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Flow Assurance and Control in Petroleum Production and Transport

The occurrence of multiphase flow is inevitable in hydrocarbon production, transportation and processing. The problems associated with multiphase flow still challenge industry and research institutions alike. In this special issue of JERT, there are five papers covering various aspects of multiphase flow in production, transportation and processing. A brief summary of the papers is provided below.

The first paper is titled "An Experimental Study on Wax Removal in Pipes With Oil Flow," and addresses the pigging as a wax remediation technique. Authors have investigated the performance of various pigs using an innovative experimental approach. They have identified the breaking force and plug transport forces as the primary forces that a pig needs to overcome for a successful pigging operation. Their experimental results also showed that the wax transport behavior of the by-pass pig is significantly different than that of the regular pig. They conclude that by-pass pigs allow the oil to flow through the by-pass holes and mobilizes the removed wax in front of the pig resulting in no discernible wax accumulation in front of the pig with no measurable transportation force. The general message to take out of this paper is that by-pass pigs are favorable to regular pigs.

The next two papers address some of the problems related to the pipeline transportation of oil and gases. The first paper is titled "Hydrodynamic Modeling of Three-Phase Flow in Production and Gathering Pipelines." The accurate prediction of multiphase flow in pipes is a real challenge for investigators. Authors of this paper attempt to address the three-phase flow under the low liquid loading conditions based on two-fluid approach. They present a comparison with a real pipeline data to verify the performance of their model. This paper directs our attention to three-phase flow and its complexities and possible shortcomings of over-simplifications in lumping two liquid phases into one. The third paper is titled "Evaluation of 'Marching Algorithms' in the Analysis of Multiphase Flow in Natural Gas Pipelines." The typical algorithm for multiphase flow calculations in pipes is called marching algorithm, an iterative process requiring an iterative scheme. This paper presents a different implicit approach requiring simultaneous matrix solution of conservation equations. The authors present the new technique and provide a comparative discussion with "Marching Algorithm."

The last two papers address the separation of the produced fluids. Petroleum industry typically utilizes large gravity based separators. Normally, this technology consists of horizontal or vertical vessel-type devices, which can be heavy and expensive. Compact separators can be considered as an attractive replacement since they are small; possess low weight, and low cost. On the other hand, due to small size of the compact separators, the separation efficiency may not be as desired for some operating conditions. Both papers discuss the ways to improve the separation efficiency of compact separators by introducing specific flow conditioning devices. The fourth paper is titled "Wet Gas Separation in Gas-Liquid Cylindrical Cyclone (GLCC) Separator." Effective gas-liquid separation is important not only to ensure that the required gas quality is achieved, but also to prevent problems in downstream process equipment such as meters, scrubbers, demisters and compressors. A common phenomenon in separation is the entrainment of liquid droplets in the gas stream, which can result in liquid-carryover (LCO). Authors discuss the application of GLCC to wet gas systems by adding an Annular Film Extractor. With this new configuration their experimental results indicate zero LCO providing 100% separation efficiency. They have also presented a predictive model for the design of such separation system. The last paper is titled "Design and Performance of Slug Damper." Compact separators due to their small size may not handle the large liquid slugs. In this paper, the authors introduce and discuss the efficiency of a conditioning device called slug damper. They also proposed a design model for the slug damper.

Cem Sarica
Professor
Department of Petroleum Engineering,
The University of Tulsa,
600 South College Avenue,
Tulsa, OK 74104-3189
e-mail: cem-sarica@utulsa.edu

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