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Analysis of Reserve Estimation using Volumetric Method on Taq Taq Oil Fields

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Abstract - *In Petroleum reservoir studies and management, a correct description of the quantity of the existing fluid is very essential in quantifying the sources and choice of production techniques, costs and general management of the reservoir. The information obtained is also the basis for resource development and planning subsequently the need for cross-examination to mitigate inherent problem resulting from overestimation or below estimation. It is expected that oil and gas production is measured with confidence since industries revenues are based on oil and gas sales. It is the process by which the Economically recoverable hydrocarbons in a field, area, or region is evaluated quantitatively. In this work, the volumetric method estimation reserve was used In the four reservoirs (pilspe, shiranish, kometan and qamchaqa) of the Taq Taq field. The OIIP estimates obtained from the analysis of the reservoirs (pilspe, shiranish, kometan and qamchaqa) were 322.296 MMSTB, 149,264,519,309 STB, 49716600472 STB and 25429490369 STB for volumetric method respectively.The information obtained in the estimated reserves from the Taq Taq field is the basis for resource development and planning for the development Taq Taq field.*

Key Words: **Reserve, Volumetric Method, Original Oil In Place, Recoverable Oil Reserves, oil and gas field.**

1. INTRODUCTION

Reserves are estimated volumes of crude oil, condensate, natural gas, natural gas liquids, and related substances anticipated to be commercially recoverable from known accumulations from a given date forward, below existing economic conditions, through installing, operating practices, and under current government regulations. Reserve estimates are based totally on geologic and/or engineering data reachable at the time of estimate. Reserves estimation is one of the most imperative duties in the petroleum industry. It is the process by which the economically recoverable hydrocarbons in a field, area, or place is evaluated quantitatively.

1.1 Types Of Reserves

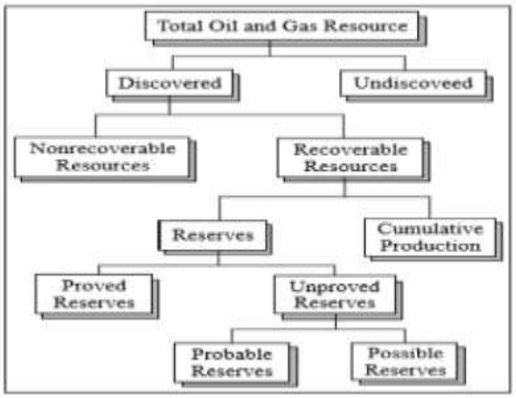

Fig 1. Resource Flow Chart

The relative degree of an estimated uncertainty is reflected by the categorization of reserves as either "proved" or "unproved"

A. Proved Reserves can be estimated with reasonable certainty to be recoverable under current economic conditions. Current economic conditions include prices and costs prevailing at the time of the estimate.

B. Unproved Reserves are based on geological and/or engineering data similar to those used in the estimates of proved reserves, but when technical, contractual, economic or regulatory uncertainties preclude such reserves being classier as proved. They may be estimated assuming future economic conditions different from those prevailing at the Time of the estimate.

Unproved reserves may further be classified as probable and possible.

A. Probable reserves are quantities of recoverable hydrocarbons estimated on the basis of engineering and geological data that are similar to those used for proving reserves, but that lack, for various reasons, the certainty required to classify the reserves as proved.

B. Possible Reserves Possible reserves are quantities of recoverable hydrocarbons estimated on the basis of engineering and geological data that are less complete and

less conclusive than the data used in estimation of probable reserves.

2. Reserve Estimation

Estimation of the in place oil and gas volumes and its recoverable part (reserves) happens to be a significant phase in the various activities leading to the development of oil and gas fields.The ultimate target of all oil companies is to increase their income by producing oil and gas. The key parameter to produce oil/or gas is the investments such as purchasing licenses, drilling wells, and constructing production facilities.Companies program their investments to a particular field by analyzing the ultimate recovery from that field.

2.1 Types Of Reservoir Estimation

Reserves-estimation methods are broadly classified as an analogy, volumetric, and performance types. Volumetric and performance methods are the more elaborate techniques, and the main difference between the two is the type of data used relating to pre- and post- production phases.

- **Volumetric Method:** As the name suggests, this method requires the volume of the reservoir to be calculated through maps and Petro physical data of the drilled wells. This method is carried out in the early phases of exploration to find the amount of Oil and Gas in place and the likely corresponding reserves.
- **Material Balance Method:** This method is carried out in the intermediary stages of the exploration and thus the production of Oil and Gas is estimated
- **Decline Curve Analysis:** This method is carried out in the late life of the field when most of the Oil and Gas has already been produced and the field production rate is on the Decline. The future production forecast gives the reserves.

3. Reserve Estimation Using Volumetric Method.

Here we consider a Zone named Pilasp (Total Eocene Zone) and Shiranish Kometan Qamchuqa (Total Cretaceous Zones) from the Taq Taq oil field. In order to estimate the reserves using the volumetric method we need to know the data generated from geological and petrophysical evaluation .Here we need to find original Oil in Place (OOIP).

3.1. Data Requirements

The following data are required for volumetric method:

1. **Rock Volume (acre feet)** = A * h
   A= Drainage area, acres
   h = Net pay thickness, feet
2. **Ø = Porosity**, fraction of rock volume available to store fluids
3. **SW** = Volume fraction of porosity filled with interstitial water
4. **Bo** = Formation volume factor (Reservoir Bbl/STB)
5. **1/Bo** = Shrinkage (STB/reservoir Bbl)

3.1.1. Rock Volume Calculations (A * h)

Reservoir volumes can be calculated from net pay isopach maps by planimetering to obtain rock volume (A * h). To calculate volumes it is necessary to find the areas between isopach contours. Planimetering can be performed by hand or computer generated. Given the areas between contours, volumes can be computed using; Trapezoidal rule, Pyramidal rule, and/or the Peak rule for calculating volumes.

3.1.2. Porosity:

Effective porosity of a sample is defined as the following ratio:

$$\text{Effective Porosity} = \frac{\text{Interconnected pore volume}}{\text{Bulk volume}}$$

Effective porosity of the reservoir rock can be determined from study of core analysis.

3.1.3. Interstitial Water Saturation, Swi:

Water saturation is defined as the following ratio:

$$\text{Water saturation} = \frac{volume\ of\ water\ present\ in\ pore\ spaces}{volume\ of\ total\ pore\ spaces}$$

Interstitial or connate water saturation may be determined from electric logging information or by laboratory determinations run on cores by restored state, evaporation mercury injection, or centrifuge methods.

3.1.4. Formation Volume Factor

The volumetric calculation uses the initial oil or gas formation volume factor at the initial reservoir pressure and temperature.Both Bo and Bg are functions of fluid composition, reservoir pressure and temperature and consequently of reservoir depth. The Bo and B_g values from analogous offset pools are often used as an initial estimate for the prospect under consideration.

$$B_{gi} = \frac{V_{reservoir\ condition}}{V_{base\ condition}} = \frac{P_b\ T_i\ Z_i}{5.615\ P_i\ T_b\ Z_b}$$

Where:
Bgi= Initial gas formation volume factor (res bbl/SCF)
pb= Base pressure (psia)
pi= Initial reservoir pressure (psia)
Tb= Temperature at base conditions (0C)
Ti= Temperature at initial conditions (0C)
Zb= Gas deviation factor at base conditions
Zi= Gas deviation factor at initial reservoir conditions.

4. Data Used.

1. Reservoir And Fluid Properties.

Imperial Units	Pilaspi Zone	Shiranish Zone	Kometan Zone	Quamchuqa Zone
Lithology	Dolomite	Limestone	Limestone	Dolomite
Maximum Gross Pay Thickness (over total field), ft	180	955	390	577
Average Depth to Reservoir, ft	1,804	5,741	6,234	6,562
Oil Water Contact Depth, ft	(148)	4,954	4,954	4,954
Initial Reservoir Pressure (at O/W Contact), atm	51	197	197	197
Initial Reservoir Pressure (at O/W Contact), psia	750	2,900	2,900	2,900
Bubble Point Pressure, atm	21.8	11.2	10.9	11.8
Bubble Point Pressure, psia	320	165	160	173
Reservoir Temperature, F	113	160	160	160
Stock Tank Oil Density,g/cc	0.900	0.786	0.786	0.786

Table -1: Reservoir And Fluid Properties of Taq Taq Field - Iraq

2. Geological/Petro Physical Data.

ZONE	Pilaspi Zone	Shiranish Zone	Kometan Zone	Quamchuqa Zone
	Fractures	Fractures	Fractures	Fractures
Area, acres	1.813	18,409	8,667	4,984
Avg Net Pay, ft	86.6	657.2	252.4	224.5
Gross Rock Volume,ac-ft	157	12,098	2,188	1,119
Porosity, %	0.30	0.19	0.35	0.35
Water Saturation, %	10.0	10.0	10.0	10.0
Oil Shrinkage, frac	0.98	0.93	0.93	0.93

Table-2: Geological Data And Other Reservoir. Information of Taq Taq Field - Iraq

5. Calculations

The equation for the volumetric determination of original oil in place (OOIP) is given as:

$$OOIP\ (STB) = Rock\ Volume \times 7{,}758 \times \emptyset \times (1 - S_w) \times 1/Bo$$

We have to take the data from the (table 1,2). Initially, we have to take the area and net pay thickness to determine the rock volume for each zone.

⇨ Rock Volume (acre feet) = A × h

- A= Drainage area, acres
- h = Net pay thickness, feet

⇨ Rock Volume (acre.feet) (pilaspe zone) = 1,813 × 86.6 = 157

⇨ Rock Volume (acre. feet) (pilaspe zone) = 157 acres. feet

Note: 7,758 = API Bbl per acre-feet (converts acre-feet to stock tank barrels)

⇨ 7,758 × 157 × 0.30 × (1 - 10.0) × 1/0.98 = 3,222,843.876 STB

Original Oil In Place (OOIP) (pilaspe zone) = 3,222,843.876 STB

In The Table.3 Below Shows Results Original Oil In Place For Each Zone In Taq Taq Field.

Zone	Pilaspi Zone	Shiranish Zone	Kometan Zone	Quamchuqa Zone
Area, acres	1,813	18,409	8,667	4,984
Avg Net Pay, ft	86.6	657.2	252.4	224.5
Gross Rock Volume ac-ft	157006	12098395	2187551	1118908
Water Saturation, %	10	10	10	10
Porosity, %	0.3	0.19	0.35	0.35
Oil Shrinkage, frac	0.98	0.93	0.93	0.93
1/Oil Shrinkage, frac	1.020408163	1.075268817	1.075268817	1.075268817
Original Oil in Place,stb	3,222,962,93	149,264,519,309	49716600472	25429490369

Table-3: Crude Oil Reserve Taq Taq Field-Iraq

6. CONCLUSIONS

- Reserve estimation is very crucial for a reserve to make decisions. Estimation provides the confidence about the economical feasibility to produce from a reservoir; whether it is cost worthy or not.
- Using a volumetric method for finding the original Oil in place has limitations on the basis of data's available from the field.
- The initial oil in place of the four reservoirs (pilspe, soreness, comedian and qamchaqa) in the oil field was found as 3,222,962,93 STB, 149,264,519,309 STB, 49716600472 STB and 25429490369 STB.
- Same values can be find out with the help of other methods known as (a) Material Balance Method & (b) Simulation Method using software.

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