Response time characterization of Organic Rankine Cycle evaporators for dynamic regime analysis with fluctuating load

Abstract:
The Organic Rankine Cycle (ORC) is one of the main technologies for recovery of low grade heat. However, many of the applications, especially waste heat recovery, present the challenge of thermal power fluctuations of the heat carrier. These fluctuations result in sub-optimal component selection and poor cycle performance at off-design conditions. This study aims to characterize the dynamic behavior of an ORC evaporator under fluctuating load as a method for dynamic behavior optimization at the design stage. This is done by constructing response-time charts that highlight the dependence of the thermal inertia of the evaporator in three main design variables: heat exchanger geometry, heat exchanger wall material and working fluid thermal properties. The characterization can then be used at a particular application to choose the proper design parameters that can reduce some of the variability of the heat input. This is illustrated with a case study from an ORC evaporator recuperating waste heat from a billet reheating furnace.

Stichworte:
ORC; WHR; dynamic modelling; transient analysis; time constant; thermal power fluctuations