APROS Thermal Hydraulics: Steady State Model with Tank Dynamics

The steady state model with tank dynamics is the simplest of the APROS thermal hydraulic models. It is based on the conservation equations of mass and energy for the mixture. The dynamic features in this model reside in the liquid level dynamics of the tank modules and in the concentration plug flow dynamics.

The solver of the steady state flow network is sequential modular. This means that the solver sequentially calculates each supported module which is in simulation, once every time step. The order in which the solver goes through the modules is defined by the user.

Mass flows are calculated from steady state mass balances, not using pressure differences as in the other models. Before the start of the simulation the solver checks that the model is not under- or over defined ie. that each mass flow can be unambiguously solved. If not, other solvers will perform their calculations and the simulation time run, only the steady state modules will not be calculated.

Enthalpies are calculated from energy balances for each node.

Pressures are not solved dynamically during the simulation. The pressures values at the input boundaries are transported down the flow line without pressure losses. When mixing two or more streams the pressure of the mixing point is defined by the pressure of the largest of the incoming mass flows. The pressure in the flow line can be changed by the user.

Concentrations are solved for each node from component mass balances. It is possible to simulate concentration plug flow dynamics in pipes and tanks.

Liquid levels are solved by the for tanks. This is done with dynamic total mass balance over the tank module. The tank modules using the steady state model also include overflow calculation.

Material properties calculation is entered after the sequential steps of the simulation. There material properties are calculated as a function enthalpy, pressure and concentrations. Temperature calculation uses also constant component heat capacities defined in by the user.

The steady state model can be connected to the homogenous and single phase models.

Summary:

- The steady state model is the simplest of the thermal hydraulics models in APROS and thus needs the least amount of parameters.
- The steady state model uses a sequential-modular mass and energy balance solver.
- The dynamics are in the tank liquid levels and concentration plug flow.