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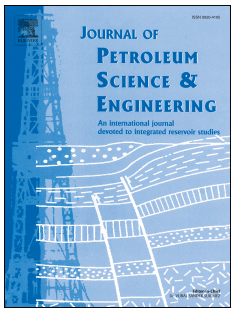

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Probing rate estimation methods for multiphase flow through surface chokes

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ABSTRACT

Choke is an essential device that controls flow rates at either subsurface or surface. Many models and correlations have appeared over decades handling multiphase flow through surface chokes. But, direct comparison of their relative performance has been a few, if any. This study evaluates several models and correlations to explore their relative performances. As expected, models anchored in thermodynamic principles outperformed others. Improvements in modeling followed the initial findings.

We studied several models to explore their relative merits and ease of use in field settings. Seven different data sets gathered from laboratory and field settings, involving about 1,000 independent data points, constituted the essence of this study. The study found the importance of PVT data in any flow through choke calculations. Specifically, we found that changes in density and heat capacity of fluids with pressure and temperature should be part of any rigorous effort for computation of flow rates.

To ensure reliability and consistency in solutions, a model based on thermodynamic considerations deserve preference for generalized applications because it can handle pressure and temperature-dependent fluid properties. In this context, the recognition of choke-discharge coefficient's dependence on flow rate and Reynolds number constitutes an important element in ensuring the reliable outcome of results.

1. Introduction

Rate metering at surface separators has a long track record in the industry. However, as pointed out recently by Maizeret et al. (2014), challenges arise when separation quality of fluids, such as in gas/condensate system becomes nontrivial. Besides separation of fluids, the requirement of flow stabilization hinders the frequency of flow metering. Measurements of the mass rate with a Venturi tube and the individual phase fraction with a dual-energy densitometer pave the way for quality multiphase rate metering. Besides direct metering of multiphase fluids, wellbore flow modeling can also provide clues about flow rates. As shown by Izgec et al. (2010), the use of wellhead-pressure and temperature data can also lead to good estimation of flow rates in different settings with wellbore flow modeling. More recently, Lorentzen et al. (2014, 2016) suggested transient multiphase well flow modeling and modern mathematical estimation techniques to decipher flow rates in diverse flow situations.

Despite all these developments, we think flow through choke will remain an option to validate other forms of direct measurements and model results. Given that no additional expense occurs typically in a given setting, flow through choke remains an attractive option for eliciting rates to corroborate both direct and indirect inference of flow rates.

In a flowing well, a wellhead choke offers the primary means of controlling the flow rate, leading to the overall management of field rates. The use of an appropriate choke correlation or a model allows selecting choke sizes, estimating rates with sufficient accuracy, and identifying