Optimization of organic Rankine cycle power systems considering multistage axial turbine design - DTU Orbit (05/10/2019)

Optimization of organic Rankine cycle power systems considering multistage axial turbine design

Organic Rankine cycle power systems represent a viable and efficient solution for the exploitation of medium-to-low temperature heat sources. Despite the large number of commissioned units, there is limited literature on the design and optimization of organic Rankine cycle power systems considering multistage turbine design. This work presents a preliminary design methodology and working fluid selection for organic Rankine cycle units featuring multistage axial turbines. The method is then applied to the case of waste heat recovery from a large marine diesel engine. A multistage axial turbine model is presented and validated with the best available data from literature. The methodology allows the identification of the most suitable working fluid considering the trade-off between cycle and multistage turbine designs. The results of the optimization of cycle and turbine suggest that the fluid n-butane yields the best compromise in terms of cycle net power output, turbine cost and efficiency for the considered case study. When a conservative design approach is adopted, the turbine features a two-stage configuration with supersonic converging nozzles and post-expansion. Conversely, a single-stage turbine featuring a supersonic converging-diverging nozzle and Mach number up to 2 is the resulting ideal choice when a more advanced design approach is implemented.

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