Challenging Water Shut off Project Utilizing Multiple Approaches: Case Studies

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Abstract

This paper discusses the different approaches used to study the mechanism and the treatment of excess water production carried out in a sand stone formation in Sudan (Block 3&7), it also describes the good practices and lessons learnt from a number of jobs. In addition to the technical analysis, the paper also addresses the economic value of the campaign.

In an environment in which the challenges include the presence of heavy oil, fresh water, differential depletion, compartmentalization and commingled flow, oil production from this field with complex geology and reservoir mechanism was negatively affected by the excess water breakthroughs in several wells. A multidisciplinary approach has been implemented in order to determine depletion profile, produced oil and remaining reserves, locate any by-passed oil zones, determine oil and water contributions from each zone and shut off the excess water production while maintaining or increasing oil production. This approach consisted of using new Ultrasonic Imaging and Cement bond log tools for investigation of the well cement and casing integrity. The source of water entry was identified performing multi-rate production logging using Production Services Platform and electrical probes through Y tool-ESP completion.

The well depletion profile was determined using Cased Hole Formation Resistivity tool. The logging data was then processed and interpreted. With the input of the operator company and all the disciplines involved, appropriate remedial jobs were performed including water shut off techniques and re perforation.

Water shut off, Excess Water production Methodologies for Diagnose and Evaluate the Mechanisms

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ABSTRACT:

Production data of Heglig field history for last ten-year shows that an alert have to be given. Heglig is now under fast water production. The creeping of it may lead to the reduction of ultimate recovery (UR) of the field. Maximum liquid rate by ESP pumping may increase oil production in a short time (half a year), it may cause serious water coning, which will reduce cumulative oil production and increase water treatment cost, and shutdown of the well in the long run.
For all reservoirs producing by dominant mechanism of bottom water drive like Heglig field, excess water production represents difficult operational problems.
Produced water will cost money and of no real value, the best thing is to leave it in reservoir.

Problem potential for coping with excess water production is always challenging task for field operators. The cost of handling and disposing produced water can significantly shorten the economic producing life of well. The hydrostatic pressure created by high fluid levels in the well is also detrimental to oil production.

The trend of water cut. Vs. cumulative oil production is suspected to be reasonable. Based on Heglig field performance and since the recovery factor about 22 % but less than 1/5 recoverable reserve can be pumped out before water cut goes beyond 50% was observed while the figure from the experience is 1/3.
Too high production rate may result in quick water coning and fast water fingering, which lower down the efficiency of water displacement, hence reducing the cumulative oil production and sharp water coning shape, if formed in most well in such a short period of development means large quantity of oil is left inter well undeveloped; and will complicated the oil/water distribution in Heglig field.

The two major sources of excess water production are coning and channelling. Water coning is a common problem encountered when reservoir is produced via bottom- water –drive mechanism. Fracture and high permeability streaks are the common causes of premature water break through during water floods.