Corrosion damage behavior with hybrid experiment for Cu-9.3%Al-3.5%Fe-4%Ni alloy in sea water

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Due to the recent development of engineering, mechanical instrument requires higher speed and higher power. Since underwater rotating system that rotates in sea water environment is significantly damaged by cavitation that is caused by the fluidic impact and the reduced static pressure, the durability life of the material is shortened and the cost of repair is increased. The main cause of the cavitation damage is the erosion and abrasion due to the micro jet that is generated by the repeated contraction and expansion of air bubbles. Breakup of the air bubble generates a huge impact pressure of a few GPa on the material surface, leading to a fatal damage. Eventually, it reduces the performance, operation and controllability of the hydraulic machine and the propulsion system [1]. Aluminum bronze used in this study is the alloy that has good strength, ductility and excellent corrosion resistance, oxidation resistance at high temperature, containing 9~12% of aluminum. This alloy is appropriate for large castings such as huge propeller, impeller, valves, high strength bearings and gear materials for ships, and widely used as the mechanical parts for chemical engineering. We investigated the corrosion resistance under cavitation and the electrochemically complicated environment of the ALBC3 that has excellent corrosion resistance and mechanical properties in sea water environment. We induced following conclusions with respect to the corrosion characteristics of an underwater rotating system. The natural potential and dynamic potential measurement showed that noble potential was found when the cavitation environment was applied, but the corrosion current density was increased as the active dissolution and the activation polarization were accelerated. Moreover, passivation or concentration polarization was not observed because the aluminum oxide film was destructed and the oxygen diffusion layer was eliminated. The observation of the surface micro-structure suggested that the corrosion took place initially in β phase that has poor corrosion resistance in spite of high hardness. The Tafel analysis showed that the corrosion current density was considerably higher and the corrosion rate was faster by about 25 times in the cavitation hybrid test than in the electrochemical test.

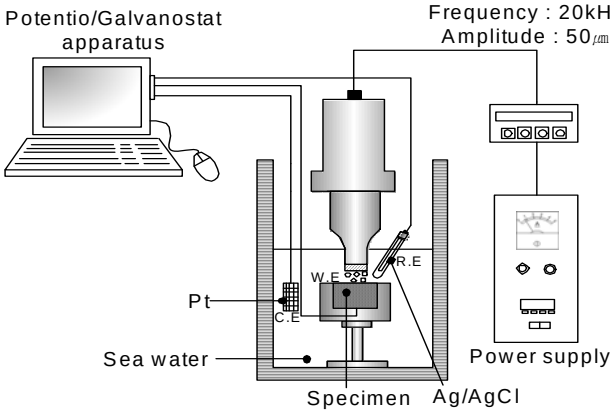

Fig. 1 Schemetic diagram of cavitation hybrid test equipment and cavitation-electrochemical cell

Reference

[1] Husnu Gerengi, et.al., Evaluation of corrosion inhibition of brass-118 in artificial seawater by benzotriazole using dynamic EIS. Corrosion Science, 51, 2573-2579, 2009

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