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Tackling Gas Field Decline with Efficient Chemical Water Shut-off : Successful Application on Peciko Field (East Kalimantan, Indonesia)

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Abstract

High water production in a gas well could significantly reduce gas production due to high friction losses in the tubing, the effect of water blocking in front of perforations and formation damage due to water, which, eventually, could lead to a significant loss of recoverable reserves. Selective mechanical water shut-off , (i.e. casing patch), the main technique used to solve this problem so far, has some disadvantages, mainly reducing the inside diameter of the production tubing which makes future mechanical water shut-off of the deeper reservoirs more difficult. Chemical water shut-off is the preferred solution to this problem.

Peciko is a giant multilayer gas field located in the Mahakam delta of East Kalimantan, with water depths of around 30 – 40 meters. There are more than 100 reservoirs per well, with average thicknesses of less than 1 m. Most of these reservoirs were perforated and produced commingled throughout the lifetime of a well. Efficient water shut-off is very critical when water breakthrough occurs at some of these reservoirs, in order to optimize gas production from the other reservoirs. Production logging measurements are used to identify the water producing reservoir to be isolated.

This paper presents a successful field application of chemical water shut-off at Peciko field. In this application, the chemical water shut-off is the unique solution due to the thickness of the reservoir to be isolated (>8 m), not feasible using current mechanical techniques, and the interest of keeping a full bore access to allow future mechanical water shut-off for the other deeper reservoirs, while isolating the water source located above. Sealing quality at the isolated water zone was confirmed by a production logging job performed after the chemical water shut-off operation. This successful chemical water shut-off reduced the water production rate from 4,000 bwpd to less than 100 bwpd, and allowed an instantaneous gas production gain of 10 MMscfd with an estimated cumulative gain of 10 Bscf in 3 years.

Introduction

Peciko is a giant offshore gas field in the Mahakam delta at East Kalimantan - Indonesia, which covers an area of of 350 km2 with water depths of 30-40 meters. The field has multilayer pay zones at around 2,000 – 4,000 meters subsea with an unfaulted structure. The producing layers are in Upper Miocene formations with a mud dominated delta environment and thin sand stone reservoirs generally less than 1 meter in thickness. Due to the complexity of the field, a phased development was applied in order to minimize the risk and to optimize the field production. 5 phases of development have already been performed to develop the field.

There are around 100 development wells already drilled in Peciko, located on 6 production platforms. The production was started at the end of 1999, with a peak production of around 1,400 MMscfd in 2005. The current gas production of the field is close to 1,000 MMscfd and the condensate to gas ratio is around 15 bbl condensate / MMscf gas. The well potentials currently range from 1 to 30 MMscfd of gas.

A typical Peciko well is a deviated well of 20-60 degree deviation with 3,500 – 4,000 meters subsea total depth. Most of of the wells have a **monobore completion** with a production tubing size of 4.5" or 5.5"(Figure-1). There are more than 50 sandstone reservoirs perforated in a well and production is commingled throughout the life time of a well. The main challenge in the monobore completion, is to optimize production from gas reservoirs when water breakthrough has occurred from one of them. No selectivity options, such as sleeves, are available to enable the water producing reservoir to be shut off.

Water shut-off in a multilayer well is very crucial to ensure production continuity and to secure reserves. Mechanical water shut-off applications in monobore completions, such as bridge plugs, casing patches and straddle packers, are the usual remedial solutions for water breakthrough problems.