Failure analysis on corrosion perforation of a 90° elbow pipe in high H_2S/CO_2 natural gas well station

Xuefen Zhao, Yuan Tian, P*eigeng Fan, Chunbi Xu*

School of Petroleum and Natural Gas Engineering，Chongqing Univercity of Science and Technology,Chongqing ,China, ,401331

Abstract : A 90° elbow pipe in high H_2S/CO_2 natural gas well station started performation leakage after less than 9 years operation. To investigate the causes of elbow perforation failure, optical microscope, scanning electron microscope, X-ray diffractometer and fluid dynamics simulation software (Fluent) were used to analyze the causes of corrosion perforation of elbow pipe in high H_2S/CO_2 natural gas well station. The test results of elemental compostion, strength and metallographic structure analysis of the failed elbow pipe material (L245NCS) showed that elbow material met the requirements of national standards. The main chemical components of corrosion products included FeS and $FeCO_3$. The fluid dynamics simulation of Fluent shown that natural gas entraining fine sand will cause serious erosion and wear to the outer wall of the 90° elbow under operation conditions, but has little influence on the straight pipe section and the inner wall. The comprehensive analysis results showed that the failure of elbow perforation was mainly caused by the coexisting corrosion of CO_2 / H_2S, galvanic effect between outer wall and iner wall in coordination with the errosion of sand-containing fluid on the outer wall of the elbow. After the corrosion product film of the outer wall of the elbow is eroded and damaged, galvanic corrosion is formed with the straight pipe and inner wall protected by corrosion products of the elbow, and the outer wall becomes the anode zone. The erosion and wear of the sand further accelerate the thinning of the outer wall, and eventually lead to perforation leakage.

Keywords :elbow pipe; corrosion perforation;erosion-corrosion;galvanic effect

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