THE SUCCESSFUL PRACTICE OF EOR-CO2 FLOODING IN LOW-PERMEABILITY RESERVOIRS IN CHINA

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ABSTRACT

CO2 flooding has been applied successfully as the primary development method for low-permeability reservoirs in China. Production response from CO2 injection has been encouraging and the expectations have been exceeded in some existing projects (Winzinger et. al., 1991); (Ring, 1995). D oilfield is a typical low-permeability reservoir, the studies demonstrate an incremental 10% of original oil in place was recovered by using CO2 flooding. This working program includes: (1) integrated reservoir characterization; (2) CO2 flooding mechanism in low-permeability reservoir; (3) oilfield development plan and design; (4) dynamic monitor and performance analysis. (5) economic analysis. The study results were applied to guide the development of D oilfield in 2008. After the application of CO2 flooding, the average daily oil production rate per well increases up to 45 bbis from 28 bbis and water cut decreases from 53% to 22%. Economic analysis indicates CO2 flooding in this oilfield is cost effective and successful.

INTRODUCTION

D oilfield is located in the south of Songliao Basin approximately 30 kilometers north of the Qianan county of Jilin province, the second largest field of Jilin oilfield (Figure 1). D oilfield was discovered in 1962 when H1 well was drilled into the ‘Hdm’ formation, perforated 4 meters of the netpay, produced 28 bopd by pump. During the late 1980’s, Gt formation was discovered and produced at rate between 28.6 bopd to 44.8 bopd. After that the oilfield development stopped, until 2000, D oilfield was put up into production, it includes more than 20 blocks. At the initial phase, only two blocks were developed, applying 300 meter rhombus well distance, water injection for half to one year later. In 2008, CO2 flooding potential evaluation of Jilin oilfield was made, the Block HY was selected as the first CO2 pilot test area. 16 wells were drilled and produced for two years by water flooding, the oil production was 356bopd, water cut was 50% and the formation pressure decreased to 14.5MPa before CO2 flooding. Natural gas produced from its neighboring gas field contains 18% CO2. The segregated CO2 was injected into the block to increase oil production.

Geology and Reservoir Properties

The field structure of ‘HY’ block, N-E trending anticlines are cut by four near S-N steep normal faults. Two of them are on the eastern side and the other two are on the western side of oil-bearing area. The dip angle of anticline is less than 5o. The Gt formation found at the average depth of 2400 meters, is sandstone deposition with an average gross thickness 50 meters and a net thickness of 18 meters. Net pay porosity and permeability average 10% and 13 md, respectively. Initial water saturation is high, average oil saturation is 45%.

The natural fracture is well developed in this region, especially in the vicinity of east faults. A type log of Gt formation is shown in Figure 2. It is the target zone, which is capped by over 15 meters of tight mud zone, The best continuity sandstone is found in Zone A and B, followed by zone C,D.

The reservoir oil is conventional black oil with a stock tank gravity 0.85 and contains only 33 m3/m3 gas, the saturation pressure is 7.1MPa, the original reservoir pressure is 24 MPa (Table 1).

A 3D geological model of the ‘HY’ block extending 300 meters beyond the limits of CO2 injection area was constructed by integrating geological, geophysical data generated within the larger regional study. The model is intended to describe the natural system and, as such, includes the geometry of the strata and faults in the block and many of the