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‘In-Situ Gas Lift’ and ‘In-Situ Gas Injection’ Successfully Improve Oil Recovery in Arthit North Field

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ABSTRACT

Recently, number of attempts using practical depletion techniques such as lowering wellhead pressure removing bottleneck at surface and perforating minor gas sand allowing restrictedly low gas rate influx inside tubing sufficing lifting capacity of the well or gas lift installation are made aiming for increasing oil production from North Arthit field. In this paper, the strategy of depletion techniques was delineated and their significance was rated based on maximum oil recovery achievable for the candidate oil wells. However, as the goal of an oil development is to accelerate production and maximize the recovery at a lowest cost, whichever technique to be selected it must retain minimum operational downtime during bad weather condition and in no way create obstruction to any well intervention operations. The lifting performance optimization effort showed a potential breaking the oil recovery limit for ineffectual wells in North Arthit field improving the oil reserves by two fold. In addition, this paper demonstrates that deployment of pressure reducer unit is suitable for not only oil wells but also weak gas wells that have upside potential.

KEYWORDS: Gas lift / Gas injection / IOR / Petroleum

1. INTRODUCTION

Arthit field is located in the Gulf of Thailand which is 700 kms south of Bangkok and 230 kms north east of Songkhla. The production area covers 3,682 sq km in concession blocks B14A, B15A, and B16A. Arthit reservoir engineers have been consistently working towards the optimization of oil and gas production with innovative ideas. The engineers put forward a blend of a conventional groundwork of lift performance optimization and an advanced recovery technology of gas injection process. As a result, an in-situ gas lift and in-situ gas injection techniques were initiated and successfully implemented to enhance oil production from the field.

2. INNOVATION FEATURES

‘In-situ gas lift’: The very same gas sand was perforated 1-shot at selected interval in well AT-X-1, intended to supply more gas into the well to optimize production GOR thus enhances lift performance. A production logging in well AT-X-1 indicated about 1.5 MMSCFD gas flows from gas sand into the well; it successfully revived the well that was no flow as a result of an increased producing GOR by almost 3 fold from previously 450 SCF/STB.
‘In-situ gas injection’: A high-pressure gas sand below the oil sand was perforated in well AT-X-2 located 0.3 km from well AT-X-1. Inner tubing continuous cross flow of gas from gas sand into oil sand was the main objective by fully shut in well AT-X-2. In-situ gas injection subsequently initiated in the oil sand, numerous runs of production logging in well AT-X-2 indicated approximately 3 MMSCFD of high-pressure gas cross flows from gas sand into the oil sand.

3. DISCUSSION

It is perceived that timing for the in-situ gas dump flood operation is important; for this case, reservoir pressure in the oil sand just partially depleted when the gas dump flood operation commenced. At this reservoir condition, fluid composition has not significantly changed and only insignificant portion of gas cap gas expanded and liberated into the oil zone. The interfacial tension between ‘high-pressure’ gas dump flood gas (CO₂ = 12.6%) and resident oil is expected low thus leading to a high microscopic displacement efficiency that enhances recovery mechanism in this solution gas drive oil reservoir.

It is concluded that a gas gravity segregation mechanism is also a dominant factor in improving recovery efficiency from the oil sand. The in-situ gas dump flood implemented in the oil sand that has a fining upward gamma-ray signature with a lateral homogeneity and average permeability of 270 mD contributed to the success of this improved oil recovery mechanism. The highest permeability layer at the bottom and the lowest permeability layer at the top contribute for high recovery efficiency by the gas gravity segregation mechanism.

The existence of high-pressure gas sand located below the target oil sand makes the gas dump flood process successful. It maintains reservoir pressure in the oil sand as it provides a continuous gas dump flood rate, at a correct amount, into the oil sand. Production rate from the oil sand at well AT-X-1, however, shall be controlled at proper choke sizes to prevent a breakthrough of the dump flood gas from happening. The gas dump flood rate, however, is not possible to control as no bottom-hole valve is used at well AT-X-2.

4. RESULT AND BENEFIT

In-situ gas lift and in-situ gas injection increase recovery from partially depleted oil reservoir making use of energy from the existing gas sands. This low cost solution has successfully improved recovery efficiency of oil in Arthit North field and forecasted to generate a monetary benefit to the company, that is a 9500 of profit to investment ratio which is a remarkably growing financial value for the asset.

The successful implementation of in-situ gas lift and in-situ gas injection techniques that is inherently trouble-free has confirmed realistic, low cost and speedy solutions for engineers to save on capital investment and operating cost thus it facilitates the
creation of a maximized value to the project particularly in Arthit North field, and could ultimately be in the E&P industry throughout Thailand.

Impact and values from these techniques to E&P industry in Thailand is significantly constructive when successful, however, as the techniques are positively low cost therefore no detrimental impact to the E&P industry when unsuccessful.

‘low cost and simple operation’ enables a timely in-situ gas injection process to achieve the main objective to preserve reservoir energy from the oil sand which at that point had only insufficient solution drive as its primary drive mechanism, as underlain aquifer and overlain gas cap were not active.

‘gas gravity segregation’ is pronounced when gas injection is implemented as the oil sand has highest quality layer at the bottom whilst lowest quality layer at the top.

5. CONCLUSIONS

The innovative and low cost recovery improvement strategies implemented in PTTEP-Arthit North field oil rim, using the so called ‘in-situ gas lift’ and ‘in-situ gas injection’ techniques have effectively disproved requirement for high-cost compressors and injection facilities. These techniques have proved to increase oil production rate and recovery from the oil sand in well AT-X-1. Cumulative oil production is expected to increase from 0.3 million barrels (at the time when the well was no flow) to 2.2 million barrels in 2014 with only little cost of perforations and a few days of operation.

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