

Standard State Thermodynamic Properties of Completely Ionized Aqueous Sodium Sulfate and Sulfuric Acid using High Dilution Calorimetry up to 598.15 K

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The integral heats of solution of sodium sulfate, $\text{Na}_2\text{SO}_4(\text{cr})$, were measured to very high dilutions (10^{-4} m) up to 573.16 K. These data were analyzed with and without invoking hydrolysis of $\text{SO}_4^{2-}(\text{aq})$ and/or association of $\text{Na}^+(\text{aq})$ with $\text{SO}_4^{2-}(\text{aq})$ and $\text{NaSO}_4^-(\text{aq})$ [1, 2, 3] in order to obtain the standard state thermodynamic properties of completely ionized $\text{Na}_2\text{SO}_4(\text{aq})$. From these and the literature data on solubility, the activity coefficients of saturated aqueous solution of sodium sulfate were calculated and compared with literature data up to 573.15 K. From the measured differences between similar properties of $(\text{H}^+-\text{Na}^+, \text{aq})$ [4], the thermodynamic properties for completely ionized sulfuric acid, $\text{H}_2\text{SO}_4(\text{aq})$, were obtained from ionic additivity from 298.15 K to 598.15 K. Although there are no comparable thermodynamic data available at such high dilutions in the literature, the present results for $\text{Na}_2\text{SO}_4(\text{aq})$ can be used for many thermodynamic studies by others [5, 6] to achieve a complete thermodynamic description of this key electrolyte over very wide ranges of concentrations.

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