Paper SPE/PS/CHOA-117285, PS2008-316

Case Study in Venezuela: Performance of Multiphase Meter in Extra Heavy Oil

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This paper presents a case study of the performance of a multiphase meter, combining a Venturi and multi energy gamma ray, applied to extra heavy oil.

The Orocual field in Monagas is one of the most diverse oilfields in Venezuela. It produces gas condensate, light and medium oil and has recently started to produce from a heavy and extra-heavy oil reservoir, with a gravity between 8.6 and 11 API and a viscosity range from 6 Pa.s to more than 20 Pa.s at line conditions. PDVSA is currently using cold production systems in this field.

PDVSA was using conventional storage tanks to try to estimate the liquid flow rate, but was unable to evaluate the gas production because no separator was able to work in the environment of low GOR, emulsion, large amounts of foam and high viscosity. The density of heavy oil is close to the density of water, so gravity separation does not work properly. Also, the heavy oil is very viscous, which means that proper separation requires a long retention time, which is not feasible from a space or economical point of view. Another associated phenomenon is that gas bubbles cannot flow freely and remain as a gas phase trapped inside the liquid. This leads to overestimation of some of the liquid flow rate and the measurement process can take longer than 24 hours.

PDVSA wanted more complete measurements of the field's oil, water and gas flow rates. The company tried several multiphase meters but found that a Venturi and multi energy gamma ray combination was the only solution able to accurately measure multiphase flow in its extra heavy oil. A test demonstrated that, compared to a tank system, the overall uncertainty of the Venturi combination was better than 2%. This extended the operating envelope for PDVSA for using this multiphase metering technology, providing the capability to monitor and optimize in real-time the production in this extra heavy oil field.