MODELING OF WELL TEST MEASUREMENT SYSTEM PERFORMANCE

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ABSTRACT

In the petroleum industry, most often, gas, oil and water are produced simultaneously from the reservoir and are transported together until the surface facilities before being separated. There are several reasons for measuring the oil and gas production from the well before separating the phases completely; the most important reasons being: custody transfer, production allocation, reservoir management and oil field optimization or smart fields.

The most common and widely used technique for measuring the well production consists of separating the phases and measuring the flow rates using single phase meters. The uncertainty of a single phase meter is affected by the contamination of the other phases. As reported by Skea et al. (1994) a turbine meter can over or under predict the liquid flow rate depending on the gas fraction and the velocity of the mixture. Thus it is necessary to understand the performance of the vessel (steady state and transient) in order to predict the uncertainty of a well test separator measurement.

Several methodologies are described in the literature for gas/liquid separator design which simply attempt to be conservative enough so that separation equipment will work for process purposes. Unfortunately, the definition of how conservative designs should be remains in question and there is a lack of proper systematic analysis which allows the prediction of gas carry under and liquid carry over under a specific operating condition.

In this work a comprehensive mechanistic model for the prediction of the vessel performance, inlet gas and liquid entrainment, and the inlet bubble and droplet size distribution is presented. Combining the performance models of the vessel separator (which predict the contamination of the phases) with the uncertainty analysis of single phase meters, a methodology for the evaluation and design of the well test measurement system performance has been proposed. Finally, using a successive steady state model, the oil and gas rate measurement uncertainty as a function of time is predicted, considering the fluctuation of the flow at the inlet of the separator. Key features of a computer simulator implementing the above methodology will also be discussed.

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