

Antifouling for plate type heat exchanger using seawater by the heat-treatment

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ABSTRACT

Plate type heat exchangers are used in an Ocean Thermal Energy Conversion (OTEC) plant and heat exchangers of ships. Long hours of seawater going through these heat exchangers form bio-films and scales on the surface of plates causing problems like obstruction of heat transfer, a great increase of losing pressure, and corrosion. So far, chemical treatment such as chloride treatment and Ozonation are used as prevention, there are still problems to be solved such as effects for the environment, disposal of remains, and so on. In this study, experiment is carried out for the purpose of preventing bio-films inside the heat exchanger by heat-treatment using high-temperature-seawater as environment friendly antifouling technology so as to sterilize microorganisms and bacteria. By the result of this experiment, validity of antifouling effectiveness by the heat-treatment is suggested.

KEY WORDS: Plate type heat exchanger, Heat-treatment, Antifouling, Ocean Thermal Energy Conversion (OTEC)

INTRODUCTION

In low thermal energy conversion such as OTEC and waste-heat power generation, unused energy produced from small difference of temperature is utilized to convert the thermal energy to electric energy. Although, in these power plant, thermal efficiency is improving by using a plate type heat exchanger as a compact and high-performance heat exchanger, problems such as deterioration of efficiency of heat conduction, a great increase of losing pressure and corrosion of materials can cause when bio-films and large-sized creature which ruins adhere inside the narrow circuit of heat exchanger (Little et. al (1979), Lewis et. al (1981), Sasscer et. al (1981)). Our previous study showed that effectiveness of antifouling by Ozonation is proved, however, remaining oxidant treatment system which injects ozone into seawater is needed. For this reason, we still have many problems for application, for example, to large-sized power plant which uses large amount of seawater (Ikegami et. al (1994), Ikegami et. al (1995), Ikegami et. al (2006)).

On the other hand, effect on the environment by the ballast water which is indispensable for movement of ships including changes of an ecological system become international problems, so that establishment of solution is at stake (Fukuyo et. al (2004) and Lee et. al (2006)).

Movement of ballast water and marine creatures which are transferred, spread, and fix by discharging are the cause of destruction of marine ecological system, bringing a bad influence upon marine field. For that reason, regulation of ballast water is taking effect in some countries, and International Maritime Organization (IMO) have adopted international treaty, “ International Convention for the control and management of Ships’ Ballast Water and Sediments, 2004 (BWM)” in February 2004, ship building after 2009 demand disposal system so as to come up to the standard (IMO (2005) and Regulation D-2 (2004)).

Filtration, heat treatment, mechanical treatment, and chemical treatment are considered for the technology to remove marine creatures and sterilization, however, capacity for large amount of treatment and effect for marine environment have to be considered for the treatment of ballast water, so that the treatment system to the point of practical use is not yet developed under the present condition (Kikuchi et. al (2003) and Okamoto et. al (2006)).

Therefore, in our study, aiming to sterilize bacteria in the sea efficiently, possible to treat large amount of sea water have low impact on marine environment, we did the experiment for the purpose of prevention of bio-membrane adhere to the plate type heat exchanger and sterilization of microorganisms and bacteria in the sea by using high temperature water from 40 °C to 80 °C. In this report, only the result of seawater at 40 °C is showed, experiments under other conditions are now continuing. By this result, if we evaluate heat exchanger’s performance on effectiveness of sterilization by water temperature and antifouling, validity of effectiveness of antifouling by heat treatment of high temperature is suggested.

**PROPOSAL OF BALLAST WATER TREATMENT SYSTEM
BY FILTRATION AND HEAT TREATMENT (HEAT
COLLECTION METHOD)**