

Process Modelling of Organic Rankine Cycles

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Overview

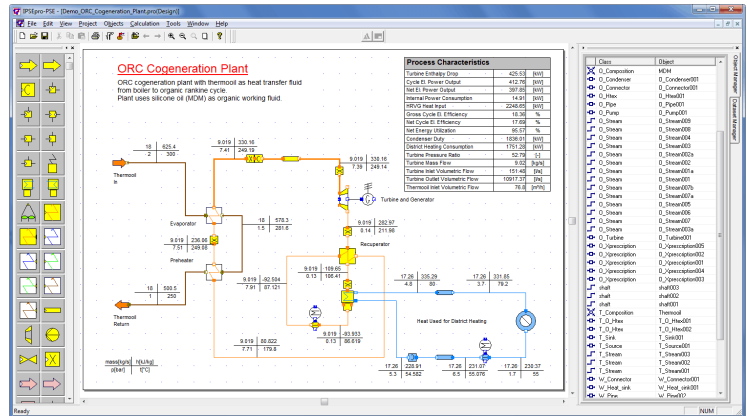
Organic Rankine Cycles (ORCs) are often integrated into more complex systems such as geothermal plants, biomass combustion and gasification plants, solar power plants or industrial processes. To optimize the performance of the combined technologies, accurate models of the thermodynamics are of great value. Here the process modeling system IPSEpro and its application to ORC modeling is presented.

Modelling Approach

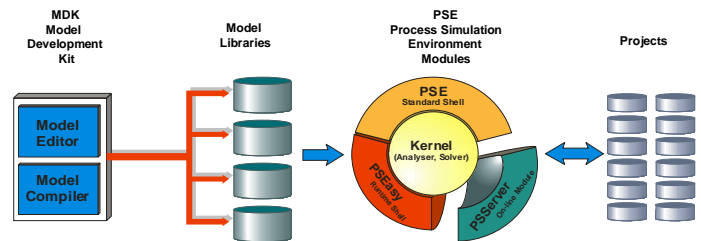
With IPSEpro, process models are created from individual components using the Process Simulation Environment (PSE). Using PSE, the user sets up the process scheme graphically by arranging components and connections, and entering the required data in the flowsheet. By setting up a process scheme, the user implicitly is creating a system of algebraic equations, which is then solved by the PSE solver core. Results are displayed graphically on the flowsheet.

Open Framework with Extended Capabilities

IPSEpro is an open framework: Components and physical property methods are not part of the core software. Instead, application-specific information is contained in *model libraries*. This makes it easy to adapt IPSEpro for new fields of application. Mathematical process models are useful for more than typical design and performance calculations: a model can also be used to identify the best operating parameters or to validate measured data. IPSEpro includes special add-on modules for these purposes, thus easily enabling parameter optimization and measured data validation for any IPSEpro model.



Process Simulation Environment PSE with ORC Cogeneration Plant Model



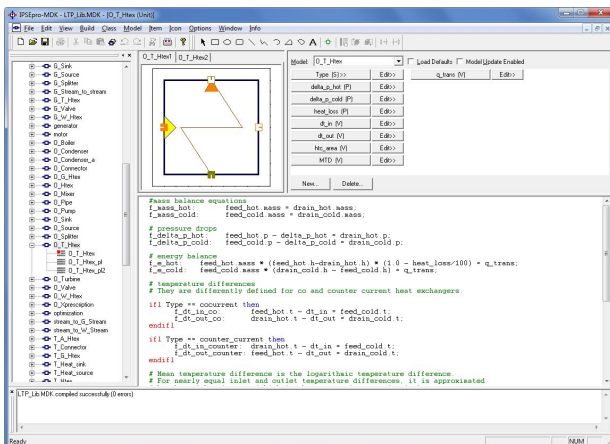
IPSEpro System Architecture

Extending the Component Models

A special Model Development Kit (MDK) is available to maintain and modify model libraries. Consequently, the user is not limited to using existing component models, but can modify and create new models, and can even create completely new model libraries whenever required.

ORC Applications

A model library for low-temperature processes (LTP_Lib) includes a comprehensive set of component models based on working fluids used in ORCs. The library includes models for the part-load behavior of the components, so the user can analyze the off-design characteristics of ORC plants. LTP_lib has been used to analyze various geothermal plants. In combination with other standard model libraries, it has also been used to investigate ORC integration with biomass gasification plants as well as solar thermal applications. IPSEpro's capability to create user-specific models has proved particularly useful when investigating industrial processes, because it enables the user to take into account key process characteristics and create an integrated process model.



Model Development Kit MDK

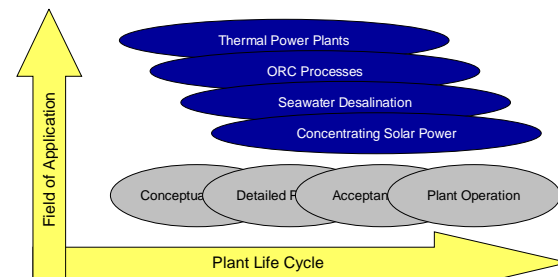
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