Flow characteristics of disk bypass Pipeline Inspection Gauge (PIG) in natural gas pipelines using computational fluid dynamics

ABSTRACT

Disk bypass pipeline inspection gauge (PIG) is considered as an efficient device for pigging operations including cleaning, maintaining and inspecting pipelines. The PIG performance is influenced by the fluid flow characteristics as PIG moves forward due to differential pressure of fluid around the PIG. This study focuses on flow characterization of fluid around disk bypass PIG for natural gases pipelines including methane, ethane, and butane using computational fluid dynamics approach. The control volume method with steady state Turbulent k-? model was applied for simulation purposes using ANSYS Fluent 19 software. Fluid velocities at different sections around PIG and differential pressure were investigated for various bypass opening percentages. The results showed that by increasing bypass opening percentages from 5% to 15%, fluid velocity at bypass opening section has reduced 28.28%, 40.43%, and 21.21% for ethane, butane, and methane, respectively, while differential pressure reduced 88%, 86% and 89%. This indicated that 15% bypass opening percentage provided the best flow characteristics among all cases considered. At 15% bypass opening percentage, methane resulted in the lowest fluid velocity at bypass opening section and lowest differential pressure compared to others. Additionally, a correlation of differential pressure of these gases as a function of bypass opening percentage and other parameters was also developed for first time. All results are important for design selection of PIG parameters for efficient pigging operation.

Keyword: Pipeline inspection gauge; Fluid velocity; Differential pressure; Bypass opening percentages