The IAPWS Industrial Formulation for the Thermodynamic Properties of Seawater

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Abstract

Development and operation of desalination plants require knowledge of accurate thermodynamic properties of seawater and their fast calculation. Therefore, the International Association for the Properties of Water and Steam (IAPWS) adopted the "Advisory Note No. 5: Industrial Calculation of the Thermodynamic Properties of Seawater" (IAPWS 2013) as an international standard for the calculation of the thermodynamic properties of seawater for industrial use. This standard contains an equation of state in the form of the Gibbs free energy for seawater which consists of one part for pure liquid water and one part for dissolved sea salt. The water part is calculated from the "IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam" (IAPWS-IF97) and the saline part from the "IAPWS Formulation 2008 for the Thermodynamic Properties of Seawater" (IAPWS-08) which represents the scientific standard for seawater. The purpose is to introduce the new IAPWS industrial standard for the thermodynamic properties of seawater to the community of water resources management developers and operators to enable more accurate and efficient calculations in their daily work. All thermodynamic properties and thermodynamic derivatives for seawater can be calculated with high accuracy sufficient for process modelling. In comparison with the use of the scientific formulation IAPWS-08, the computing speed of the industrial formulation IAPWS 2013 for seawater is increased by a factor of 100 to 200 depending on the requested property function. The industrial formulation IAPWS 2013 for seawater may be applied in calculations for analyzing, designing, simulating, operating, and optimizing desalination processes and for calculating cooling processes with seawater in power plants.