AMESim

LIBRARIES – TWO-PHASE FLOW

KEY POINTS

- Transient and Steady-State simulation.
- Fully based on the physics of two-phase flows
- Description of the refrigerant thermodynamic properties from the 32 coefficients Modified Benedict Webb-Rubin (MBWR) equation of state
- Fluid states modelled:

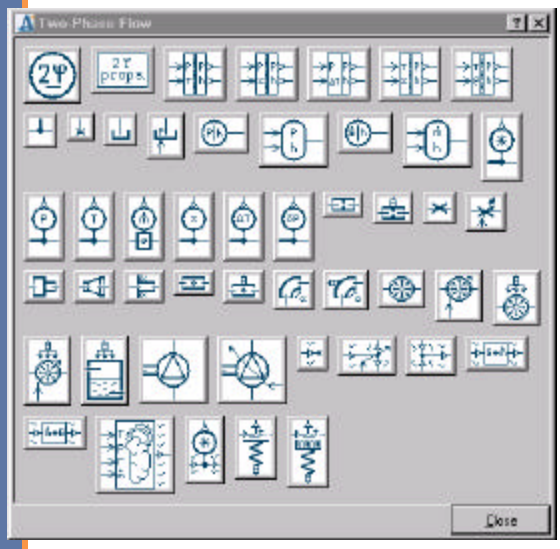
Superheated vapor	Saturated vapor	Two-phase fluid
Subcooled liquid	Saturated liquid	Supercritical

- Easy manipulation of variables using thermodynamic converters
- State of the art theory for the calculation of single phase or two-phase pressure losses
- State of the art theory for the calculation of internal convective heat transfers in single phase or two-phase conditions (condensation or boiling)
- Easy initialisation of the entire set of state variables of your system from the “charge and temperature” initialization facility
- Possibility to model external flow convective heat transfer with moist air (evolution of the air humidity, influence of the water vapor condenstation on the heat transfer, calculation of condensed water vapor mass flow rate)

Overview

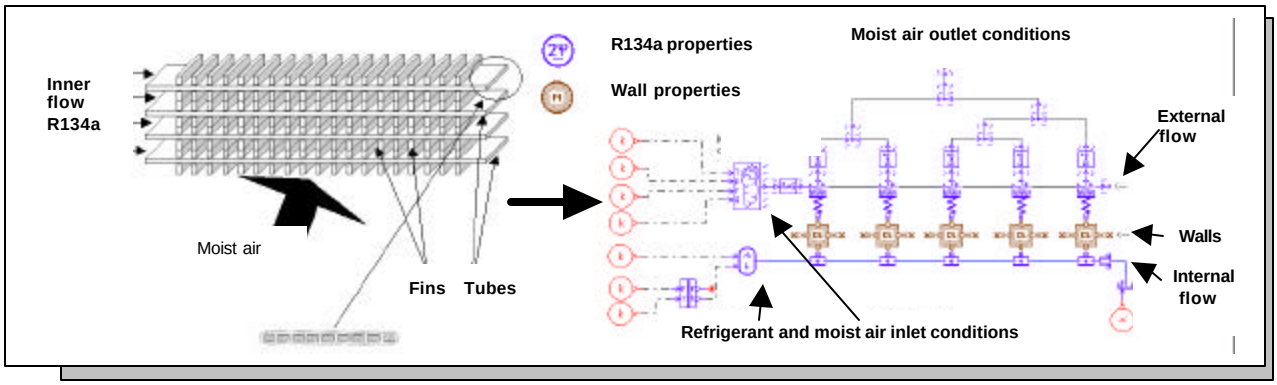
Applications involving two-phase flows are commonly found in industrial processes. Among others we can name automotive air-conditioning systems, climate systems for buildings (industrial, offices), cryogenic applications ... For those applications, the interest is to benefit from the capability of pure fluids to change phase in order to respect some constraints.
The AMESim Two-Phase Flow library enables you to model complex system networks in which the fluid, at some stage, is submitted to phase changes. This library is based on a lumped transient heat transfer approach to compute:

- Energy transport through the system,
- Internal flow convective heat exchanges in single or two-phase conditions (convective boiling or condensation),
- Pressure losses, temperature levels, mass flow rate and enthalpy flow rate distribution
- Gas mass fraction evolutions in the system,
- Mass transfer between the vapor and liquid phase,
- External flow convective heat exchanges (wall / moist air) including the influence of water vapor condensation.



Benefits

The AMESim Two-Phase Flow library is based on a basic element approach giving the possibility to the user to model a maximum of two-phase flow network configurations from a minimum set of components.
This library includes the multi-fluid functionnality and is fully compatible with the AMESim Thermal and Air-Conditioning Libraries.



Example of two-phase flow model: condenser pass including internal refrigerant flow, condenser walls and external moist air flow

Features

The AMESim environment and the AMESim Two-Phase Flow library offer a large number of capabilities in order to:

- Model thermodynamic cycles of refrigerant fluids.
- Choose your favourite empirical correlation to be used for the calculation of two-phase pressure losses (homogeneous or separated flow correlations)
- Choose your favourite correlation to model two-phase flow internal convective heat exchanges either in condensation or boiling conditions
- Design complex components from a collection of basic geometrical and empirical components
- Proceed to sensitivity and sizing analysis as well as component optimisation
- Matlab/ Simulink interface for control design
- Time and frequency domain analysis thanks to linear analysis tools
- Recognizable technological icons for direct model correlation with technical drawings
- User-friendly graphical interface

Requirements

The AMESim Two-Phase Flow library runs on Unix®, Linux® platforms and Pentium®-based PCs.

The AMESim Thermal library is required.

Two-Phase Flow models

- Refrigerant fluid properties.
- Fluid state calculator.
- Thermodynamic variables transformers.
- Nodes, plug, tanks.
- Ideal and modulated pressure and mass flow rate sources.
- Pressure, temperature, mass flow rate, gas mass fraction, superheat / subcooling generic sensors.
- Regular pressur losses (adiabatic or with heat transfer).
- Constant and variable flow path area restrictions.
- Sudden and progressive expansion / contraction.
- Volume connected to pipe.
- Pipes (adiabatic or with heat transfer).
- Bends (adiabatic or with heat transfer).
- Volume (adiabatic or with internal or external heat flow source).
- Stratified chamber or accumulator (with external heat flow source).
- Fixed displacement compressors.
- Variable displacement compressors.
- Moist air nodes, plugs, tanks.
- Moist air sources.
- Moist air generic sensor.
- External convective heat transfer between moist air and planar wall
- External convective heat transfer between moist air and finned wall

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