ABSTRACT

Ocean Thermal Energy Conversion (OTEC) can supply stable electric power and a variety of integrated applications. This paper investigates on the thermal performance of Rankine cycle using HFC245fa as working fluid. Rankine cycle was compared among working fluids of different properties that are HFC245fa and ammonia and has shown same performance in terms of maximum output power. As the calculation results, because latent heat of ammonia is larger than that of HFC245fa, the working fluid flow rate at the maximum output power of Rankine cycle using ammonia was found to be less than that using HFC245fa.

KEY WORDS: Ammonia; HFC245fa; ocean thermal energy conversion (OTEC); recuperated Rankine cycle.

INTRODUCTION

OTEC using the temperature difference between the warm surface seawater and the cold deep seawater can supply stable electric power and a variety of integrated applications, such as the seawater desalination, residential cooling and aquaculture, etc. In addition, effect of OTEC system on global warming and energy shortage problems seem promising. Oceans have a huge amount of stored thermal energy; however, energy density is low. As OTEC system operates under small temperature difference conditions, appropriate working fluid of low boiling point should be used in closed-cycle OTEC. HFC245fa has no harmful effect on the ozone layer and is expected to be utilized for Low-grade thermal energy conversion using low heat source temperature usually under 100°C, such as the solar thermal energy, hot spring water and waste heat, etc. This paper investigates on the thermal performance of Rankine cycle using HFC245fa as working fluid. Rankine cycle was compared among working fluids of different properties that are HFC245fa and ammonia and has shown same performance in terms of maximum output power. Moreover, Rankine cycle was compared with the kalian cycle using ammonia/water mixture as working fluid and has shown worse performance in terms of maximum output power.

Calculation Model

The thermal performance of cycle using HFC245fa as working fluid is compared among working fluids of different properties. 

Rankine cycle calculation model Conceptual Temperature-entropy (T-s) diagram using pure substance as working fluid is shown in Fig. 1. Thermal efficiency of the cycle using pure substance as working fluid that converts thermal energy of the ocean to work increases with a decrease of irreversible losses in the cycle or an increase of the effective temperature difference, the working fluid temperature difference between evaporating and condensing temperature. For that reason, it is necessary to decrease energy losses in the heat exchangers, namely to decrease temperature difference between seawater and working fluid. This is done by increasing of the heat transfer area or the overall heat transfer coefficient.

Fig. 1. Conceptual T-s diagram of pure substance