EcosimPro
Modelling and Simulation Software

PIPELIQTRAN LIBRARY

The PIPELIQTRAN library facilitates the construction of piping system models and the analysis of hydraulic transients that may occur during the operation of these types of systems.

EcosimPro

EcosimPro is a powerful **modelling** and **simulation** tool with a simple interface that makes the design of **multidisciplinary** dynamic systems easy and intuitive using graphic diagrams.

For users with specific needs, EcosimPro provides an object-oriented non-causal approach towards creating reusable component libraries and is based on very powerful symbolic and numerical methods capable of processing complex systems represented by differential-algebraic equations (DAE) or ordinary-differential equations (ODE) and discrete events. However, low-level problems such as programming calls with numerical solvers, equation handling, etc, are solved automatically or using simple wizards.

Features

PIPELIQTRAN is a professional EcosimPro library designed to analyse **Hydraulic Transients** or **Water Hammer** phenomena in pipelines.

The resolution method based on ordinary-differential equations (**ODE**) is used instead of the characteristics method traditionally used for this type of analysis. This method does not require the user to have any advanced knowledge in hydraulic transient modelling, and it leads to quite precise results. It also facilitates easy analysis of different hydraulic transient scenarios that may occur in a system without having to modify the initial system model.

Using **drag & drop** methodology and **input data editors,** the user can quickly create a flow diagram of the pipeline model and specify the input data and parameters.

Thanks to EcosimPro's features, the PIPELIQTRAN library is very easy to **configure** and **extend,** adding any components and characteristics as needed. This can be done graphically through a simple, user friendly interface, or through EcosimPro's **object-oriented language** which makes it possible to re-use existing codes.

The library enables you to start the transient calculation as soon as the system is in steady state operation. The transients can be generated due to events in time or events in the system. It is possible to evaluate the **thermal balance** of the system and the effects caused in the piping system due to **cavitation** and the **release** of gas dissolved in the fluid.

The **speed of sound** is calculated taking into consideration the elasticity of the pipe and the release of gas in the fluid. Moreover, **wave forces** can be also calculated.

The working fluid is considered incompressible and of constant composition. A list of working fluids is available, but the user can easily include new fluids in the library. The library takes into consideration dependence on temperature in the calculation of thermodynamic properties of the working fluid. Also, one or more fluids can be considered in the system model.

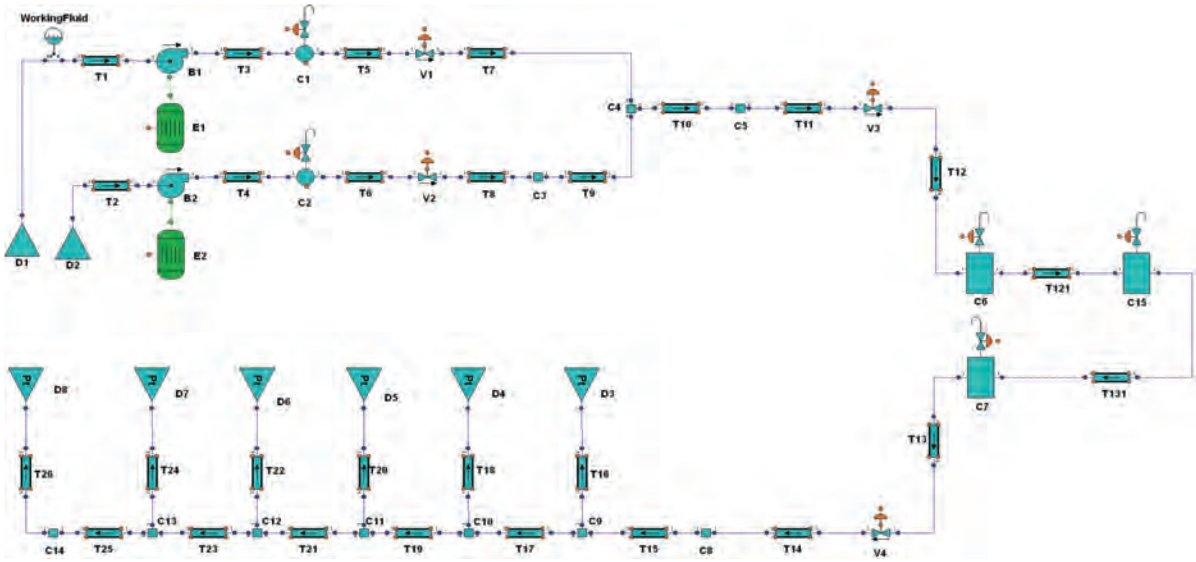
The library is designed to include the process control system using the standard **CONTROL** library supplied with EcosimPro.

EcosimPro allows the user to display the propagation of pressure waves along the pipeline and draw any variable of the system model. Furthermore, the specification of pipe elevations and pressure losses along the pipes is easily managed by the EcosimPro input data editors.

The components

The library includes a wealth of piping system components and boundary condition components:

- **Pipes:** The fundamental component of the library, it can calculate cavitation, thermal balance, release of gas dissolved in the fluid and wave forces. The data editor allows the number of pipes to be specified in parallel, along with the fittings, the nominal diameter and schedule



- **Pumps:** The library contains two different types of pump models. The first is a simple pump model in which the user can specify the pump power curve as a function of the volumetric flow at pump design speed. The second is a pump model in four quadrants that includes all four areas of pump operation. The library has a motor model that enables you to simulate pump startup, establishing the ratio between motor torque and the number of turns

- **Boundary conditions:** The library contains a set of components to specify the boundary conditions in the pipelines; ie, mass flow boundary condition, total pressure condition or static condition, etc

- **Valves:** The library includes three valve models that represent exit valves, check valves and control valves

- **Headers:** These elements serve to join or form pipe branches. You can choose from several types of header models based on the number of connections

- **Vacuum Breaker and Water Box:** The vacuum breaker component enables you to simulate vacuum hydraulic systems; ie, systems in which the pipeline is full of air. The library has a water box model that enables the volume and height to be defined. It can also be used to define different condenser configurations

- **Sensors:** The library includes a set of sensors that enable a control system to be implemented

- **Miscellaneous components:** The library also includes models of other typical piping system equipment such as **expanders, heat exchangers, filters, tanks,** etc

Example

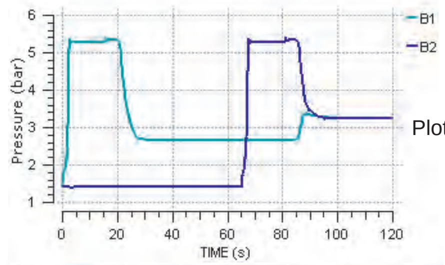
This example consists of a model of a **circulating water system** of a **combined cycle power plant**. The system is illustrated in the diagram.

The case in point consists of the sequential startup of both pumps with the system full. The purpose of this analysis is to check the correct opening time of the pump relief valves so that system pressures do not exceed the maximum allowable pressure. The opening time of the valves is 10 s: the relief valve of pump B1 starts to open at 20 s and that of pump B2 at 85 s. The first plot, B1, is connected during the first instant, whereas pump B2 is connected after 65 s. Vacuum breakers C1 and C2 have an initial air volume of approximately 5m3.

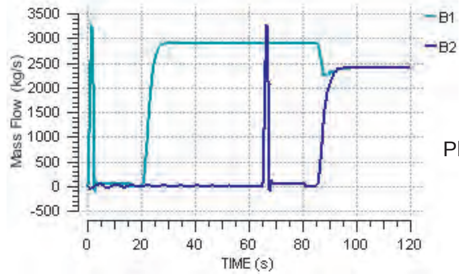
The first plot illustrates the evolution of the relief pressures of both pumps.

With a 10 s valve opening time, there are no overpressure or negative pressure problems in the system. The maximum pressures occur during air discharge and the minimum pressures are due to the geometrical configuration of the system. As can be seen, the discharge of air through the discharge line of pump B1 occurs before 20 s elapses, before the valve opens. The same is true for the pump B2 discharge line.

Plot 2 illustrates the evolution over time of the mass flow circulating through the pumps.



Plot 1



Plot 2

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