PARAMETRIC STUDY OF RADIAL-INFLOW TURBINE DESIGN FOR LOWER TEMPERATURE ORC

Michael Deligant*, Simone Braccio, Emilie Sauret, Sofiane Khelladi and Farid Bakir

*Arts et Métiers ParisTech
151 Boulevard de l'Hôpital, 75013 Paris,
France

ABSTRACT

Low grade heat resources can play a central role in providing new ways to produce electricity at low carbon emission rates, and alleviating the need for fossil fuels. Radial-inflow turbines are compact and efficient expanders for converting low grade heat into electricity. They have been shown to be particularly suitable in Organic Rankine Cycles (ORC) to deliver high cycle efficiencies.

The availability and cost reduction of high rotational speed motor/generator allow the development of small turbines in a variety of applications from micro CHP to automotive waste heat recovery (WHR) including solar ORC.

In order to provide reliable experimental data, an experimental setup has been designed based on the adaptation of a high speed spindle with a maximum power of 9 kW and a maximum rotational speed of 60,000 rpm.

In this study, we considered SES36 as working fluid with fixed inlet pressure and temperature corresponding to a low temperature solar ORC. The design of 4 turbines is considered varying the specific speed but with the same polytropic enthalpy drop at the design point for each turbine. The specific speed is varied through the adjustment of the rotational speed and the cycle power within the limits of the considered generator, which will be used in future experiments.

The turbine designs are achieved using adapted 0D/1D meanline models. The performance maps of the turbines are then computed with real gas CFD simulations. The results show the evolution of the maximum efficiency with the specific speed. The off-design behaviour of the different turbines are compared.
In future work these designs will be manufactured and tested on the experimental setup providing experimental data for comparisons that will be used to validate and improve the numerical models.