

Experimental Study of OTEC using Ammonia/Water Mixture as Working Fluid

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ABSTRACT

Recently, to improve the thermal efficiency of OTEC system, utilization of non-azeotropic mixtures as working fluid was proposed. In this paper, to clarify the characteristic of the effect of the non-azeotropic mixtures on OTEC, we carried out experiments using 30kw OTEC plant using ammonia/water mixture as working. As a result, the cycle thermal efficiency using ammonia/water mixtures is increased with the increase of warm water volumetric flow rate, but maximum net power ratio is obtained at minimum warm source volumetric flow rate. In conclusion, the relationship among warm source volumetric flow rate, cycle thermal efficiency and net power ratio are confirmed.

KEY WORDS: OTEC, non-azeotropic mixtures, Ammonia/water, Maximum power

INTRODUCTION

The ocean thermal energy conversion (OTEC) power plant is the system for generating electric power using temperature difference between warm surface seawater and cold deep seawater. The seawater temperature is stable and insusceptible to climate, so OTEC can generate electric power more constantly than other renewable energy conversion systems. In addition, the seawater used for electronic generation can be used in many fields for living, such as seawater desalination, agriculture, and more. Although OTEC provide above benefits, it is environmental friendly, so these are reasons the OTEC draw attention as valuable renewable energy. As the temperature difference between warm water and cold water in OTEC is smaller than it in conventional thermal and nuclear power system, the system cycle thermal efficiency is theoretically small and requires huge heat source pumping power to drive the power plant. So to develop the OTEC system, various studies have been carried out for a long time. As one of these studies, the use of non-azeotropic mixtures as working fluid was proposed to expect the increase of available exergy of the system. But actually few experimental studies

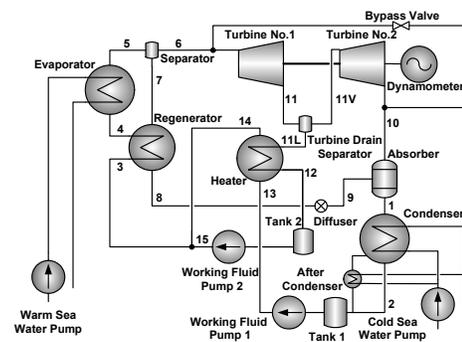


Fig.1 Schematic diagram of Uehara cycle

of the OTEC system have been conducted using non-azeotropic mixtures. And in these experimental studies, the pump power tended to exceed the turbine power, so to get the net turbine power was difficult.

In this paper, to clarify the characteristic of cycle using the non-azeotropic mixtures as working fluid, experiments for 30kw OTEC plant using ammonia/water mixture as working fluid is carried out. In this study, new embossed plate heat exchangers as an evaporator and a condenser are adopted to decrease the pump power.

EXPERIMENTAL METHODS

Uehara Cycle

Fig.1 shows the schematic flow diagram of Uehara cycle and state point numbers. Uehara cycle consists an evaporator, a regenerator, a separator, two turbines, an absorber, a condenser, two working fluid pumps, a heater and diffuser. The ammonia /water mixture (working fluid) passes through the regenerator and enters into the evaporator to perform heat exchange with warm seawater. After heat exchanging,