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Data Analytics in Oil and Gas Industry: Application in Original-Oil-in-Place Determination

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The original Oil in Place (OOIP) size of the EE-Pool is uncertain due to the variation of the water-oil contact and two reservoir areas. Uncertainty in the area can seriously affect net pay, volumes, and later estimated reserves, which will result in wrongly predicted evaluated reservoir potential. The EE-Pool has no unique values of OOIP. EE-Pool contains a heavy amount of data: production for decades, PVT, geological, and pressure data. To reduce the uncertainty in predicting the OOIP of EE-Pool, we combined data analytics with industrial OOIP determination methods.. Based on the case study results, approaches for determining the OOIP were explored, classified, implemented, and critiqued. This paper is novel due to the following reasons: all available classical and modern methods of OOIP determination have been used, categorized, compared; the applicability and challenges of each method for specific filed EE-pool were commented; data analytics approach has been combined with classical petroleum engineering methods. This study applied the Data Analytics approach through 6 different OOIP determination techniques: Volumetric method, Linear Regression Technique, Material Balance Equation (Schilthuis) ,Material Balance Equation, as a straight line (Havlena-Odeh technique), Reservoir Simulation, Monte Carlo Simulation Combined with Crystal Ball.

Reference (optimum) value. This value is selected among the results of the six methods. The ultimate oil recovery for water-drive reservoirs generally ranges between 35-75 %. During the primary recovery, with no injection or artificial lift, the expected recovery is in the range of 35-45 % [1]. Considering this fact, a value from Material Balance Equation, as a Straight-Line method was selected as a reference.

The most accurate results compared with reference value were demonstrated by: Reservoir Simulation and Stochastic method, using Crystal Ball Software (Shallow case). The OOIP values from these methods resulted in the lowest loss in barrels and dollars. Deterministic static methods resulted in the largest loss in money and oil barrels compared with other methods. The worst results have been shown by the Volumetric and MBE methods by Shilthius. Compared with the reference value of OOIP, the volumetric method demonstrated the worst result with 63-% error and 63 MMSTB. While the Monte Carlo Simulation combined with Crystal Ball provided the most optimistic results with 9.1-% error and 9.1 MMSTB of oil. The static methods are not accurate compared with dynamic and stochastic ones: the data and uncertainty analysis are not carried out. To avoid uncertainty and loss, it is advised that geology, production, and PVT data be regularly updated to estimate the OOIP using the existing methodologies from both groups. The difference between the worst and best results was: 53.9 MMSTB of oil, 1.8 billion dollars. The mistake in methodology selection may cause economic issues, ruin the field's profitability, and damage the future field life.

References

1 Ahmed, T.H., and P.D. McKinney. 2012. Advanced Reservoir Management and Engineering. Boston: Gulf Professional Pub.