熱交換器의 海水冷却細管의 腐蝕과 防蝕(3)

——外部電流에 의한 海水冷却細管 內面의 直接的 防蝕裝置를 갖춘 熱交換器의 設計要領과 特性——

田 大 熙

On the Corrosion and Its Prevention of Sea Water Cooling Tubes of Heat Exchangers (3)

——On the Design Points and the Features of Heat Exchangers equipped with the Direct Protective Device by the External Current for the Inner Surface of Sea Weter Cooling Tubes.——

Dae Hie, Jeon

Abstract

A heat exchanger is designed to be used for a long period without repair and cleaning. In this heat exchanger, the twisted tapes, to both faces of which the insoluble linear auxiliary anodes fixed, are inserted into its cooling tubes, and the sea water pipe line has an anti-biofouling device by sea water electrolysis. Therefore, the inner surface of those tubes are protected against corrosion and biofouling by the external current.

The heat exchanger is designed on the following conditions:

1. The cooling tubes made of a metal which is more heat-conductive but less anti-corrosive are used in the heat exchanger, for the tubes are protected against completely and economically. The tube whose inside diameter is more than 20 mm must be used for the reduction of the sectional area of cooling tube by inserting the twisted tape into it, the wall of the tube must be more thick than 2.0 mm and the thickness of the tube sheet must be neary epual to the cooling tube diameter to be fixed the tube to the sheet tightly for a long period. The tube pitch must be from 1.5 to 1.8 times as the diameter of the cooling tube and the tubes must be arranged with equilateral triangles because of the electric line net for protection.

2. The twisted tapes (twist pitch/tube inside diameter$=6\sim8$) must be wide enough and its edge side must be coated thicker not to be shaken in the cooling tube, the internal electric lines of the heat exchanger must be arranged with double line system not to be broken, and the tapes must be protected against corrosion by the stray current.

3. The rubber plate for the electric line net the rubber plate for packing and the metal plate for pressing rubber plater must be fixed with 4-6 stopper bolts and many cover flange bolts, and the water passage holes of the plates must be enlarged from 20° to 30°

4. The electrodes whose potentials are stabilized in sea water for long period must be fixed on the center part of the 3 typical tubes to be able to measure the potentials of the inner surface of cooling tubes, for the protective current densisty must be controlled by the porential of the inner

surface of a cooling tube (2 electrodes are for spares)

5. The heat exchanger must be equipped with an anti-biofouling device by sea water electrolysis and a strainer on the sea water pipe line to be used continuously for along period without cleaning.

6. The capacity of the oxternal D. C. source is calculated by the current density estimated by the operating conditions.

The heat exchanger is more complex in structure and more expensive in manufacturing cost, but has better effects on corrosion prevention and heat transfer, and it needs less current consumption than the heat exchanger equipped with an anti-corrosive device by iron eiectrolysis and an antibiofouling by sea water electrolysis.

AISI 304 스텐레스鋼의 應力腐蝕龜裂에 관한 연구

朴 弼 相　尹 勝 烈

A Study on the Stress Corrosion Cracking of AISI 304 Stainless Steel

P. S. Park and S. R. Yoon

Abstract

Stress corrosion cracking phenomenon of the commercial type 304 stainless steel wire in the boiling 42% magnesium chloride solution has been investigated. Main experimental techniques were to measure the time to faliure of the wire varying the applied tensile stress, to follow potential of the material versus time, to observe potentiostatic polarization behavior, and to examine the microstructure of the failed specimens. Results showed that every crack propagates in the transgranular fashion. With the more applied stress up to 53,200 psi, the more crack density appeared per unit length of specimen and the less time was taken to the final fracture. The role of applied stress seemed to be involved both in the crack initiation and in the crack propagation, but more pronounced in the latter process. Potential vs. time curve and potentiostatic polarization behavior of the wire indicated that a passive film would be present on the corroding specimen surface. Breaking of such a film induced by strain due to the applied stress would initiate crack formation when anodic dissoulution of the metal was followed at the resulting bare sites. It was found that crack propagation started at the base of a pit especially when large anodic current was forced to flow into the wire. A cathodic polarization to the potential slightly more active than the steady state corrosion potential retarded remarkably the time to failure of the wire specimen. Data revealed that such a slight cathodic protectection was slowing down crack propagation.