# Optimization model for minimizing the energy demand in an industrial heat recovery system

## Background

To ensure an efficient use of energy in process industry, it is necessary to recover heat that is in excess in some parts of the process and reuse it as a heat source in other parts of the system through a heat exchanger network. One way to increase energy efficiency in industrial plants is to improve the design of existing heat exchanger networks through different retrofit actions. In an ongoing research project, researchers from Chalmers collaborate with the pulp mill company Södra to develop better methods for retrofit of heat exchanger networks.

One issue dealt with in the project is how to ensure that the heat recovery systems have the flexibility to cope with variations, e.g., in inlet temperature and mass flows. To be able to calculate the energy savings for a given retrofit proposal, the resulting heating and cooling demands need to be calculated for many different operating conditions. This means that there is a need to determine how the heat exchanger network operation will respond when subjected to these variations. This is a difficult task due to the many degrees of freedom or control variables of a heat exchanger network. A combination of valves controlling heat exchanger bypasses and stream splits may be manipulated to achieve the optimal utility consumption for each unique set of deviations. To avoid trial and error network simulation, optimization of these control variables is desired.

The aim of this project is to formulate and implement an optimization model to minimize the heating and cooling demand of any fixed heat exchanger network structure when exposed to variations. The model will be used as part of a toolbox for retrofit design of industrial heat recovery systems.

## Task description

Suggested workflow:

- Literature review on mathematical modeling of heat exchanger networks
- Formulation of the optimization model i.e. objective function, constraints, bounds, etc. based on the literature review
- Translation of the optimization model into a mathematical programming language e.g. Matlab, Python, GAMS
- Validation of the optimization results by means of various test problems (e.g. simple literature examples but also (prepared) industrial case studies)

The thesis project is open for one or two students.

## Prerequisites

- Industrial energy systems (KVM013) or equivalent course on process integration (recommended)
- Course on mathematical programming and optimization (necessary)

**Credits**
30 credits

**Starting time**
Flexible (suggested is January 2019)

**Examiner**
Simon Harvey

**Supervisor**
Christian Langner
Elin Svensson

**Contact information to supervisor**
Christian Langner, PhD student
Christian.langner@chalmers.se
Energy Technology