Minutes

IAPWS Subcommittee on Seawater (SCSW)

Plzeň, Czech Republic, September 5-8, 2011

NOTE: These Minutes include some items that were held jointly with the TPWS and/or IRS Working Groups. Items are listed according to their order on the SCSW agenda, which is Attachment A. **Bold print** denotes significant actions.

1. The meeting was opened on Monday, September 5 by the SCSW Chair, Rainer Feistel. The agenda (Attachment A) was adopted.

2. Allan Harvey was appointed Clerk of Minutes for SCSW.

3. (included as item #3 in the TPWS Minutes)

4. (thermal conductivity) (included as item #5 in the TPWS Minutes)

5. (0.1 MPa liquid properties) (included as item #6 in the TPWS Minutes)

6. (humid gases) (included in IRS Minutes)

7. (seawater for industrial use) (included as item #9 in TPWS Minutes)

8.1. R. Feistel reported on the implementation into software libraries of the TEOS-10 standard formulations, which has been officially recommended for marine science by the International Union of Geodesy and Geophysics (IUGG) in 2011. Next steps in library development were described, although progress has been slowed by loss of key personnel. Details on the libraries are available at www.TEOS-10.org.

8.2. R. Feistel reported on recent measurements of density and sound speed in the group of F. Millero for seawater to moderately high temperatures at atmospheric pressure. J. Safarov reported on recent measurements, not yet published, of seawater densities over a wide range of temperature (to 195 °C), pressure (to 140 MPa) and salinity (to 55 g/kg). These data will all be useful for possible extension of the seawater thermodynamic formulation to higher temperatures as desired for some industrial applications.

8.3. S. Seitz and P. Spitzer reported on an ocean metrology project through the EMRP (European Metrology Research Programme). Areas of interest to IAPWS include traceability of practical salinity to density, getting data for sound speed over a wider range, metrology of dissolved oxygen, and standards for the pH of seawater and trace composition measurements.

8.4. B. Laky and S. Weinreben reported on the development of an instrument for high-accuracy measurements (also at sea) of the difference between seawater density and pure water density at the same temperature, as part of an effort toward making density-based salinity standards. The need to degas the fluids for reliable operation of the vibrating-tube instrument was emphasized. Some results were presented for Baltic Sea Water.

8.5. M. Hiegemann (with contributions from Task Group member H. Glade who was not present) reported on industrial requirements for seawater properties in desalination and other applications. To meet the needs of these industries, the tentative recommendation is for temperatures up to 150 °C to be covered, with salinities at least to 70 and preferably to 100. Pressures are not so high compared to oceanographic conditions (80 MPa to cover reverse osmosis). An industry survey was made, with 5 of 10 recipients responding. Suggestions regarding needs mostly did not affect the required range, but also included zero liquid discharge plants which have high salinities (and varying composition) at crystallization. In discussion, cooling towers was mentioned as another area of interest. **The Task Group will follow up with those who did not respond to the initial survey, and then incorporate the results into a revised seawater ICRN to be considered in 2012.**

8.6. A. Anderko summarized his work with P. Wang on modeling the thermal conductivity of seawater. The work turned out well, and has been submitted for publication. **Dr. Anderko and the Task Group on Transport Properties appointed in item 6 of the 2009 SCSW minutes were encouraged to work toward developing a an IAPWS Guideline, with minor changes to the current work so that it meets the new pure-water thermal conductivity correlation in the pure-water limit. The draft Guideline should be distributed prior to the 2012 meeting, at which time an Evaluation Task Group will be appointed with the goal of approving the formulation in 2013.**

8.7. R. Feistel, in conjunction with R. Pawlowicaz who was absent, presented an update on the electrical conductivity of natural waters and seawater. There is a desire to produce an IAPWS correlation equation for this property as a function of salinity, meeting the low-density limiting laws (part of which has been newly derived). Progress was also reported on a project for relating the chemical composition to conductivity, density, temperature, and salinity for less concentrated natural waters.

8.8. A. Anderko reported on his recently published work with P. Wang on surface tension of electrolyte solutions, which can be applied to seawater.

8.9. P. Spitzer presented work, some of which was done by G. Marion, on the varying standards and definitions used for pH and efforts to rationalize them in a way that works for seawater, including establishing uniform nomenclature, definitions, and conventions.

8.10. J. Safarov reported on his experimental work in progress for measuring the solubility of carbon dioxide in water and seawater from 273 K to 298 K up to about 5 MPa.

8.11. R. Feistel reported on some preliminary work with Jeremy Lovell-Smith on clarifying the different definitions in use for relative humidity..

8.12. Regarding the Mission Statement requested by the President, the following minor modification of last year's statement was adopted:

Intended for application in oceanography, marine technology and industry, it is the aim of the Subcommittee on Seawater to develop new and to improve existing formulations on thermophysical properties of seawater, including physical and chemical properties of related ambient substances such as ice, humid air and seawater solutes.

9. (metastable steam and nucleation) (included as item #12 in the TPWS Minutes)

10. (supercooled water) (included as item #13 In the TPWS Minutes)

11. (IAPWS/BIPM cooperation) (included as item #15 in the TPWS Minutes)

12.1-12.6 (included under item 19 of the TPWS Minutes)

13. **It was voted to accept to membership in SCSW O. Hellmuth (Leibniz Institute for Tropospheric Research) and J. Safarov (University of Rostock). It was announced that T. McDougall was stepping down as a Vice-Chair of SCSW. Rich Pawlowicz was selected as a new Vice Chair; we recommend that the EC approve this change.**

14. The SCSW endorsed the recommendations of the Website Task Group and the proposed change to the By-Laws.

15. The Chair and Clerk of Minutes were appointed to prepare the formal motion of the WG to the EC.

16. The meeting was adjourned at 5:15 PM on Thursday, September 8.

Agenda for the Subcommittee on Seawater (SC SW)

Pilsen, Czech Republic, 04-09 September 2011

1. Opening Remarks; Adoption of Agenda
2. Appointment of Clerk of Minutes
3. OPAL Web Space for Working Material for WGs TPWS, IRS, and SC SW, joint with WG IRS and TPWS
4. Release on the IAPWS Formulation 2011 for the Thermal Conductivity of Ordinary Water Substance, joint with WG IRS and TPWS
   - Report (J.V. Sengers, E. Vogel, R.A. Perkins, M.L. Huber, D.G. Friend, M.J. Assael, I.N. Metaxa)
   - Test Report on the Scientific Formulation (R. Mares, J. Hruby, K. Miyagawa, V. Vins, K. Orlov)
   - Test Report on the Industrial Formulation (W.T. Parry, J. Hruby, K. Miyagawa, V. Vins, K. Orlov)
   - Formal consideration of the Release
5. Revised Supplementary Release on Properties of Liquid Water at 0.1 MPa, joint with TPWS and WG IRS
   - Report (A.H. Harvey)
   - Test Report (K. Miyagawa, H.-J. Kretzschmar)
   - Formal consideration of the Revised Supplementary Release

Tuesday 01:30 pm:

6. Properties of Humid Air and Humid Combustion Gases for CCS Technology, joint with WGs IRS, PCAS, and TPWS
   - Thermodynamic Modeling of Processes Related to Carbon Dioxide Capture and Sequestration (A. Anderko)
   - Closing Statement for ICRN-14 (A.H. Harvey, R. Span)
   - Proposal for a new ICRN (R. Span, A.H. Harvey)
7. Guideline on the Properties of Seawater for Industrial Use, joint with WGs IRS, PCAS, and TPWS
   - Report of the Task Group (J. Cooper, R. Feistel, M. Hiegemann)
   - Report of the Evaluation Task Group (J. Hruby, R. Mares, K. Miyagawa)
   - Formal consideration of the Guideline
8. Properties of Seawater (R. Feistel), joint with TPWS and in part with WG IRS
   - 8.1 Implementation of TEOS-10 Libraries (T.J. McDougall, P. Barker, R. Feistel, J. Reissmann)
   - 8.2 New Seawater Measurements (R. Feistel, F.J. Millero, J. Safarov, A. Heintz, E. Hassel)
   - 8.3 The EMRP ENV05 Ocean Metrology Project (S. Seitz, P. Spitzer, H. Wolf)

8.4 Regular measurement of seawater density with Anton Paar instruments (B. Laky, S. Weinreben, R. Feistel)

8.5 Task Group Report "Industrial Requirements" (M. Hiegemann, J. Bellows, H. Glade)

8.6 Task Group Report "Transport Properties" (A. Anderko)

8.7 Electrical Conductivity of Seawater (R. Feistel, R. Pawlowicz)

8.8 Surface Tension of Aqueous Electrolytes (A. Anderko)

8.9 pH of Seawater and Pitzer Equations (P. Spitzer, G.M. Marion)

8.10 Solubility of CO_2 in Seawater (J. Safarov)

8.11 On the Definition of Relative Humidity (R. Feistel, J. Lovell-Smith)

Thursday 08:00 am:

9. Metastable Steam and Nucleation, joint with WGs IRS, PCAS, and TPWS
   - Report of the Task Group (J. Hruby, K. Yasuoka, N. Okita)

10. Properties of Supercooled Water, joint with PCAS and TPWS

    - Novel Thermodynamics and Equation of State for Supercooled Water - Proposal for an ICRN (V. Holten, Ch. Bertrand, J. Kalova, D. Fuentevilla, M. Anisimov, J. Sengers)

11. Suggestion for IAPWS - BIPM Collaboration, joint with TPWS
    - Report (R. Feistel, S. Rudtsch)

12. Reports on Other TPWS Activities

    12.1 Guideline on Fundamental Constants (A.H. Harvey), joint with WG IRS and TPWS

    12.2 Update of Advisory Note # 2: Roles of Various IAPWS Documents (J.R. Cooper, A.H. Harvey), joint with WG IRS and TPWS

    12.3 Report of the Advisory Note Task Group (I. Weber, W.T. Parry) , joint with TPWS

    12.4 Web presentation of Releases, etc. (A.H. Harvey), joint with WG IRS and TPWS

    12.5 Links to Live Calculations of IAPWS Releases on IAPWS Website (K.A. Orlov, V.F. Ochkov), joint with WG IRS and TPWS

    12.6 Discussion about IAPWS Meetings Regarding Locations and Costs (H.-J. Kretzschmar), joint with WG IRS and TPWS

13. Membership

14. Other Business

15. Preparation of the Formal Motion to the EC

16. Adjournment