Development of Electrochemical Systems for Prevention of Biofouling


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Marine biofouling is commonplace in immersed marine structures, including cooling systems of seawater cooled power plants and heat exchangers. Disposal of attached macroorganisms is cost effective and attachment of macroorganisms degrades energy transfer rates. We have focused on the use of an electrochemical disinfection method and applied this technique for prevention of marine biofouling (Fig.1).

In this study, we have developed electrochemical systems for prevention of biofouling that consist of an electrochemical reaction monitoring unit, a power control unit and a remote control and monitoring unit (Fig.2). Titanium nitride plate or titanium plate was used as the working electrode. Iron plate and silver-silver chloride were used as the counter and reference electrode, respectively. Generation of chlorine and hypochlorite was not observed using titanium as the working electrode. Fig. 3 shows the field experiment outline for electrochemical prevention of biofouling.

Field experiments were conducted in several places in Japan in Nagasaki, Tokyo Bay, Chiba, and Aomori (Pacific ocean side). Application of a constant current of 100mA/m² enabled complete prevention of biofouling for over one year using both types of working electrodes. After 2 years of seawater flow in intake channel of Matsura Thermal Power Stations of Kyushu Electric Power Inc., the wet weight of attached organisms was 10,826g/m². In contrast, the wet weight of organisms attached on the titanium nitride electrode and titanium electrode was 206g/m² and 38g/m², respectively (Fig. 4). Generation of oxygen free radicals is the most probable cause of prevention of biofouling. Therefore, it was shown that application of the constant current of 100mA/m² using the developed electrochemical system is useful for prevention of biofouling.

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References