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Subsea Oil/Water Separation of Heavy Oil: Overview of the Main Challenges for the Marlim Field—Campos Basin

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Abstract

Subsea water separation is an attractive method for debottlenecking water-processing capacity where it cannot be accomplished topside. This enables additional oil production to an existing host facility which is an alternative for several platforms on the Marlim field in the Campos Basin.

Ever since the last decade several operators have started their projects, all focused on light oils. Petrobras has aimed at subsea water separation for heavy oils in very deep waters - a natural consequence of its large portfolio of oils with API lower than 20 degrees, as is the case of Marlim. However these low API and high-viscosity oils pose a huge challenge as their emulsions are much more difficult to break and heating is not considered an option.

The subsea separation pilot system has to consider new compact separation technology instead of conventional gravity separators, aiming scaling up to a definitive system, since in this system it will be impossible to use a huge gravity separator (implying thick shells, required to resist external pressure).

For that purpose, there are a series of R&D projects targeting different technology gaps foreseen in subsea processing equipment. Experimental tests for emulsion generation prediction, development of additives with chemical compatibility, determining reservoir limitations of oil and solids content in injected water, studies on slug flow impact and mitigation strategies, solids handling, water cut measurement method are some of the projects.

In terms of subsea equipment several new technologies are under evaluation to be employed underwater for the first time. Equipments as hydrocyclone, electrocoalescer and oil in water monitor are the main ones, and availability of those ones is a major issue.

This article shows an overview of the design premises for a prototype on the Marlim scenario, the results of the subsea processing investigations and their impact on defining the process conception and the design specifications for the subsea system.

Introduction

Within the next five years, several new developments will be considering the Oil Water Subsea Separation – SSAO (for the terms in portuguese) what, when applicable, will permit the oil processing on a platform to be always closer to the highest percentages of the oil processing capacity during its lifetime. In that way, it will optimize field developments in terms of oil production and it will be possible to treat much more liquid reducing the CAPEX on larger platforms.

In terms of Petrobras drivers, looking into its prospects, one can observe that they are considerably constituted of heavy oil on deepwaters. This means that productions either subsea or topside are only viable with fewer wells, limited infrastructure, and high flowrates.

It shall be added that heavy oil solutions may involve high amount of fluid handling due to high water injection flowrates.

In terms of mature fields it has an immediate potential application in Marlim, in Pampo and several other small flowrates aplications. Nevertheless for high flowrates, the ones on the queue are Marlim Sul, Albacora, Marlim Leste and Jubarte. By the time the technology should be available, 2009/10, these fields will be natural candidates based on its expectations for the water production curves. So, it is time now to start designing the SSAO systems for application on these fields.

Scenario for the Prototype

The Marlim field is located on the Campos Basin, North of the state of Rio de Janeiro, 110km from São Tomé cape, on waterdepths ranging from 650m to 1050m on a total area of 146 km2. The picture bellow shows the Marlim field on the Campos Basin