

Research on Stress Corrosion Simulation and Magnetic Memory Testing of Casing in CO₂ Medium

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Due to being in an acidic CO₂ environment and high-pressure underground, the stress corrosion phenomenon on the inner wall of the CCUS wellbore is more pronounced, with the possibility of wall thickness reduction and crack propagation, which affects the integrity and storage reliability of the wellbore. This article conducted indoor experiments on stress corrosion of oil casing, and characterized the stress corrosion through magnetic memory detection technology. Through experiments, the stress corrosion morphology of specimens under different concentrations, stresses, and defects was obtained. The microstructure of the stress corrosion site was observed using SEM electron microscopy, and the stress corrosion situation of the material in CO₂ was observed, laying a foundation for magnetic memory detection; A stress corrosion detection method under CO₂ environment was proposed, and the magnetic memory detection method was used to measure that the more severe the stress corrosion, the more obvious the magnetic signal mutation; The shape and morphology of different defects vary, but the main factors affecting magnetic memory signals are concentration and loading force. This article verifies the feasibility of magnetic memory in stress corrosion detection through experiments, and characterizes the stress corrosion situation using magnetic memory signals, which is of great significance for non-destructive testing of wellbore stress corrosion in CO₂ storage.