PAPER • OPEN ACCESS

Evaluation of Formation Capacity and Skin Phenomena of Mishrif Reservoir -Garraf Oil Field

To cite this article: H A Baker *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **579** 012039

IOP Conf. Series: Materials Science and Engineering **579** (2019) 012039 doi:10.1088/1757-899X/579/1/012039

Evaluation of Formation Capacity and Skin Phenomena of Mishrif Reservoir -Garraf Oil Field

H A Baker, A Al-Rikaby* and I S Salih
University of Baghdad, Baghdad- * Dhiqar Oil Company, Dhiqar, Iraq

Corresponding author's e-mail address: ha.baker@yahoo.com

Abstract. Mishrif Formation is the main reservoir in Garraf Oil Field. It is divided into three productive units (M1, L1.1, and L1.2), the unit L2 contains a very small percentage of oil with high majority of water so it is considered to be of a non-economic feasibility. Developing of such reservoir requires a study of its capacity and how the effective communication properties changes laterally. Build up pressure testing was conducted for five wells (A16P, Ga-1, A4P, B5P and C43P) in Garraf oil field. The data have been analysed by Ecrin Kappa Saphir program and well behaviour was detected by pressure and pressure derivative responses (or signature) with time. The results show a difference in capacity with good flowing capabilities. All the wells exhibit a negative skin factor due to stimulation.

1. Introduction

In well testing, pressure data interpretation recorded has been used to evaluate reservoir properties. Shut in reservoir pressure used to predict reserve in place during calculations of material balance. Reservoir flowing behavior has been described during transient pressure analysis. There is a proposal for interpretation method based on derivative pressure analysis with respect to Horner/superposition time or natural logarithm time functions [1]. Many methods are presented to construct a type curve derivative pressure. The most commonly used type curve of pressure derivative is based on ideas of Bourdet et. al. [2] who made type curve based on dimensionless pressure derivative with respect to logarithm of dimensionless time that have two advantages above type curve based on a log-log of dimensionless pressure vs. dimensionless time for uses wellbore storage and skin problems. Construction of type curve has an alternative method based on pressure derivative presented by Onur, Veh, and Reynolds [3] that involves plotting both dimensionless times vs. dimensionless pressure and dimensionless pressure divided by logarithm derivative dimensionless pressure for uniform flux and infinite conductivity vertically fractured wells. Pressure buildup behavior must be plotted on semi log coordinate as a straight line for approaches of asymptotic represented by Soliman, Correa and Ramey [4] who represents approximation a long time to Horner solutions that uses only a data portion in period of radial flow if the data are available [5]

2. Brief Idea about the Field

1- Garraf oil field is located in southern of Iraq, approximately 5 km northwest of Rife city in Thi-Qar governorate.
2- Garraf consists of an anticline forward northwest-southeast, 10 km width and 31 km long. [6]

IOP Conf. Series: Materials Science and Engineering **579** (2019) 012039 doi:10.1088/1757-899X/579/1/012039

3- Five wells were used in this study (Ga-1, C43P, A4P, B5P and A16P) for the detection of wells behavior and its characteristics by data analysis through pressure derivative vs. time. Figure 1 illustrates the location of these wells.

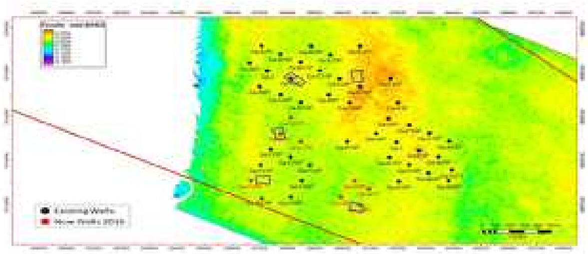

Figure 1. Wells location

3. Bourdet type curve:

This curve represent relationship between dimensionless group which are:, dimensionless pressure(P_D) ,dimensionless time(t_D) ,dimensionless pressure derivative(P'_D) and dimensionless wellbore storage C_D. Mathematically:

$$P_D = \frac{k\ (P_i - P)}{1\quad .2q\mu B} \tag{1}$$

$$t_D = \frac{0.0\qquad k}{\phi\ \ C_t\, r_w} \tag{2}$$

$$C_D = \frac{0.8\qquad C}{\phi C_t\, h\, r_w^2} \tag{3}$$

$$P'_D = t_D\left(\frac{\partial P_D}{\partial t_D}\right) \tag{4}$$

The type curve is illustrated in figure 2.

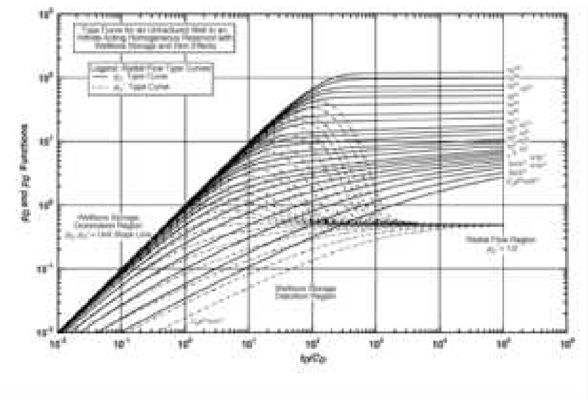

Figure 2. Bourdet type curve.

4- Transient Test Analysis and results

Pressure transient analysis was done in five wells producing from heterogeneous limestone formation. The produced fluid is black oil with API of 24 and GOR of 450 Scf/STB. The layer is considered highly anisotropic where the pressure flow regime changes in signature (shape of pressure derivative) from well to another. The first example is a slightly deviated well (well A16P) of 28 degrees in relatively lower permeability region, the well production rate is 3500 b/d. The pressure build up response shows a homogenous layer of effective permeability of 69.5 m.D and effective thickness of 223 ft. The values of layer capacity, skin factor, storage coefficient is calculated by matching the plot with Burdate type curve which done with the aid of software. Figure 3 shows the pressure response of the well. The curve of green colure is the pressure difference between shut-in pressure and bottom-hole flowing pressure prior to shut-in (Pws-Pwf) versus time, the curve of red colure represents the pressure derivative versus time. The plot shows the absence of unit slop line at the early time of test which gave a good evidence of low damage or stimulation.

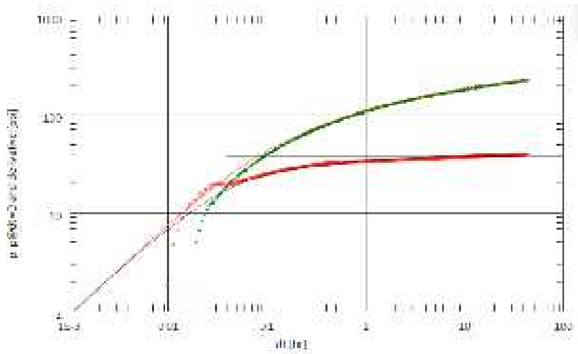

Figure. 3. Pressure build up of well A16P

The skin parameter reported is - 6 which represent a very strong acid stimulation, however, the geometrical skin is positive, this is because the well is partially penetrated and not centered in mid-layer. Figure 3 represent the well architect

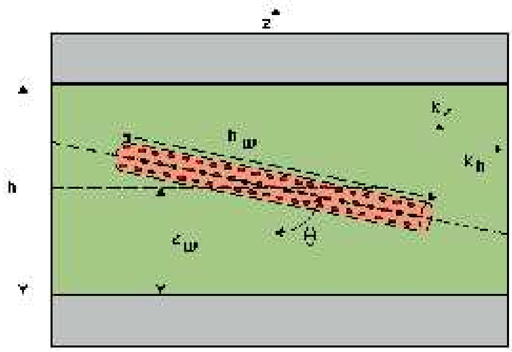

Figure 4. Slanted well architect

The effect of time was studied at constant applied voltage of 10v, mixing speed of 400rpm and initial concentration of 100NTU. Figure 2 illustrates the turbidity as a function of operating time. It is clearly seen that the operating time has an important effect on the turbidity removal.

There is a high possibility that when dealing with heterogeneous rocks; partial depletion, vertical changes in flow permeability could occur, and because the productive interval (hw) is less than layer thickness (h), there is a chance that only small portion of the perforated interval is well stimulated and gives production more than 90% and the rest of the layers are not strongly stimulated either due to lower permeability or higher pore pressure. Production logging here is requested to confirm whether there is or no uniform acid distribution.

The second well (Ga-1) has similar response. The well penetrating the same layer but here the estimated reservoir capacity (kh) of 3740 m.D-ft. is much smaller than previous well. The stimulation job has a good efficiency in a single layer model. Skin is -4.5.Figure 5 represents the transient behavior of the well during test

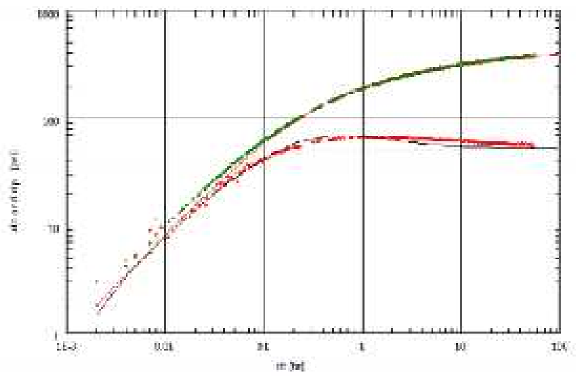

Figure 5: Transient response of well Ga-1

The third well (A4P), is horizontal well penetrating the same layer The flow regimes of a horizontal well is clearly visible starting with early hemiradial flow reached around 0.2 hour and swiftly changed to early linear flow as shown in figure 6 The early radial flow reached less than 1 hour of buildup, which shows a very strong geometrical permeability in the region surrounding the well. The early linear flow regime starts at 1 hour and ends with the build- up end. The build- up time was not sufficient to reach the pseudo radial flow which is expected around 150 hours. The well producing effectively with 267 mD, and geometrical skin of the well is -6.64

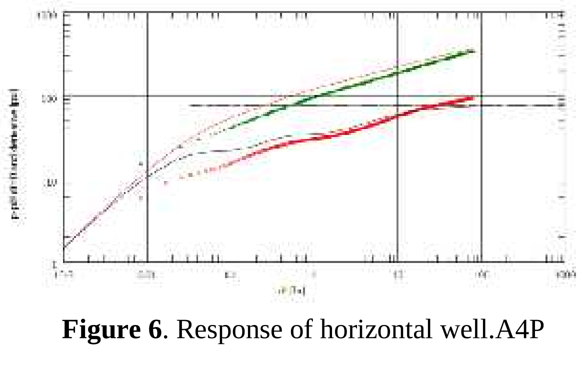

Figure 6. Response of horizontal well.A4P

The fourth case is a vertical well with a clear dual porosity response (well B5P) as shown in figure 7

IOP Conf. Series: Materials Science and Engineering **579** (2019) 012039 doi:10.1088/1757-899X/579/1/012039

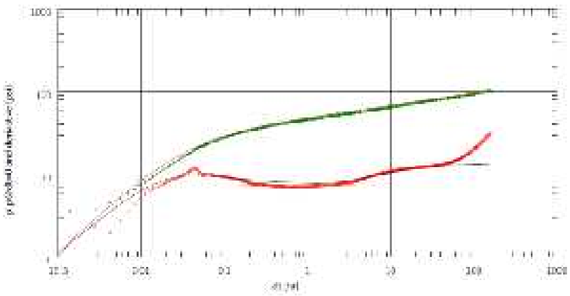

Figure 7. Dual porosity response of well B5P

The after-flow period is approximately ended at Δt=0.03 hr., the pressure response from Δt=0.03 till Δt=3 hr. during buildup represents the transient response of a high permeability layer contributing to high level of production and has as well a very low skin factor. From Δt =3 to Δt =7 hours the derivative shows a ¼ slope due to transition period between the high permeability layer to the overall system flow capacity. The late response on the derivative after 70 hours of buildup correlated to a hydrodynamic well interference boundary, which is clear as the pressure difference increases rapidly.

The fifth well (C34P) shares the same concept yet no second layer stabilization reached as indicated by figure eight.

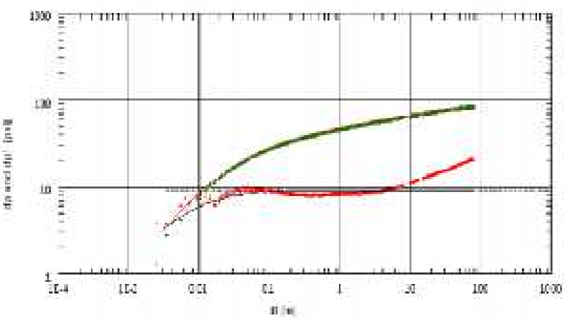

Figure 8 .Transient profile of well C34 P

Only one layer reaches radial flow and the buildup still in transition period to reach total system radial flow the kh here is considered low compared with offset cases 3500 mD.ft. Table 1 summarize the test results.

Table 1: Summary of results of test analysis

Well	kh mD.ft	Total skin
A16P	15500	- 4.84
Ga-1	12500	-4.68
A4P	24200	-6.64
B5P	51496	-5.5
C43P	11400	-3.37

IOP Conf. Series: Materials Science and Engineering **579** (2019) 012039 doi:10.1088/1757-899X/579/1/012039

Nomenclature and Abbreviations

C:Wellbore storage(bbl/psi)
Ct: Total Compressibility,psi-1
dP: Pressure difference, psi
dp': Pressure derivative
dt: time ,hrs
h:layer thickness
hw: length of the productive zone of well
K: Permeability, mD
Kh: Horizontal Permeability, md
Kz: Vertical Permeability
rw: well radius, ft.
S: Skin factor, dimensionless
Φ:Porosity,fraction

References

[1] Bourdet D, Ayoub J A and Plrard Y M 1989 *SPE Form. Eval*. 293.
[2] Soliman M Y 1986 *SPE Form. Eval*. 363.
[3] Onur M Veh N and Reynolds A C 1989 *SPE Form. Eval*. 429
[4] Correa A C and Ramey H Jr 1986 SPE 15579 *SPE Annual Tech. Conf. and Exhi.* (New Orleans) .
[5] Ozkan E Vo D T and Raghavan R 1987 SPE 16811.
[6] PETRONAS Co 2016 Final development plan for Garraf oil field.
[7] Internal report.