Erosive WearBehavior of Steel and Iron Materialunder theStress StateAbstracts

Sun BingCai, Fan JianChun*,Wen Dong,ZhangLaiBin,Chen YingYing

China University of Petroleum-Beijing, Fuxue Road 18, Changping, Beijing 102249，P.R. China.
*Corresponding author for sunbcyy@163.com

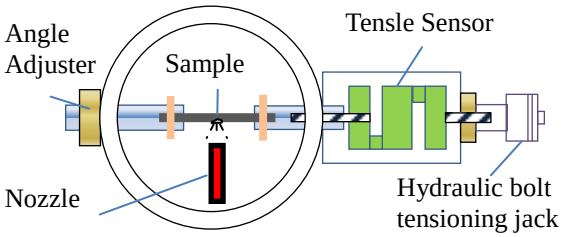
1. Introduction

During the massive hydraulic fracturing for oilfield，the fracturingequipments adopted have the characters of high pressure, great displacement, high sand concentration and long continuous operation time,as a result of that, the ground pressure pipe manifold are not only under high internal pressure, but also suffering the erosion from the solid particles in the fracturing liquid. Beneath these coupling working conditions, the pipe manifold could be easily damaged, especially in the elbow.

Experiments for solid particle erosion have been studied for years, and researchers have discussed various influencing factors on erosion such as angle of impingement,particle velocity, concentration,particle size, grooves and pipe shape,etc[1-3].Surprisingly, there is adearth of research on the configuration related to the study ofpipe erosionwith high internal pressure.

2. Experimental set-up

There arevarious erosion test equipments for studying erosion wear under different influencingfactors, but no one can evaluate the erosion degree under high pressure.The high pressure pipe bend which is subjected to pure internal pressurewill generate stress concentration inthe longitudinal and circumferential direction, and the circumferential stress is considerably larger thanthe longitudinalstress[4].As the circumferential stress is tensile , a simplified experimental installation was designed and built.The self-designed tension loading equipment which is a portion of the experiment deviceis shownschematically in Fig. 1.



3. Materials and range of parameters

Two high-pressure pipe materials namely,30CrMo and 40CrNiMo steelhave been selected for the investigation.Both the steelsare commonly used in the high-pressure manifold due to their high strength. A new type of sand named prcoated sand is choen to be the erosion particle.

4. Results and discussion

Fig.2 shows the variation of the erosion rate with tensile stress under the condition of20m/s velocity, 8% solid concentration (by weight) and 30° erosion angle.As can be seen from the Fig.2, when the tensile stress is lower then 200Mpa, the erosion rate forboth the two kinds of steeldoes not have obvious variation, when the tensile stress is larger than 200MPa, the erosion rate goes up with the tensile stress increasing.

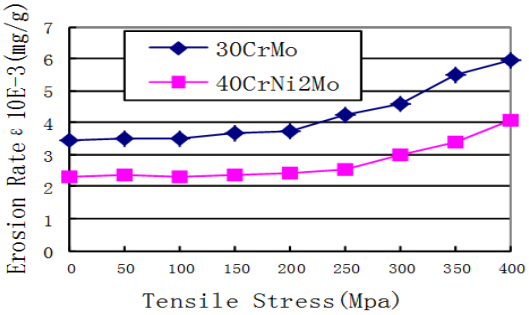


Fig.2 Variation of erosion rate with stress (impact angle 30°)

5. Concluding remarks

Based on the present experimental investigations on erosn wear for steel and iron materialunder stress state in sand–water mixtures,the conclusion can be obtained , that when the tensile stress is lower than a critical value, the erosion rate is not sensitive to stress, but when the tensile stress is greater than the critical value, the erosion rate goes up obviously with the tensile stress increasing.

6. References

[1] Iain Finnie .,“Some reflections on the past and future of erosion,” Wear ,186-187 ,1995 ,l-10.

[2] Bhupendra K. Gandhi, S.N. Singh, V. Seshadri., “A study on the effect of surface orientation on erosion wear offlat specimens moving in a solid–liquid suspension,” Wear ,254, 2003,1233-1238.

[3] E.S. Venkatesh., “Erosion Damage in Oil and Gas Wells,” SPE 15183. Alaska; 1986.

[4] Kenji Oyamadaa,∗, Shinji Konosub, Takashi Ohnoc.,“Development of a plastic collapse assessment procedure in the P-M diagrammethod for pipe bends with a local thin area under combined internal pressureand external in-plane bending moment,”Nuclear Engineering and Design,247 2012, 42-57.