Electrochemical Corrosion Studies of Alloy 22 Weld with Aqueous KCl Electrolytes

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High level radioactive waste and spent fuels are being stored in Alloy 22 canisters welded shut by Alloy 22 lids in repository sites at Yucca Mountain, Las Vegas, Nevada. This study provides the useful data on corrosion susceptibility of Alloy 22 weld in the anticipated environment of repository. The corrosion study of Alloy 22 welds may be useful in life prediction of canister and the lids, which are joined together with welds. According to the previous studies, Alloy 22 has good corrosion resistant properties in the anticipated environment of repository. This study compares the corrosion susceptibility of Alloy 22 welds with respect to the Alloy 22 itself by potentiodynamic polarization technique. The primary goal of using this technique is to determine the active corrosion, corrosion potential, passivation, and the transpassive region.

Electrochemical corrosion studies were conducted using a flat cell (PAR- Model K0235), in addition to the Potentiostat/Galvanostat (PAR Model 283) instrument and PowerCorr (Model 352) software. An Alloy 22 weld sample has been made by joining two flat plates of Alloy 22 through a tungsten gas arc welding process. The weld fabrication was done as per the certified inert gas tungsten arc welding process. All material used in the experiments were procured from a YMT accepted vendor. The potentiodynamic polarization measurement was done with a 0.1 N KCl aqueous solution as electrolytes in the flat cell. The reference electrode was a saturated calomel electrode (SCE) which has 0.242 volts potential with respect to the normal hydrogen electrode. The platinum sheet was used as counter electrode and Alloy 22 weld sample has been used as working electrode. Alloy 22 weld sample was polished up to the 3 to 5 micron flatness followed by the 240, 340 and 600-grit SiC paper.

Potentiodynamic polarization measurements consisting of potential voltage (vs. NHE) with variance as a function of current were conducted in aqueous KCl (0.1N) electrolyte. The electrochemical study clearly shows indications for formation of passive films in two or more potential regions (ranging from ~0.2 V & 0.6 V vs. SCE) with active corrosion as shown in Fig 1. Ultimately, corrosion process sustained trans-passive break down or dissolution of passive Pitting corrosion and inter-granular corrosion was observed with an optical microscope (Olympus-Model C-35 A) as shown in Fig. 2. Further studies will be conducted with aqueous KCl and Na_2SO_4 electrolytes by using potentiodynamic polarization, potentiostatic and cyclic voltametry measurement techniques.

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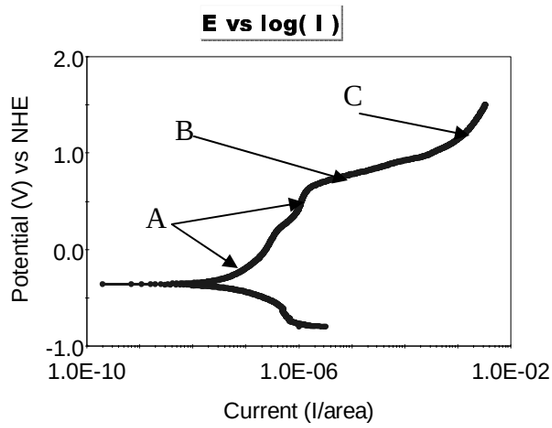

A: Active Corrosion Region
B: Passive Region
C: Transpassive Region

Fig. 1.Potentiodynamic polarization measurement of Alloy 22 weld (0.1N KCl)

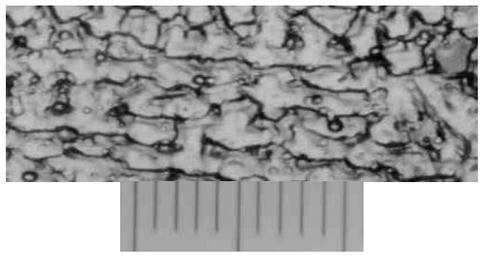

Fig.2 Optical Microscope image of an Alloy 22 weld exposed to 0.05N KCl (each size marking is 0.1 mm).

Reference:

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