EUtech Scientific Engineering

A COMPANY WITH ENERGY

Thermolib

Toolbox for Thermodynamic Modeling and Simulation with MATLAB®/Simulink®

OVERVIEW

Thermolib Expands the MATLAB® /Simulink® Suite

with tools to design, model and simulate complex thermodynamic systems.

You can use this extensive library of thermodynamic components, such as pumps, compressors, valves, heat exchangers, heaters, chemical reactors etc., to build a model of your highly dynamic and nonlinear system. Use your Thermolib model to address issues of optimal design and control strategy. Simulate real gas behavior, liquid mixtures and chemical reactions all the while knowing that correct thermodynamic equations and calculations drive your model.

Key Features:

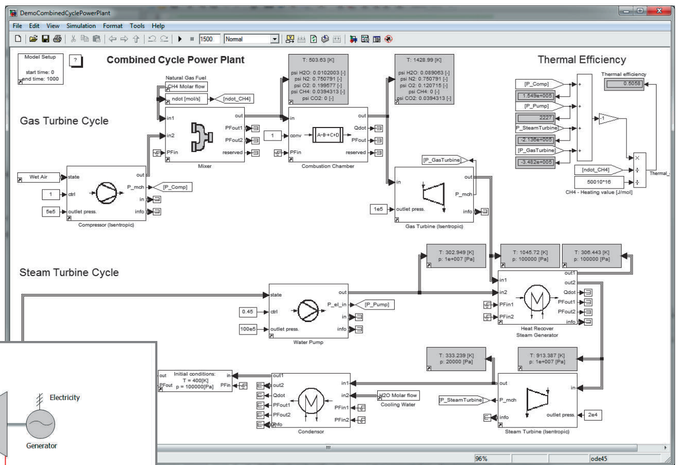
- Tools based on the fundamental principles of engineering thermodynamics
- Thermodynamic state and state change calculations including real gas modeling
- Component blocks including heat exchangers, reactors, pumps, turbines, and valves
- Equilibrium and reaction chemistry
- Customizable and extendable thermophysical database and IAPWS-IF97 water and steam properties
- MATLAB command-line functions for thermodynamic calculations and plots

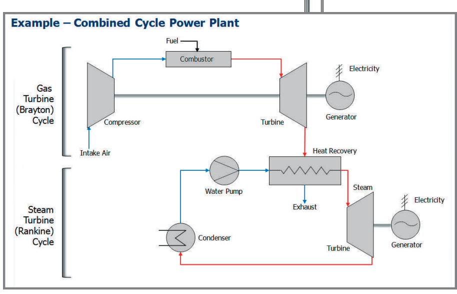
Use Thermolib

to design and optimize your complete thermodynamic system in a modular way. Design changes are implemented and tested within minutes. You can test, verify and optimize single components, groups of components or the entire system. You can even simulate component failures to test the robustness of your system design.

Thermolib can be used for all types of energy related areas such as power generation, heating and air conditioning, automotive and aerospace applications.

Convert your Thermolib model into C code using Simulink Coder to use it in modern development strategies like rapid control prototyping (RCP) and hardware-in-the-loop (HiL) simulation.





Thermolib

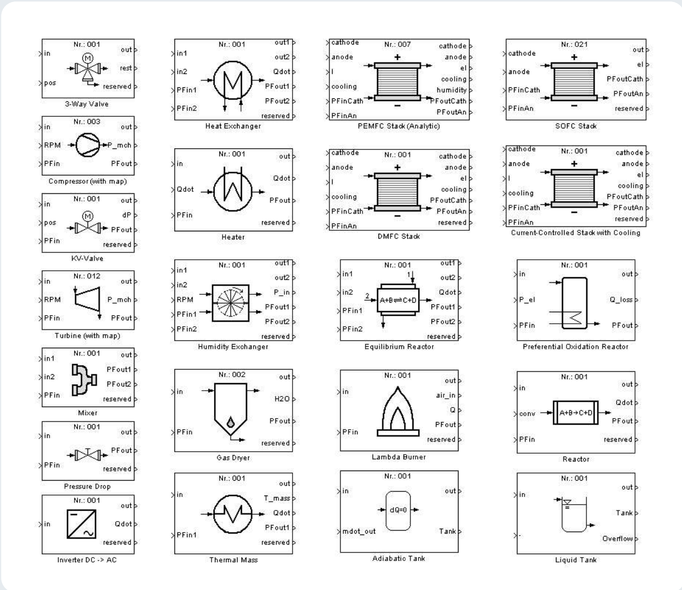
Features and Functions

➔ Components

Thermolib contains a blockset with ready to use components commonly used in thermodynamic systems. Thermolib provides blocks for heat exchangers, pumps, compressors, turbines, valves, tanks, chemical reactors, fuel cell stacks, Li-Ion cells etc.

The generic component blocks can be adapted to measurement data via customized characterization curves of components, e.g. compressor maps, valve characteristics or fuel cell polarization curves.

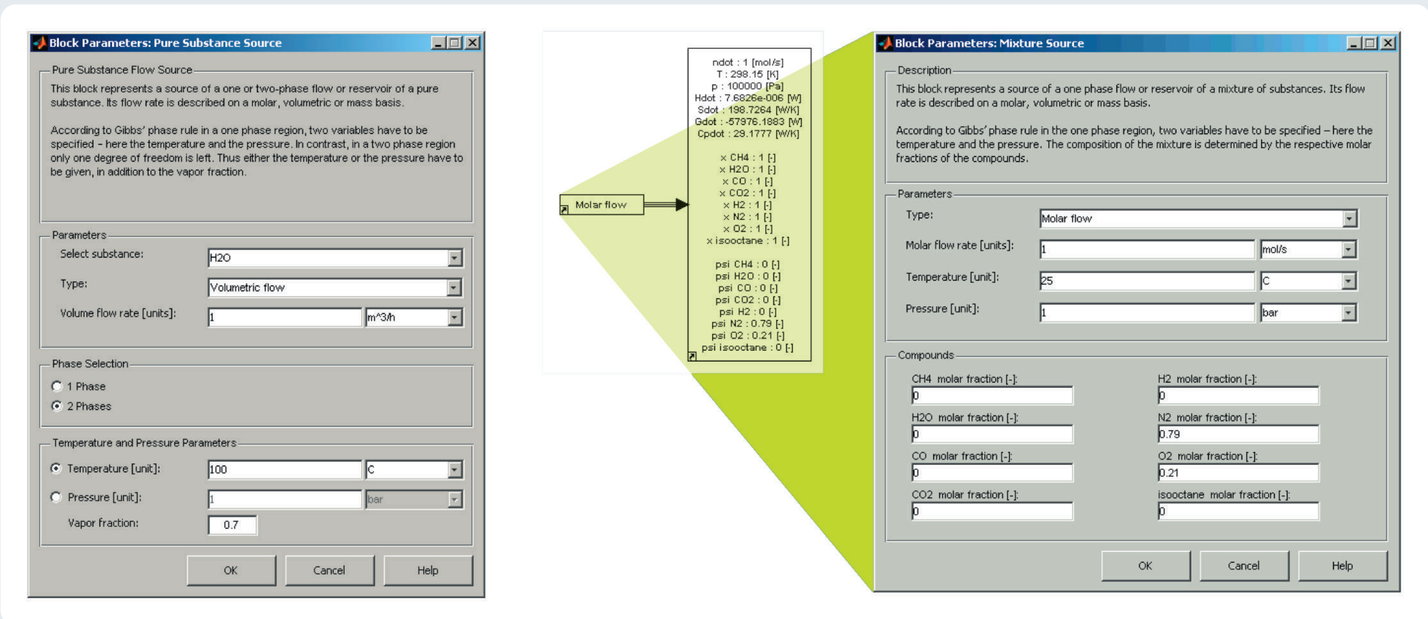
Thermolib helps you to create dynamic operational models for balance-of-plant components using first principles and experimental data. All components are built on a set of fundamental thermodynamic building blocks. You can make use of these building blocks to take care of the thermodynamic calculations so that you can fully concentrate on modeling your key components!



➔ Sources & Sinks

Use Thermolib source blocks to define and configure media flows with predefined thermodynamic states. Set up your flows using the user friendly GUI and select from a multitude of commonly used species (from CO_2, H_2O, NH_3 to refrigerants like R134a, R125 and R32). Alternatively, you can use application-specific sources, e. g. air-vapor mixtures.

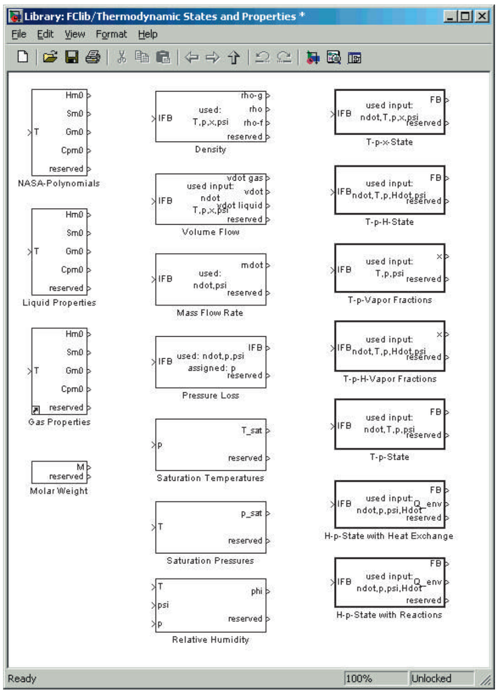
The media source allows you to set the flow rates, temperatures, pressures etc. with the appropriate units. On the other end, keep track of the media flows and their properties using Thermolib's sensors and display blocks.

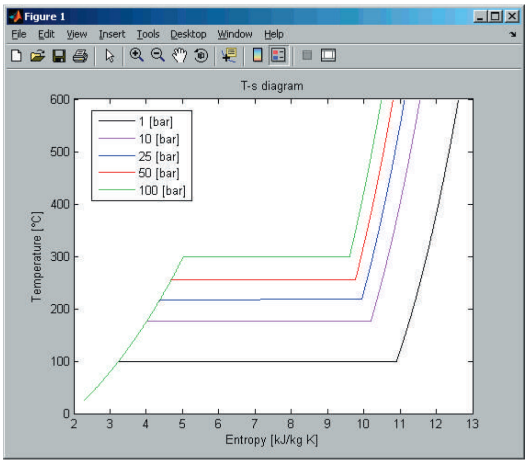


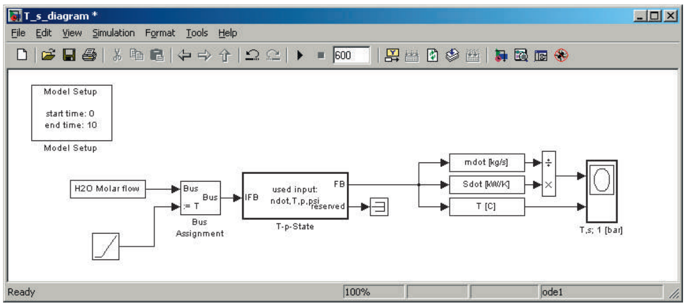
Thermodynamic States and Properties

All Thermolib components are based on thermodynamic property and state calculations for condensable gases, liquids and their mixtures. Thermolib computes enthalpy, entropy, free Gibbs enthalpy and heat capacity using the well documented JANAF thermophysical tables in the NASA polynomial representation. Thermolib computes properties such as viscosity and thermal conductivity, useful in modeling convective heat transfer and pressure drop phenomena.

The thermophysical data for calculating the properties of the various species and their mixtures, including the vapor fractions, are provided through an extendable and expandable species database. To convert among different state variables, Thermolib provides a wide array of conversion blocks.



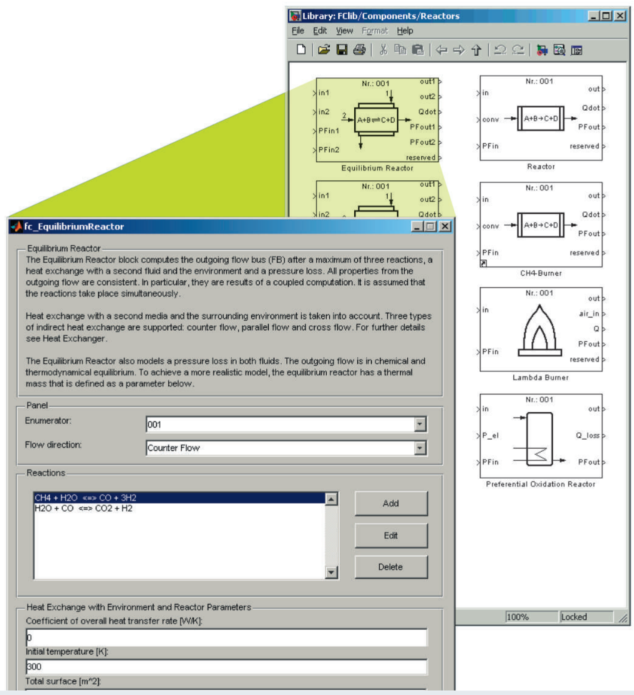




Reaction Chemistry

Thermolib contains different blocks for modeling chemical reactions. The user can choose between a chemical reactor with equilibrium chemistry or a reactor with irreversible overall reaction and prescribed conversion. Reactions can be configured to be adiabatic or non-adiabatic. The user can modify the chemical reactions via parameter masks.

Thermolib provides predefined blocks for modeling reformer and water gas shift reactions, combustion, preferential oxidation reactor etc.

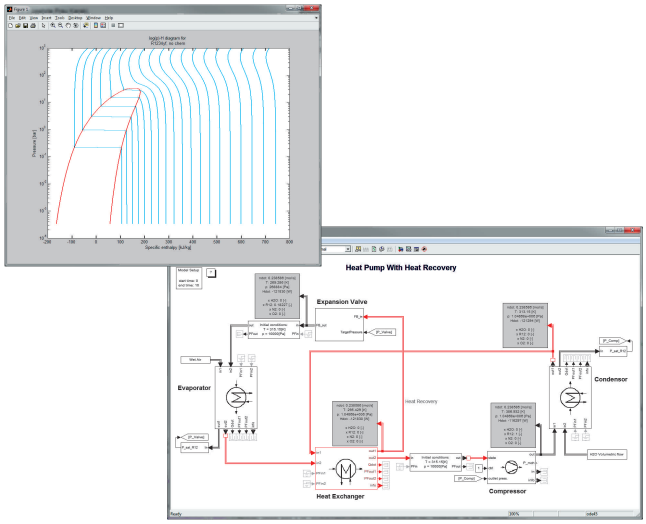


➔ Real Gas Behavior

Using the Peng-Robinson Equation of State, Thermolib can calculate real gas behavior. This allows your Thermolib model to provide good accuracy near the critical point and near condensation, particularly for calculations of the compressibility factor and liquid density.

In addition to modeling real gas behavior, Thermolib models the vapor-liquid equilibrium state in both pure and multi-component systems. Thermolib can handle general flash calculations, which makes simulation of phenomena such as the temperature glide of mixtures possible. This, in combination with Peng-Robinson EOS yields reliably accurate modeling of systems such as heat pumps.

For precise calculations involving water and steam, particularly in power plant models, use the add-on IAPWS-IF97 formulation of thermodynamic properties.



➔ Extensive Demo Set

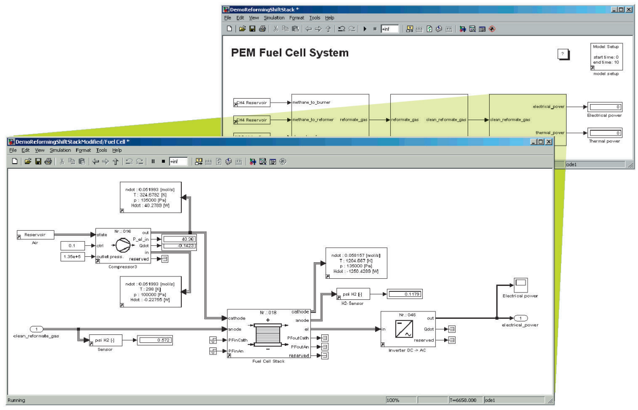
To provide you with a starting point in Thermolib, you have access to many example models that cover basic thermodynamic concepts (such as the Brayton, Carnot and Rankine cycles), modeling of physical properties (such as evaporation/condensation, state changes, and behavior of mixtures), and hydraulic models with pressure feedback.

In addition to the built-in help, each Thermolib component comes with a demo model that shows how to configure and use that particular component with other Thermolib blocks in Simulink. Examples that show how to interface with other Simulink tools (such as Simscape) are also covered.

Most importantly, Thermolib comes with an extensive set of system demo-models of applications that span several industries including:

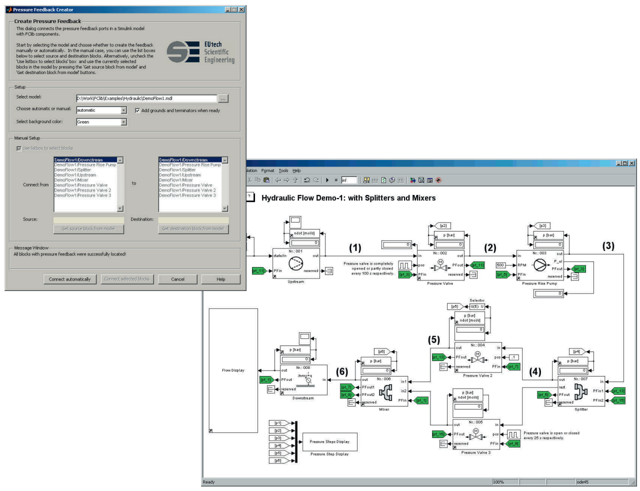
- Power plants
- Heat pumps
- Combustions
- Gas-Reformation
- Fuel cell systems
- Air conditioning / refrigeration

and many more.



➔ Hydraulic Networks

Thermolib supports computation of quasi stationary hydraulic networks. It contains the most relevant blocks for handling hydraulics, e.g. a splitter, a mixer, pressure valves, reservoirs, pumps and compressors as well as auxiliary elements. Pressure feedback is explicitly modeled with separate feedback signals. Automatic generation of feedback pressure connections is supported via special integrated tools.



Interested? – Next Steps

→ 1

Get a better understanding and feel for Thermolib and visit one of our regularly scheduled webinars. You will have access to a thorough explanation of Thermolib's capabilities, useful examples and the chance to ask questions live.

→ 2

Visit our website at www.thermolib.de and watch a video tutorial and recorded webinars.

→ 3

Contact us for a free 30-day trial of Thermolib.
Feel free to ask us about our training and development services.

Thermolib

→ More Information about Thermolib

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Required Software

32 bit:
MATLAB 7.5 (R2007b) or newer
Simulink 7.0 (R2007b) or newer

64 bit:
MATLAB 7.8 (R2009a) or newer
Simulink 7.3 (R2009a) or newer

Windows XP, Windows Vista or Windows 7

Recommended Software

Microsoft Excel 2003 or higher

Related Products

Home Energy Simulator
HiL Starter Kit

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