Corrosion behavior of tubing string in simulated environment of production well in underground coal gasification

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Abstract The production-well tube string in underground coal gasification (UCG) transports mixed coal gas and suffers corrosion due to high-temperature CO_2, H_2S and water vapor. Corrosion tests of 9Cr and 13Cr materials in simulated UCG environments between 150℃ and 300℃ were carried out by a high temperature and high pressure autoclave equipment. The effects of gas partial pressure and temperature on the corrosion of the two materials were compared and analyzed. , and material selection suggestions were provided. The results show that the most important factor affecting the corrosion of well tubing is temperature, followed by CO_2 partial pressure. As the temperature increases from 150℃ to 300℃, the corrosion rates of both materials first increase and then decrease. When CO_2 partial pressure is 3 MPa, corrosion rates of 9Cr and 13Cr materials reach the maximum at 250℃, which are 1.620 mm/a and 0.7284 mm/a respectively. Microscopic results obtained by Scanning electron microscopy (SEM) show that corrosion films of 9Cr material are porous and relatively thick, while those of 13Cr material are dense and intact. It is recommended that 9Cr tubes should be used at temperatures below 150℃,and 13Cr tubes should be used at temperatures below 200℃.