Understanding of the Corrosion Behavior of Carbon Steel in the NH_4Cl - H_2S - CO_2 Coexisting Environment

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In this work, NH_4Cl corrosion induced failure accompanied by H_2S and CO_2 corrosion in the overhead systems of a hydrotreater was studied. Electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization techniques were used to evaluate the effect of temperature, low-level H_2S and pH on the corrosion behavior of carbon steel in NH_4Cl - H_2S - CO_2 coexisting environment. The results indicated the presence of H_2S (10 ppm) that inhibited the corrosion of the carbon steel in the H_2S - CO_2 - NH_4Cl corrosion system at 60 °C. In this case, the minimum corrosion rate of 0.7 mm/y could be achieved. H_2S played a key role in influencing the cathodic and anodic reactions. The corrosion rate increased rapidly with the increase in H_2S concentration above >10 ppm, and the relationship between the corrosion rate and the concentration of H_2S was established. The dominant cathodic reaction was found to be the carbonic acid reduction at $\text{pH} > 4$, meaning that H_2S - CO_2 - NH_4Cl induced corrosion can be effectively controlled by adjusting the content of H_2S component.

Keywords: H_2S corrosion; NH_4Cl corrosion; CO_2 corrosion; Corrosion behavior.

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