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New Class of Meter Solves Old Problem Impacting Well Test Accuracy

Abstract

For the first time in a BP-operated asset, the impact of entrained free gas (not solution gas) in the liquid outlet line of a well test separator is quantified for the purpose of correcting gross fluid volumes and density measurement. This paper describes the results of deploying a sonar based, clamp-on gas void fraction (GVF) meter at a test facility in the Prudhoe Bay Unit (PBU) on Alaska's North Slope. This particular test facility employs a coriolis meter to measure density and gross flow rate of the oil/water mixture. It was confirmed that discrepancies in allocation factors and individual net oil measurements, especially for cold high viscous crude oil, was due in part to unrecognized gas carry-under in the liquid outlet. Measured GVF associated with wells flowing 'non-viscous' oil, the less viscous crude (22 to 32 API) ranged from 0 - 2.0 %, whereas the GVF of wells flowing viscous crude (17 to 22 API) was between 0 - 8% at normal vessel liquid levels increasing to >20% at reduced separator levels.

The additional secondary phase measurement enables PBU to now report real time corrected densities and volumes using an in-house method to calculate water cut. In addition to viscous crude, we believe that application of this technology to smaller, somewhat under-sized separators with less stable operations will provide value across the industry. Well testing importance is increasing on the maturing fields of the North Slope of Alaska as it is not only used for the critical function of field management that ensures optimum production from a field; it also is a regulatory requirement set by the State of Alaska and may be used for Production Volume Accounting on fields with co-mingled production facilities.

Introduction

The PBU has been in production since 1977. Over the life of the field several different Test Separator configurations have been utilized. Approximately 16 years ago, PBU started to use the density water cut method on 2-Phase Mini Test Separators to overcome problems that were encountered on the conventional 3-Phase Units. In general these units operated successfully; success was measured by repeatable water cut results that enabled the petroleum engineers to improve management of the wells and have more confidence in production changes as a result of well workovers. Cold viscous crude oil has now been introduced into the PBU production facilities increasing the range of the oil API gravity from 22 to 32 API now down to 17 API. This brought a whole new set of problems. As part of this project two new mini 2-Phase Test Separators were installed. A review of the liquid leg densities of the units handling viscous oil indicated the possibility of free gas with a resultant gas void fraction (GVF).

This paper is a brief report of the findings of a preliminary test and a more extensive pilot project of a strap-on sonar based GVF meter on both 'non-viscous' crude oil and satellite field viscous oil. The preliminary test was a quick check to determine if the GVF meter could measure a meaningful GVF on the two crudes. With a favorable result to the preliminary test the pilot project was instigated and the unit was installed and fully integrated into the well testing system. Since being installed in October 2005, the unit has been used for on-line well testing. The objective was not only accurate GVF measurement to improve water cut and gross fluid volume accuracy but also to check for long term stability. A stable Zero GVF measurement is a critical issue especially when the unit is used for all types of crude oil and on many wells having little to no GVF.

To quantify the impact of GVF on the Test Separator operations in PBU, a 1% GVF equates to an understatement of water cut (WC) by 5% and a direct 1% over statement of gross fluid flow.