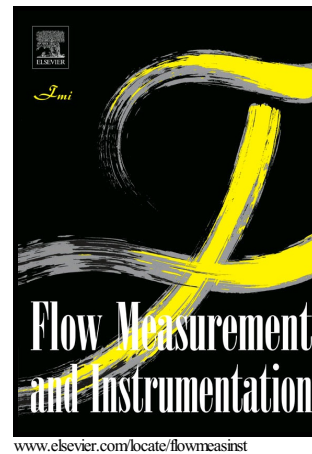


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Study on the Measurement Accuracy of an Improved Cemented Carbide Orifice Flowmeter in Natural Gas Pipeline

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Abstract

Standard orifice flowmeter has been widely used in the field of natural gas metering. However, the traditional stainless steel orifice flowmeter (TSSOF) is not resistant to wear and corrosion, especially the entrance sharpness will gradually increase. In order to improve the measurement accuracy and working life of the orifice flowmeter, the cemented carbide is embedded in the opening place of the TSSOF, thus, an improved carbide orifice flowmeter (ICOF) is manufactured. For conducting the field comparison experiment, four ICOF and four TSSOF were installed in four natural gas pipelines, respectively. The experiment results show that the variation ranges of the entrance sharpness of them are 9.863 to 26.438 μm and 9.192 to 57.329 μm , respectively; the entrance sharpness is increased with the increasing of the use time, but the change rate of the ICOF is smaller. The CFD simulation was also carried out. The simulated discharge coefficient values were compared with the calculated discharge coefficient values by the ISO empirical correlation. The results show that the accuracy of the two types of orifice flowmeter display a same decreasing trend with the increasing of the use time, and the absolute value of the relative error ranges are 0.51% to 2.28%, 0.13% to 4.25%, respectively, but the descent rate of the ICOF is smaller; the measurement accuracy of the ICOF is improved up to 2.39 times compared with the TSSOF, and it is more stable when the gas flow rate changes in the pipeline. Additionally, the effect of downstream inclination angle was studied. The result demonstrate that the measurement accuracy can be improved by 0.34%, when the downstream inclination angle is 60° at the gas flow rate of 5 to 15 m/s, which is superior to the commonly used inclination angle of 45°. In summary, the ICOF can be better applied to engineering practice.

Keywords: Natural gas pipeline; Standard orifice flowmeter; Cemented carbide; Stainless steel; Discharge coefficient; Measurement accuracy

1. Introduction

Even though some non-standard differential pressure type flowmeters with new structures, such as

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