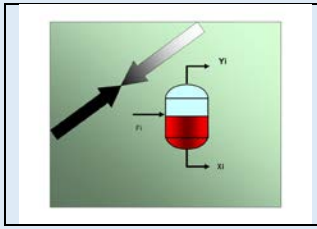


Xpsim

eXtended Process SIMulation

XPSIM is a simple and complete industry simulator for modeling and optimization of chemical plants, oil & gas installation and fluid transportation in the petroleum and the oil and gas industries

A single product for process engineering and flow-assurance simulation

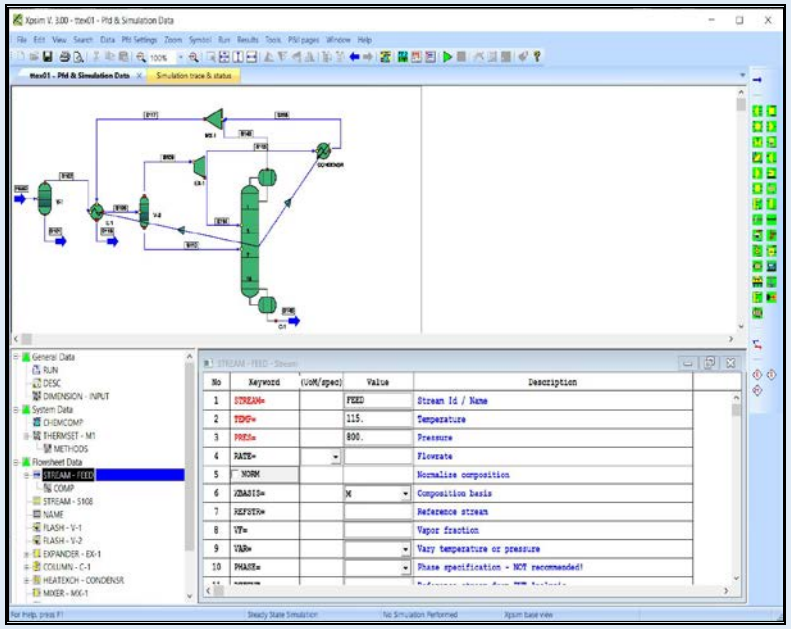
Steady state and dynamic simulation are provided by a single product.

An overview of the Windows user's interface is shown on the next page.

Process Simulation Services - www.xpsimworld.com
e-mail: info@xpsimworld.com

User interface

Steady state and dynamic simulation are provided by a single product and the main window is shown on the next figure.

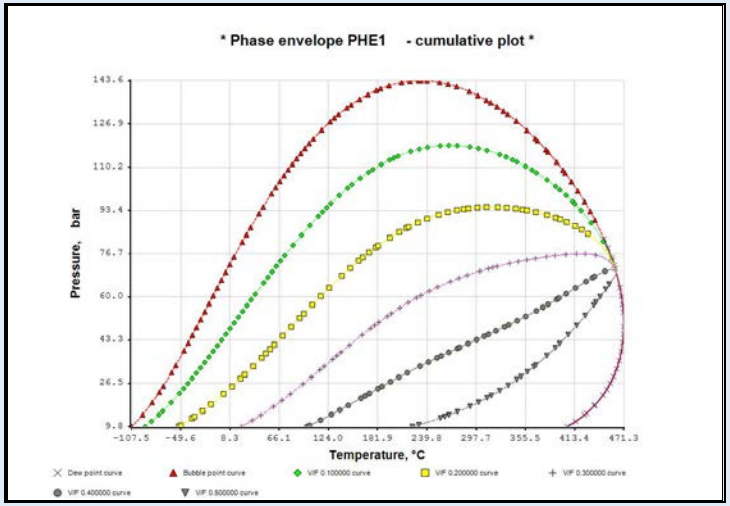


This interface provides a seamless bridge between the historical key-word input language of process simulators and the graphic windows interface which enables the drawing of process flow diagrams with unit-operation symbols and connecting streams.

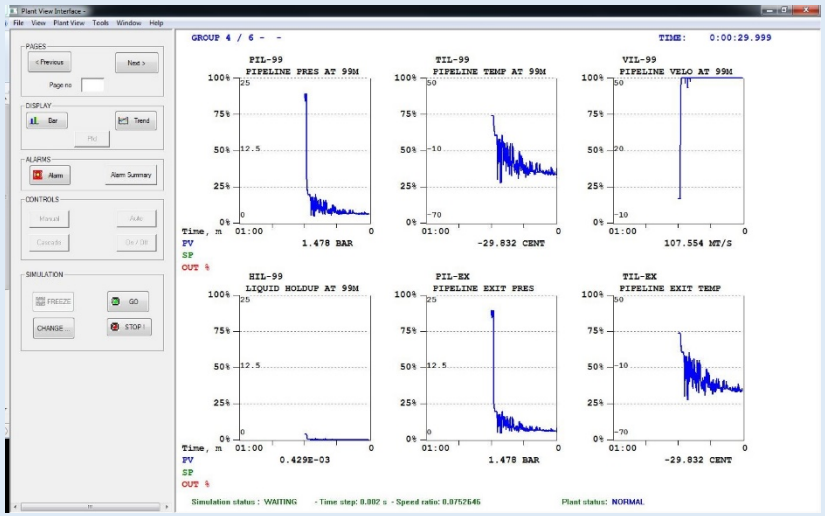
The user's guide of the Windows interface can be downloaded from the Xpsim web site: www.xpsimworld.com

Graphics functions allow the user to manage a large number of graphical results especially when dynamic simulation studies are developed.

Numerous graphs are generated and can be easily customized to provide graphic support to process engineering projects and studies.



When a dynamic simulation is started the user can view process variables changes along the time on another window which can be viewed as a plant control console.



Trend history of virtual instruments, whose number can be very large as over 100, can be saved as graphic file which can be subsequently viewed and analyzed by the process engineer.

Main simulation capabilities overview

- Rigorous thermodynamic methods
  A large number of methods are provided for the evaluation of thermodynamic and transport properties for pure components and petroleum cuts or pseudo-components.

- Regression analysis
  The capability of regression of experimental data to provided interaction constants for the SRK, PR equation of state and of liquid activity models as NRTL, WILSON, etc. is included as a standard feature.

- PVT experimental analysis
  The simulation of PVT experiments is provided and this feature allows the optimization of chemical components and petroleum fraction of various equations of state and models to match experimental data.

- Crude module simulation
  The simulation of crude oils assays is also provided as a basic function and is not required as an add-on module.

- Pipeline simulation
  This module provides a most reliable and complete function for the simulation of transfer line. Coupled with gathering and general network solutions it provides the tools for design, optimizations and de-bottlenecking of pipeline systems.

- Gathering and Networks
  XPSIM includes efficient algorithms for the solution of gathering and network systems. The process engineer can easily solve complex design options and optimizations of pipelines systems for either oil and gas productions.

Steady State Simulation

PETROLEUM AND PSEUDO-COMPONENT DATA

The user can define characteristic data (normal boiling point, standard specific gravity, molecular weight) to be used for the calculation of critical properties and other thermodynamic properties.

USER'S DEFINED COMPONENT DATA

This section provides capabilities for the definition of chemical components not included in the standard component library. A number of correlations for the estimation of pure component properties are available.

USER'S DEFINED THERMODYNAMIC DATA

The user can modify or add parameters for the various equation of state provided by Xpsim.

Example are binary interaction parameters for the Peng-Robinson and Soave-RK equation of state, component interaction parameter for the NRTL, Wilson and UNIQUAC models.

THERMODYNAMIC METHODS AND DATA

REACTION DATA

The user can define chemical equations to be used by unit operations such as chemical reactors, vessel depressurization etc.

VAPOR-LIQUID EQUILIBRIUM DATA AND REGRESSION

When experimental data for vapor-liquid equilibrium are available the user can verify and optimize interaction parameters for a number of equation of state as: PR, SRK, CPA, NRTL, WILSON, UNIQUAC, etc.

PVT ANALYSIS AND OPTIMIZATION

When PVT analyses are available it is possible to verify calculated data with respect to experimental data for a number of experiments carried on oil&gas mixtures from reservoirs. Constant composition expansion curves (CCE), Differential Liberation, … can be calculated and results plotted against experimental data. Component parameters to be used in cubic equation of state can be optimized with respect experimental PVT analyses.

DEFAULT DATA FOR UNIT OPERATIONS

In this category the user can set default data for the definition of elements used by unit operations. The user can defined solid material used for the definition of walls of pipes and pipelines.

STREAM SPECIFICATION AND DISTILLATION DATA

Stream compositions can be defined also by using ASTM distillation data such as TBP and D86 curves.

MIXER, SPLITTER

Two or more process stream can be mixed into one. One process stream can be split in two or more products.

FLASH

This unit operation provide 2-phase and 3-phase vapor liquid equilibrium calculation such as: flash at constant T/P, isenthalpic flash, bubble point and dew point, flash with vapor/feed ratio specifications.

VALVE

Valves can be calculated by giving either the outlet pressure or a pressure drop. Calculations can also be performed on the basis of a defined CV value.

PUMP

Pumps for liquid can be calculated either by defining the pressure drop or on the basis of its operating curves.

EXPANDER

Calculation can be performed on the basis of the isentropic operating curve efficiency

COMPRESSOR

Adiabatic or polytropic compression can be calculated. Operating curves can be defined.

HEATING AND COOLING

Simple heating and cooling of process stream can be calculated.

HEAT-EXCHANGER

This unit operation can be used to simulate multi-stream or shell-and-tube heat exchangers. Multi-stream heat exchangers are typically used in LNG plants.

COMPONENT SEPARATOR

A stream is splitting according to user's specification. This module can be used to simulate special packages as black-box equipment.

DISTILLATION COLUMN

Complex distillation column can be simulated. In addition to the usual condenser and reboiler, other can be defined and attached to any other tray. For petroleum separation pump-arounds can be defined.

COLUMN OPTIMIZATION

For the separation of multi-component fluids that can be reduced to pseudo-binary components a column optimization method is available. This efficiently computes the number of trays and feed-locations as function of the reflux.

REACTOR

The user can simulate a general reactor either by defining reaction and component conversion or by requesting the calculation of the chemical equilibrium.

CSTR REACTOR

The simulation of a Continuous Stirred Tank Reactor (CSTR) is available.

PLUG-FLOW REACTOR

The simulation of a plug-flow reactor i.e., typically a tubular reactor is available

AIR-COOLED HEAT EXCHANGER

The user can define air-cooler which are greatly used in refinery and chemical plants

GAS AND OIL WELLS

Gas and oil well production curves can be defined. This feature is very useful in the simulation of up-stream gathering and networks.

PIPELINE

This unit operation is what extends the program into the field of single and multiphase flow as an efficient tool for the analysis of complex installations in for on-shore or offshore hydrocarbon production fields. The user can simulate the transport of single phase fluids (gas or liquid), two-phases systems (oil+gas, air+water, etc) or three-phase systems (gas+oil+water). For prediction of multiphase flow patterns (stratified, wavy stratified, plug, slug, bubble and annular) many literature correlations and mechanicistic proprietary models are available. Pipelines may range from few meters to hundredth of kilometers.

PIPE

A simple pipe for the simulation of fluid transport from one equipment to another. This unit operation is a simplified version of the pipeline.

NODE

This unit operation is designed for the solution of networks of pipes/pipelines where flow reversal can be realized.

PRESSURE SAFETY DEVICES

Pressure safety devices (pressure safety valves or rupture disks) can be rigorously simulated. This unit operation becomes a key for the calculation of equipment and pipeline depressurizations.

VESSEL DEPRESSURIZATION

As many other products, a calculation module for the calculation of vessel depressurization in case of fire is available.

PHASE ENVELOPE

Phase envelopes can be calculated also for non-cubic equation of state.

USER CALCULATOR

The process engineer can write simple functions for the calculation of particular results. Input are process variables and the results can be passed to other equipment.

STREAM CREATION AND SET

This function allows the creation of steams using data from other streams or equipment.

SET OPERATION

This module can be compared to feed-forward controller. A calculated process parameter can be passed to one unit operation which is not calculated yet.

CONTROL OPERATION

Performance specifications can be defined and the solution obtained by varying one parameter. It works like a traditional feed-back controller.

MULTI-VARIABLE CONTROLLER

This operation allows the definition of multiple specifications to be satisfied by changing the same number of parameters.

NETWORK SOLUTION

This section provides the guidelines for the definition of process specifications and variables for the solution of complex networks.

VAPOR-LIQUID EQUILIBRIUM CURVES

The user can perform vapor-liquid equilibrium curves as a post-processing option to obtain fluid properties.

HYDRATE FORMATION CURVES

The previous function includes also the generation of hydrate formation curves.

PROPERTY TABLES

Property tables as required by dynamic simulation codes like OLGA or LedaFlow can be calculated and filed out.

RESIDUE CURVE MAPS

Residue curve maps can be calculated for 3-components or multicomponent systems.

Dynamic Simulation

The same thermodynamic framework used by the steady state module is the core for the dynamic simulation. To perform a dynamic simulation the user must extend the process description from a PFD (process flow diagram) description into a P&ID (Process and Instrument Diagram) schema.
So the connection between the unit operations is not realized by streams but by lines. Lines will be represented by streams flowing in pieces of pipe defined by diameter and length. During a dynamic simulation the user can freeze the simulation, restart the calculation or stop its execution.

VESSEL

Single phase (gas or liquid), two phase (gas and liquid) and three phase (gas,liquid oil and water) can be simulated. A vessel can be horizontal or vertical with diameter and length defining its volume

LINES (Simple Pipes)

A line can be defined by one or more pipe segments of different lengths and diameter.

PIPELINES

The dynamic simulation of pipelines operation can be performed. The simulation is full compositional so the internal composition can be monitored either during a depressurization or when the flowrate of more feed lines is changed. Two phase flow patterns are identified by reliable mechanicistic models and transient slugs can be calculated.

Liquid compressibility is considered with a detail sufficient to obtain reliable values of pressure surge (or water hammer) when fast closure of valves is considered.

PUMP

Liquid pumps are described by their operating curves.

COMPRESSOR

Gas compressors can be simulating on the basis of their operating curves with changing their revolution velocity.

CONTROL VALVES

As in real plants the change of gas and liquid flowrate from one unit operation to another is realized by changing the openness of a valve. This item is the final control element in a refinery, chemical plant or off-shore installation. The valve lift can be defined by a controller, event definition, alarm switch or manually by the user mimicking operator’s decision.

PRESSURE SAFETY VALVES

For the simulation of the plant behavior in case of upsets pressure safety valves can be defined.

CONTROLLER

The control of process variables can be realized by controllers which can operate as proportional-integral-derivative algorithms.

EVENT DEFINITION

A number of process variables can be manipulated by defining events which can complete in a certain period of time: for example the start of a leak in pipeline.