Effect of Fluoride Ion on the Corrosion of 304 Stainless Steel in $(\text{NH}_4)_2\text{SO}_4$ Solution Containing Chloride Ions

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The corrosion behavior of stainless steel in contact with an ammonia desulphurization slurry, which contains a high concentration of both fluoride ions (F^-) and chloride ions (Cl^-), affects the commercialization of the ammonia desulphurization technology. In this paper, 304 stainless steel was taken as a typical stainless steel sample to explore the influence of F^- on its corrosion behavior in a simulated ammonia desulfurization slurry. The open circuit potential, polarization voltage, polarization current, cyclic voltammograms, electrochemical impedance spectroscopy, and Mott-Schottky plots, for different F^- concentrations, have been studied using electrochemical methods. At the same time, the influence of different F^- concentrations on the corrosion of stainless steel was studied by an immersion test, and the specimens were characterized by scanning electron microscopy and X-ray photoelectron spectroscopy. The experimental results show that in the simulated ammonium desulfurization slurry, at a given concentration of Cl^- , low concentrations of F^- aggravated the corrosion of stainless steel, while a high concentration of F^- (the molar ratio of F^- to Cl^- is higher than 10) produced significant corrosion inhibition. The reason may be that F^- can combine with H^+ , preventing the pH of the solution from becoming too low, and simultaneously, F^- can also react with metal ions to form insoluble sediments, which prevent the aggravation of the corrosion process.

Keywords: Ammonia desulfurization; stainless steel; fluoride; corrosion; inhibition

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