HOCHSCHULE ZITTAU/GÖRLITZ (FH) - University of Applied Sciences

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Research Activities on the Thermodynamic Properties of Water and Steam

Report "Research in Progress 2003"

1. Supplementary backward equations $T(p,h)$, $v(p,h)$, and $T(p,s)$, $v(p,s)$ for region 3 of IAPWS-IF97
   - The backward equations $T(p,h)$, $v(p,h)$, and $T(p,s)$, $v(p,s)$ for region 3 of IAPWS-IF97 were successfully evaluated by IAPWS. During the evaluation process, further comparison and test calculations were carried out.
   - The Draft of "Supplementary Release on Backward Equations for the Functions $T(p,h)$, $v(p,h)$, and $T(p,s)$, $v(p,s)$ for region 3 of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam" was completed

2. Supplementary backward equations $p(h,s)$ for region 3 of IAPWS-IF97
   - The backward equations $p(h,s)$ for region 3 were completed and successfully tested in process modelling.
   - In addition, equations of h and s for the region boundaries and an equation $T_{sat}(h,s)$ for wet steam were developed.

     The equations can be used in combination with the Industrial Formulation IAPWS-IF97.
   - The Draft of "Supplementary Release on Backward Equations $p(h,s)$ for Region 3, Equations as a Function of h and s for the Region Boundaries, and an Equation $T_{sat}(h,s)$ for Wet Steam of the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam" was formulated and submitted to the IAPWS Working Groups "Industrial Requirements and Solutions" and "Thermophysical Properties of Water and Steam"

3. Supplementary backward equations $v(p,T)$ for region 3 of IAPWS-IF97
   - The investigations regarding the achievable accuracy close to the critical point and the division of region 3 into subregions were completed.
   - First equations were developed for the subregions.

4. Supplementary backward equations $p(h,s)$ for regions 1 and 2 of IAPWS-IF97
   - The comprehensive publication:
     Kretzschmar, H.-J., Cooper, J. R., Dittmann, A., Friend, D. G., Harvey, A., Gallagher, J., Knobloch, K., Mareš, R., Miyagawa, K., Stöcker, I., Trübenbach, J., Wagner, W., and Willkommen, Th., "Supplementary Backward Equations for Pressure as a Function of Enthalpy and Entropy $p(h,s)$ to the Industrial Formulation IAPWS-IF97 for Water and Steam"
     was completed and submitted to the Journal of Engineering for Gas Turbines and Power.

5. Investigations on Thermodynamic Properties of Humid Air - Part of the project "Advanced Adiabatic Compressed Air Energy Storage" (AA-CAES) of the European Union
   - A property data base for humid air was set up
   - Comparison calculations of different models for calculating thermodynamic properties of humid air were started

6. Implementation of the Industrial Formulation IAPWS-IF97 on pocket calculators
   - The program FluidCASIO for Casio ALGEBRA 2.0 was completed.
   - The program FluidTI for the model voyage 200 of Texas Instruments was prepared.

7. Property libraries for water and steam, combustion Gas mixtures, and humid air for education
   - The Versions for students of the programs
     Add-In FluidEXL for Excel®
     FluidMAT for Mathcad®
     were revised.

Zittau, August 19, 2003

H.-J. Kretzschmar