Study on the Effect of Carbon Dioxide on the Direct Corrosion Process of Pipeline Steel Induced by Sulfate Reducing Bacteria

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Abstract

There are numerous oil reservoirs exhibiting low permeability. The strategic injection of carbon dioxide (CO_2) into these reservoirs has been identified as a promising approach to enhance the extraction efficiency of low-permeability oil fields [1]. However, those operations are often compromised by the corrosion failure of pipeline steel, which can have adverse effect on the overall exploitation process. The CO_2 can be used as a carbon source for microorganisms in underground pipelines for chemoautotrophic metabolism and induce microbiological induced corrosion (MIC). As a typical corrosion microorganism, sulfate reducing bacteria (SRB) is capable of directly causing E-MIC and accelerate iron corrosion via chemical attack of its corrosive metabolites [2]. Some studies showed that the E-MIC may cause more severe corrosion than M-MIC. This work focus on whether the injection of CO_2 will have an impact on this corrosion process of MIC.

In this present study, the corrosion behavior of X70 pipeline steel induced by Desulfovibrio Bizertensis SY-1 was studied via electrochemical measurements and weightloss experiments. The bacterial culture experiment found that CO_2 had little effect on the cell number and attachment ability of SRB bacteria. The weightloss experiments results showed that corrosion of pipeline steel is more severe in the CO_2 system and the proportion of E-MIC in corrosion in CO_2 systems is significantly increased. Surface investigations revealed that corrosion products in CO_2 systems are denser and pitting pits are generally deeper. Cytochrome c level tests shows that the Cyt C level in SRB increased by about 20% in CO_2 system. The result of electrochemical measurements is consistent with the above conclusion, which suggests that CO_2 promotes the secretion of Cyt C in SRB cells, thereby promoting their direct corrosion.

Keywords CO_2、X70、SRB、Direct Corrosion

Reference

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