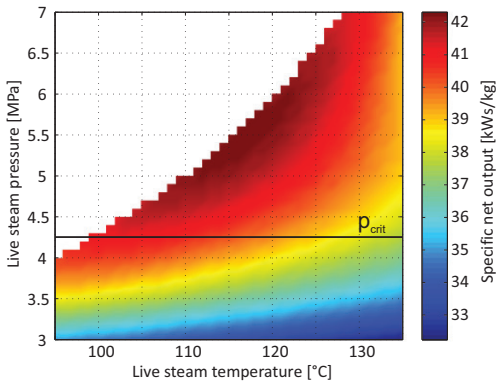
Accompanying simulations

The GeSi software allows the thermodynamic optimization of ORC circuits.



Depending on the external boundary conditions, calculations for local or integral cycle data can be determined. This makes it easy to analyze the sensitivity of influencing variables and cost-effectiveness.

Applications of MoNiKa

- Thermodynamic investigation of the stationary and transient behavior of ORC circuits at different operating conditions.
- Characterization and optimization of components.
- Generation of validation data for code development and simulation.
- Use of the central heating system as a generic heat source for the testing of:
  – ORC power plants
  – drinking water treatment plants
  – coolers
  – heat storage
  – General test benches requiring large quantities of low-temperature heat

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Karlsruhe Institute of Technology

MoNiKa
Modular low temperature cycle Karlsruhe

Research and development of power generation from low-enthalpy heat sources using organic Rankine cycle power plants.

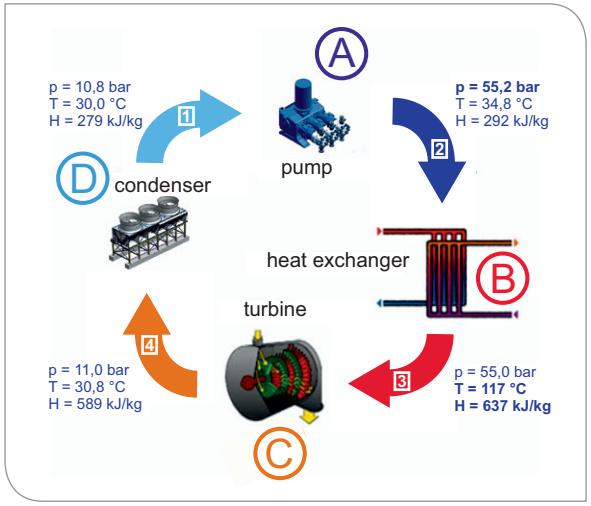
INSTITUTE FOR NUCLEAR AND ENERGY TECHNOLOGIES
EVT ENERGY AND PROCESS ENGINEERING

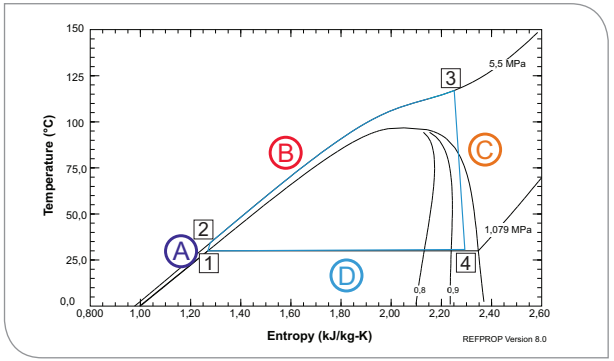
Introduction

In order to generate electricity a Clausius Rankine steam circuit is the usual choice. The heat supplied is used to generate steam, which is then expanded in a turbine and finally used to generate electrical energy. If the temperature is too low, this process with water no longer functions efficiently and instead of water, another, mostly organic fluid, is used in the process. This is referred to as the „Organic Rankine Cycle“ (ORC).

MoNiKa is such an ORC cycle with propane as a working fluid.

The figure below shows the four process steps of the propane cycle with supercritical live steam parameters:





The propane working fluid feeds the turbine at supercritical steam state.

The pilot power plant was built on the premises of the Karlsruhe Institute of Technology in order to carry out basic and applied research in the field of low temperature power plant technology.

In order to enable a flexible test operation, a heating station is used as a heat source. This makes it possible to continuously adjust the temperature and heating output over a wide range.

Objective

- Thermodynamic consideration of the entire power plant process.
- Characterization and optimization of the main components (heat exchanger, pump, turbine, condenser); customized components.
- Increase in the net power yield or increase of the efficiency of ORC circuits.
- Investigation of environmentally relevant aspects (e.g. emissions).
- Implementation of innovative concepts (supercritical fluids, mixtures, new fluids, innovative circuits).
- Comparison of different circuits and components (e.g. with 2 turbines, inverter, gearbox, recuperation)
- Provision of location-independent cycle data for simulation and model development (benchmarking) using detailed instrumentation.

Technical data of MoNiKa

- Variable thermal water temperature up to 150 °C.
- Variable heating capacity up to 1 MWtherm.
- Hybrid cooling (air/spray cooling).
- Supercritical propane cycle.
- Extensive instrumentation.
- Axial 4-stage turbine or parallel / serial arrangement of two 1-stage axial turbines.
- Plant control Siemens T3000.
- Adaptation of other test systems or components possible due to modular design.
- Optical accessibility for flow analysis.

Application of ORC-Technology

- Power generation in geothermal energy
  - Balancing energy
  - Use of surplus heat
  - Use of industrial waste heat
- Coupling with CHPP.
- Micro Power Plants / Power Generation Plants.