Thermodynamic properties, Water activity, hygrometric method

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