

IAPWS Certified Research Need – ICRN

Thermophysical Properties of Seawater

Closing Statement

In 2007, the IAPWS Working Group “Thermophysical Properties of Water and Steam” and the IAPWS “Subcommittee on Seawater” examined the published work and experimental data available for the description of various properties of seawater with a natural composition of dissolved salt, relevant to conditions of temperature, pressure, and salinity appearing in the world ocean and in technical systems like power stations or desalination plants. They found that the available data was not sufficiently accurate and comprehensive to fully construct a thermodynamic equation of state, as well as further equations for transport properties, refractive index and surface tension, and gas solubilities, over the entire range of interest to oceanographic research, underwater technology and land-based industrial plants running on seawater. Effects of sea salt composition anomalies, which occur throughout the oceans, on most of these properties were also not known. ICRN-16 was issued to encourage advancement in these areas. The ICRN was updated in 2010 and 2014. In these updates significant progress was tabulated in these areas, but many of the outstanding issues were still unresolved.

Importantly, over 2007-2014 the available data was used to construct workable equations and software for many of these purposes, at least over smaller ranges of interest (e.g., IOS et al., 2010, Nayar et al., 2016). New researchers are also exploring other technical approaches towards in-situ measurements of, for example, refractive index. Much of this work, as well as proposed research directions for the future, was then comprehensively described in a 4-part set of articles (Feistel et al., 2016, Pawlowicz et al., 2016, Dickson et al., 2016, Lovell-Smith et al., 2016).

However, since then there has been little further fundamental advancement in the required knowledge, although many details have been clarified and some critical long-term studies into the stability of seawater reference materials have been finally completed (Uchida et al., 2025a, 2025b). In addition, there have been some new experimental measurements of seawater density (Schmidt et al., 2016, 2018; Romeo et al., 2019, 2021; Kayukawa and Uchida, 2021; Blahut et al.) and sound speed (Lago et al., 2015; Fehres, 2021) that increase the knowledge base and in some cases expand the range of parameter space for eventual improvement or extension of the thermodynamic equation of state of seawater.

Although the broader requirements of the ICRN still exist, at present it may be more useful to close this document, and to instead issue new documents on more restricted topics according to future interests as they arise.

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