ELECTRONIC STEAM TABLES AND PROPERTY LIBRARIES FOR CALCULATING HEAT CYCLES, BOILERS, AND TURBINES

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The program libraries developed for the calculation of the thermophysical properties of water and steam, humid combustion gases, and humid air, can be used in the day-to-day work of the engineer who has to calculate heat cycles, boilers, steam and gas turbines, or further thermal processes. Thermodynamic properties, transport properties, thermodynamic derivatives and inverse functions can be calculated.

The electronic steam table library *LibIF97* has been set up to facilitate the modeling of heat cycles, boilers, and steam turbines. It calculates the properties of water and steam from the Industrial Formulation IAPWS-IF97 including the supplementary backward equations of IAPWS-IF97-S01 and IAPWS-IF97-S03.

Today, gas turbines are being developed for ever higher temperatures and pressures. The calculation of the combustion gases as ideal gas mixtures will, however, be inaccurate at high pressures. For this reason, the property library *LibHuGas* has been developed for humid combustion gases calculated as ideal mixtures of real fluids. The pointing effect for the saturation pressure of water in a gas atmosphere under pressure and the influence of the dissociation of the components at high temperatures have been taken into consideration.

At present, processes using humid air as a working fluid are designed for pressures up to 10 MPa and, conceivably, higher. For example, the advanced adiabatic compressed air energy storage technology requires very accurate algorithms for the thermodynamic and transport properties of humid air at low temperatures and high pressures. At these parameters, humid air cannot be calculated as an ideal gas mixture. For this reason, the property library *LibHuAir* has been developed. It comprises the calculation of humid air as an ideal mixture of real fluids. Again, the pointing effect and dissociation are taken into consideration.

The following software solutions will be presented:

- Add-In *FluidEXL* for MS Excel
- Interface *FluidMAT* for Mathcad
- Program *FluidDIA* for calculating and plotting large size and camera-ready thermodynamic charts
- Steam tables on pocket calculators:
  FluidTI for Texas Instruments TI 89, TI 92, and voyage 200
  FluidHP for Hewlett Packard HP 48G and HP 49
  FluidCASIO for Casio CFX-9850GB and Algebra 2.0 .

Student versions of all programs are available.