Corrosion Behavior of CCUS Production Wells in Deep Oil Reservoirs and Anti-Corrosion Strategy

Zhengrong Ye[1], Peiran Liu[1],Xiang Zhou[1],Xiang Liu[1], Ran Yi [1] , Zhihong Zhao[1],

Tong Peng[2],Haiwei Lu[2], Xueqiang Lin[3], Jianbo Sun[3]

[1] Research Institute of Petroleum Exploration and Development, PetroChina, Beijing, 100083, China: 12 point type, centered, italicized

[2] Jidong Oilfield Company, PetroChina, Tangshan 063000, China

[3] School of Materials Science and Engineering, China University of Petroleum (East China), Qingdao 266580, China

Presenter's e-mail address: yezr@petrochina.com.cn

Abstract CCUS pilot tests are carried out in several deep oil reservoirs over 3000m depth in the region of North China. In the oil production process, the temperature and pressure is high, and the CO_2 phase will change from supercritical to gaseous state, which leads to the complex corrosion mechanism. This article will investigate the corrosion behavior under different CO_2 phase environments, providing a basis for the design of anti-corrosion measures. Weight loss method is employed to study the corrosion rate of N80 carbon steel in different CO_2 partial pressure. Subsequently, techniques such as SEM, EDS, XPS, and Raman spectroscopy are used to study the morphology and composition of the corrosion products. The results show that when the temperature is 80℃, within the CO_2 partial pressure range of 0.4~18 MPa, the average corrosion rate of N80 steel varies from 0.1916mm/a to 0.8191 mm/a, and exhibits a trend of initially increasing, followed by decreasing, and then increasing again, with the peak under the condition of 10.5 MPa. The corrosion product film forms double-layer compound film structure by the deposition of crystalline $FeCO_3$ particles, and the corrosion morphology exhibits typical uniform corrosion. In order to enhance the long-term safe production of the wellbore, a combined casing design is proposed, utilizing of 13Cr stainless steel from 50m above the top boundary of the target interval to the bottom hole, N80 carbon steel for the rest casing. The anti-corrosion method for the tubing is recommended of N80 carbon steel with corrosion inhibitor injection. The anti-corrosion plan has been successfully implemented in an oilfield of North China. This article clarifies the corrosion behavior and morphology of N80 carbon steel under different CO_2 phase state, providing reference for CO_2 flooding anti-corrosion design.

Keywords CCUS; Deep oil producer; Supercritical CO_2; N80 carbon steel

Reference

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