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SCIENTIFIC & RESEARCH PROJECTS

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Project Title:

Thermodynamic Analysis of Application of Organic Rankine Cycle for Heat Recovery From an Integrated DIR-MCFC with Pre-Reformer

Abstract:

This work deals with waste heat recovery from a proposed direct internal reforming molten carbonate fuel cell (DIR-MCFC), including an integrated pre reformer. In this regard, some advantages are attainable over exhaust gas recycling. For instance, due to low temperature in the pre-reformer, carbon deposition and coke formation resulting from higher hydrocarbons can be eliminated. In this study, the cathode outlet provides the heat requirement for the pre-reforming process. After partial heat recovery from the cathode outlet, the stream still has a considerable energy and exergy (352.55 C and 83.687 kW respectively).

This study investigates waste heat recovery from the proposed DIR-MCFC, using an organic Rankine cycle (ORC) with two different configurations. In the first case, the cathode outlet provides the heat requirement for the pre-reforming process; then, it enters the heat recovery vapor generator of the organic Rankine cycle. In the second case, the cathode outlet is split into two streams for using in an ORC and supplying the pre-reforming process required heat. Several substances are selected as working fluids in order to compare their performance in the waste heat recovery system. The overall results at optimum conditions indicate that the energy and exergy efficiencies of the compound system are increased, and its exergy loss is decreased with cathode splitting for all substances (1.1% average over all fluids). It is concluded that cathode splitting has a significant impact on the substances which have better performance in the first case. In both cases, toluene is the most efficient working fluid. In the second case, global energy and exergy efficiencies are found to be 60.45% and 57.75%, respectively, which are almost 2.67% higher compared to the first case for toluene.