THERMODYNAMIC ANALYSIS OF A NOVEL ORGANIC RANKINE CYCLE INTEGRATED WITH ABSORPTION-COMPRESSION REFRIGERATION CYCLE WITH HYDROFLUOROOLEFIN/IONIC LIQUID AS WORKING FLUID

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ABSTRACT

With the development of industrialization, the energy consumption rises very rapidly. Organic Rankine cycle (ORC) is able to convert the exhaust heat into useable energy, so it has attached much attention. However, the exhaust vapor of ORC still have high-temperature heat which can be recovered. Absorption refrigeration cycle (ARC) is an effective way to recover waste heat of the exhaust vapor of ORC. However, the widely used working pairs (NH_3/H_2O and H_2O/LiBr) of ARC have obvious drawbacks including crystallization, corrosion, negative pressure operation and toxicity, etc. Ionic liquids (ILs) are a new class of liquids which are thought to be superior substitute for conventional absorbent because of their advantages such as non-volatility, good thermal and chemical stability, low melting point, non-crystallization, nontoxicity, etc. Hydrofluoroolefin (HFO) is the possible alternative of HFC, which has zero ozone depletion potential and nearly zero global warming potential. Therefore, HFO and ionic liquid are promising working pair for ARC.

In this paper, a novel system combining absorption-compression refrigeration cycle (ACRC) with ORC using HFO/IL working fluid is proposed. The ACRC unitizes the heat of the exhaust vapor of ORC while ORC can provide the power required by compressor in ACRC. The exhaust vapor of ORC and the solution of ACRC exchange heat by mixing directly in desorber to reduce heat loss. R1234ze(E) and R1234yf are used as the working fluid of ORC while R1234ze(E)/[HMIM][Tf_2N] and R1234yf/[HMIM][Tf_2N] are used as the working pair of ACRC. Analyzed results show that the new system has better thermodynamic performance than original ORC.