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Role of Comprehensive Reservoir Surveillance and Monitoring in the Dukhan Gas Cap Recycling Scheme - A Case Study

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Abstract

This paper describes the various initiatives which have been introduced by the reservoir surveillance team to monitor the movement and breakthrough of lean injection gas during the recycling of a large gas cap reservoir. Faulting in the crestal area could complicate the movement of the injection gas. In addition, it was noted that the measured CGR (as measured with a test separator) was not consistent with either the current production from the process plant or expectations based upon the initial oil column properties and composition. Also described are the different measures which were taken to confirm the actual CGR.

The different techniques used to monitor the movement of the lean injection gas and to identify breakthrough include:

- Tracer injection into crestal wells.
- Fingerprinting produced fluids taking advantage of compositional differences.
- Routine testing of individual wells and fluid analyses.
- Continual monitoring of reservoir pressure.

Establishing an extensive hydrocarbon allocation process.

The current CGR was established by:

- Collecting and analyzing single phase samples.
- Using different metering methods to accurately measure condensate flow rate.

The paper describes each of the above processes and, in some cases, the unusual reservoir characteristics which made these techniques successful.

As a result of the above, CGR values are now being successfully monitored and condensate metering systems on the test separator have been successfully upgraded. The results of the above techniques indicate that injection gas breakthrough is occurring in some locations.

A compositional reservoir simulation model is under continuous development and will be used to monitor reservoir performance. Comprehensive reservoir surveillance and monitoring have generated a versatile reservoir management and resumption plan (RMP) to cater for any unforeseen circumstances such as shortage of re-injection gas or deterioration of product quality.

Introduction

The onshore Qatar, Dukhan, Arab D reservoir is a gently dipping anticline with over 700 feet of oil column initially in equilibrium with 700 feet of gas cap in the crestal area. It is some 70 kilometers long and exhibits an oil water contact. For reservoir and production management, the reservoir is split into four sectors from North to South, Khatiyah, Fahahil, Jaleha and Diyab. This late Jurassic carbonate reservoir was discovered in the late 1930's and production from the oil column commenced under normal pressure depletion in the early 1950's. During the early production years, pressure depleted by around 600 psi. This pressure depletion resulted in expansion of the gas cap together with retrograde condensation in the pore space. Power water injection started in the mid seventies and, on average, reservoir pressure was increased by some 50 to 100 psi. This pressure has generally been maintained until the present.