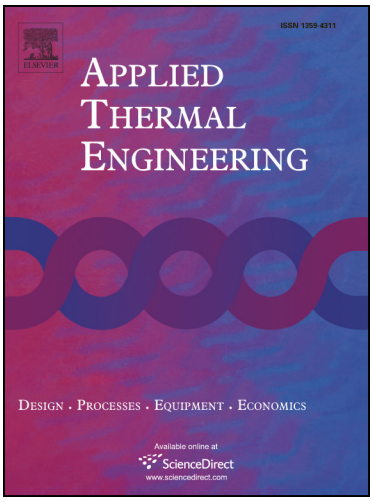

Thermodynamic analysis of a regenerative organic Rankine cycle using dry fluids

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PII: S1359-4311(17)31750-7
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2017.05.158
Reference: ATE 10473

To appear in: *Applied Thermal Engineering*

Received Date: 14 March 2017
Revised Date: 4 May 2017
Accepted Date: 27 May 2017

Please cite this article as: A. Javanshir, N. Sarunac, Z. Razzaghpanah, Thermodynamic analysis of a regenerative organic Rankine cycle using dry fluids, *Applied Thermal Engineering* (2017), doi: http://dx.doi.org/10.1016/j.applthermaleng.2017.05.158

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Highlights

- Analyzing thermodynamic performance of a regenerative ORC.
- Selecting the best working fluid suitable for a regenerative ORC.
- Offering new expressions for thermal efficiency of a regenerative ORC.

Keywords:

Regenerative Organic Rankine cycle- Dry Working fluids- Thermal efficiency- Subcritical ORC- Transcritical ORC

Abstract

Detailed design, analysis, and optimization of a regenerative Organic Rankine cycle (ORC) using dry working fluids is the main focus of this study. Large number of parametric calculations was performed to evaluate the thermodynamic performance (thermal efficiency and net power output) of the regenerative ORC over a range of operating conditions for fourteen dry working fluids. A systematic method is proposed for selection of optimal working fluid(s) considering the cycle operating conditions and thermo-physical properties of the working fluids. Regression analysis was used to develop expressions for thermal efficiency for the subcritical, superheated subcritical, and transcritical regenerative ORC. For all analyzed configurations of the regenerative ORC, the relationship between thermal efficiency and relevant cycle parameters, such as maximum, minimum and evaporation temperatures, is logarithmic. Based on the results, it is concluded that regeneration can decrease the difference in thermal efficiencies for different working fluids. In the case of a regenerative ORC operating with a dry working fluid, thermal efficiency increases as the maximum temperature is increased at constant minimum temperature. The results show that adding regeneration to the cycle does not change the specific net work output. Working fluids Butane, iso-Butane, and R113 offer the highest specific net work output.