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**ANALYZING
AND FORECASTING THE PERFORMANCE OF
WATER DRIVE GAS RESERVOIRS**

Abstract: The manner of estimating water drive gas reservoir recovery can vary considerably. Several mathematical models have been developed for estimating water influx in petroleum industry, but the current paper will address the application of Fetkovich aquifer model to predict the gas reservoir performance considering the pressure changes that gradually occur within the aquifer and between the aquifer and reservoir.

The applicability of this model has proven to be extremely useful in estimation of initial gas resources, aquifer volume and its parameters, confirming the producing mechanism but also forecasting the production performance of the gas reservoir.

The authors will highlight through some case studies, the importance of the water influx analysis and prediction, in particular for natural gas reservoirs, which subsequently allows for adequate planning in optimizing the reserves' recovery.

Keywords: natural gas reservoirs, recovery factor, water drive mechanism, Fetkovich aquifer model, performance prediction

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1. INTRODUCTION

The economic importance of natural gas production has become increasingly in the last years and this trend has been noted through the efforts made in the exploitation area where, permanently, gas-producing companies are seeking viable solutions to increase the recovery factors of the reservoirs.

The recovery factors of natural gas reservoirs are highly dependent on the existing energy types in the reservoirs and these are mainly those of gas-expansion drive mechanism and water drive mechanism. The drive mechanisms are determined based on the production history, in particular, based on the evolution of reservoir pressure in time and the water cut.

If the recovery factors of the reservoirs which are producing through gas expansion drive mechanism can reach values up to 80–90%, the situation is more unfavorable in the case of water drive mechanism (through the expansion of the adjacent aquifer), where statistically has observed that recovery factors rarely exceed 50–70%. To obtain attractive recovery factors it is necessary to re-evaluate, periodically, the reservoir potential based on the new information that completes the production history along with new reservoir characterization data.

Petroleum reservoirs are often surrounded by water aquifers that support the reservoir pressure through water influx. In response to a pressure drop in the petroleum reservoir, the water aquifer reacts to offset, or retard, pressure decline by providing a source of water influx or encroachment. To determine the effect that an aquifer has on the gas production, it is important to estimate the amount of water that has entered into the reservoir from the aquifer.

Such calculation is not a simple and risk-free task due to the involvement of many unknown parameters. Challenges and difficulties related on the exploitation of water drive reservoirs must be treated in such manner to prevent premature water flooding of the reservoirs [1].

Forecasting studies are based on the existence of physical and mathematical models that, however rigorous they may be, cannot capture all the real aspects, and therefore the mathematical equations that reveals the behavior of some parameters within the models deviate subjectively from their identity. But this deviation is controllable and adjustable in the process of analyzing and interpreting the results [2].

Many authors have presented different models for estimating the water influx: Schilthuis model (1936, steady state), van Everdingen and Hurst model (1949, unsteady state-edge water and bottom water drive), Carter and Tracey model (1960, unsteady state), Small aquifer model (Havlena–Odeh, 1963) Fetkovitch model (1971, radial and linear aquifer).

The idea is to use a simple approach that utilizes the stabilized aquifer productivity index and an aquifer material balance in order to be accurate enough for engineering purposes, especially for field production forecasting.

The accurate estimation of water influx into a petroleum reservoir is very important in many reservoir engineering applications such as material balance calculation, design of pressure maintenance programs, and advanced reservoir simulation studies.

Whenever we make a production forecast, we use a model of the reservoir and production system, in the form of mathematical models to simplify the reality. The aim of the forecaster, in making reliable predictions, is to use a model that is sufficiently representative of the physical processes and constraints, and that adequately allows to reduce the uncertainties [3].

If we are to predict realistically the performance of water drive reservoirs, a simple method must be used that can readily handle all the aquifer characteristics; the method should also be flexible enough that it can be further improved or added to as a problem requires.

Selection of the best fit-for-purpose method must consider the existing data and the final applicability in reservoir studies for field development plans.

2. RECOGNITION OF THE DRIVE MECHANISM IN NATURAL GAS RESERVOIRS

As reservoir fluids are produced and reservoir pressure declines, a pressure differential develops from the surrounding aquifer into the reservoir. Following the basic law of fluid flow in porous media, the aquifer reacts by encroaching across the original hydrocarbon-water contact.

Based on the degree of reservoir pressure maintenance provided by the aquifer, the natural water drive is often qualitatively described as the active/strong water drive and the partial/weak water drive. The term “active” water drive refers to the water encroachment mechanism in which the rate of water influx equals the reservoir total production rate. Active water drive reservoirs are typically characterized by a gradual and slow reservoir pressure decline [4].

Material balance method is a production prediction method and is developed in terms of cumulative fluid produced and changes in reservoir pressure. Comparison of reserves estimates from both methods, respectively volumetric and material balance, can provide a qualitative measure of the degree of reservoir heterogeneity and allow a more accurate assessment of gas reserves for a given field-development strategy. If there is sufficient and representative production and pressure histories available from the gas field, application of these methods can provide insight into the predominant reservoir drive mechanism.

Plots of form p/z vs G which represents the pressure data and production data in time, are used in practice to determine or estimate the gas reserves, respectively the drive mechanism.

As can be noticed in Figure 1, for a volumetric and strong aquifer drive mechanism the behavior and production prediction of gas reservoir it can be completely understood, while in some instances, for a weak water drive mechanism (or mixt regime) the field pressure measurements can mask the effects of water influx. These aspects have a critical role on estimating the gas reserves and especially on the ultimate recovery factor. The rate of reservoir pressure decline with increasing cumulative withdrawals is indicative of fluid influx.

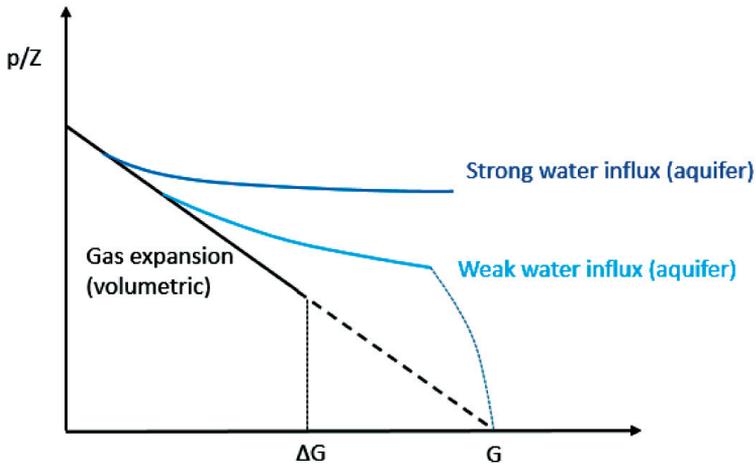


Fig. 1. Graphical representation of p/z vs G plots for drive mechanism

3. FETKOVICH METHOD – A RELIABLE ANALYTICAL APPROACH IN PERFORMANCE PREDICTION OF WATER DRIVE RESERVOIRS

Several models have been developed for estimating water influx which are based on assumptions that describe the characteristics of the aquifer. Due to the inherent uncertainties in the aquifer characteristics, all of the models require historical reservoir performance data to evaluate constants representing aquifer property parameters. The material balance equation can be used to determine historical water influx provided original gas in place is known from pore volume estimates.

Fetkovich (1971) developed a method of describing the approximate water influx behavior of a finite aquifer for radial and linear geometries. The Fetkovich application is

much easier than van Everdingen and Hurst or Carter–Tracy approaches and this method is also often utilized in numerical simulation models [5].

The Fetkovich model is based on the premise that the productivity index concept will adequately describe water influx from a finite aquifer into a hydrocarbon reservoir. This means that the water influx rate is directly proportional to the pressure drop between the average aquifer pressure and the pressure at the reservoir–aquifer boundary. The method neglects the effects of any transient period. Thus, in cases where pressures are changing rapidly at the aquifer–reservoir interface, predicted results may differ somehow. However, in many cases pressure changes at the waterfront are gradual and this method offers an excellent approximation.

The Fetkovich approach involves two simple equations [5]:

- **Productivity index for the aquifer (PI)** which is analogous to the PI equation used to describe a gas well:

$$e_w = \frac{dW_e}{dt} = J(p_a - p_r) \quad (1)$$

where:

- e_w – water influx rate from aquifer [bbl/day],
- J – productivity index for the aquifer [bbl/day/psi],
- p_a – average aquifer pressure [psi],
- p_r – inner aquifer boundary pressure [psi].

- **Aquifer material balance equation** which states that the amount of pressure depletion in the aquifer is directly proportional to the amount of the water influx from the aquifer:

$$W_e = c_t W_i (p_i - p_a) f \quad (2)$$

where:

- W_i – initial volume of water in the aquifer [bbl],
- c_t – total aquifer compressibility [psi^{-1}],
- p_a – average aquifer pressure [psi],
- p_i – initial pressure of the aquifer [psi],
- f – $\theta/360$.

Equation (2) suggests that the maximum possible water influx (W_{ei}) occurs if $p_a = 0$, or:

$$W_{ei} = c_t W_i p_i f \quad (3)$$

From (2) and (3) results:

$$p_a = p_i \left(1 - \frac{W_e}{c_t W_i p_i} \right) = p_i \left(1 - \frac{W_e}{W_{ei}} \right) \quad (4)$$

Equation (4) provides a simple mathematical expression to determine the average aquifer pressure, p_a , after removing W_e of water from the aquifer to the reservoir, i.e., cumulative water influx.

Differentiating equation (4) to time, results:

$$\frac{dW_e}{dt} = -\frac{W_{ei}}{p_i} \frac{dp_a}{dt} \quad (5)$$

Fetkovich combined equation (5) with (1) and integrated to give the following form:

$$W_e = \frac{W_{ei}}{p_i} (p_i - p_r) \exp \left(\frac{-J p_i t}{W_{ei}} \right) \quad (6)$$

where:

W_e – cumulative water influx [bbl],

p_r – reservoir pressure, i.e., pressure at the oil gas-water contact,

t – time [days].

Equation (5) has no practical applications since it was derived for a constant inner boundary pressure. To use this solution in the case in which the boundary pressure is varying continuously as a function of time, the superposition technique must be applied. Rather than using superposition, Fetkovich suggested that, if the reservoir–aquifer boundary pressure history is divided into a finite number of time intervals, the incremental water influx during the n -th interval is:

$$(\Delta W_e)_n = \frac{W_{ei}}{p_i} \left[(p_a)_{n-1} - (p_r)_n \right] \left[1 - \exp \left(-\frac{J p_i \Delta t_n}{W_{ei}} \right) \right] \quad (7)$$

where $(p_a)_{n-1}$ is the average aquifer pressure at the end of previous time step. This average pressure is calculated from equation (4):

$$(p_a)_{n-1} = p_i \left(1 - \frac{(W_e)_{n-1}}{W_{ei}} \right) \quad (8)$$

The average reservoir boundary $(p_r)_n$ is estimated from:

$$(p_r)_n = \frac{(p_r)_n + (p_r)_{n-1}}{2} \quad (9)$$

The *productivity index* J used in the calculation is a function of the geometry of the aquifer. Fetkovich calculated the productivity index from Darcy's equation for bounded aquifers.

4. CASE STUDIES – FETKOVICH METHOD APPLIED IN PERFORMANCE EVALUATION OF A GAS FIELD LOCATED IN GETIC DEPRESSION

Following the mathematical model described above, the authors will present the application of Fetkovich model in evaluation of the performance of a gas field located in Getic Depression (eastern part of extra-Carpathian Romanian region). The field comprises 75 hydrodynamic units (gas reservoirs) characterized by unitary pressure systems. The authors will present two case studies to highlight the applicability of Fetkovich model in analyzing and forecasting the gas water drive reservoir performance.

Case study 1 (Tab. 1)

Table 1
Mixed drive mechanism

Input parameters for reservoir "a"	Value	Source
Reservoir pressure [bara]	138	Well testing data
Reservoir temperature [°C]	60	Well testing data
Permeability [mD]	20	Cores, well testing
Porosity [%]	12	Cores, logs
Salinity [% wt.]	6.4	Lab analysis
Assumed aquifer model	Linear	Geological maps, production history of the wells
Lithology	Interbedded thin sandstone layers in a shale matrix	Logs and drilling reports
Initial aquifer model properties		
Thickness: 3.6 m	Water viscosity: 0.53 cP	
Permeability: 20 mD	Productivity index J : 0.3 m ³ /bar	
Width: 5 000 m	W_{ei} : 0.17 MMm ³	
Length: 8 000 m	Initial water saturation: 0.31	

Reservoir “a” was produced since 1992 through 10 gas wells and currently 6 wells are into production. In Figure 2 it is represented the historical production of the reservoir “a”, showing the performance of the gas rates, water rates and pressures during the exploitation.

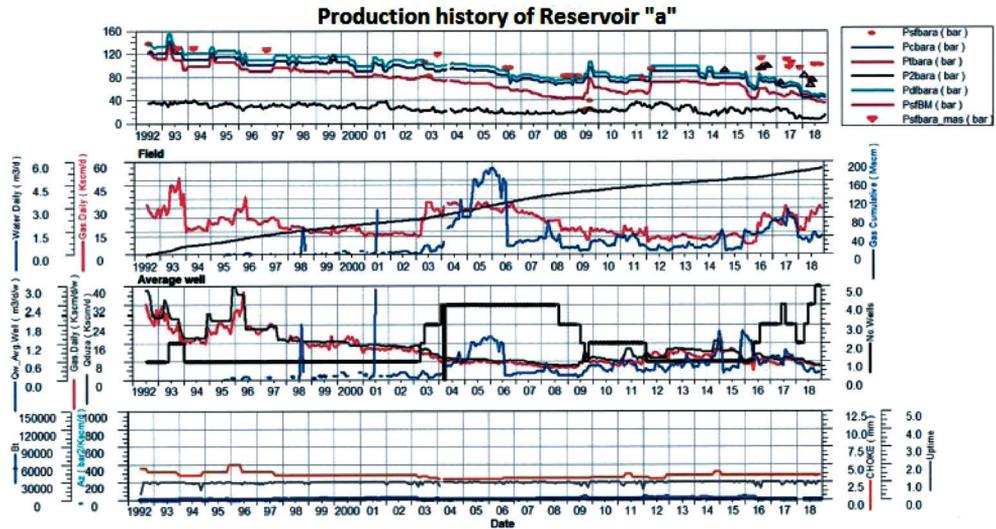


Fig. 2. Case study 1 – Production history of natural gas reservoir “a”

In order to select the method to make performance prediction of a reservoir we use some techniques that, typically, are based on the reservoir pressure evolution in time.

In case of reservoir “a” the plot p/z vs G_p has highlighted a mixed drive reservoir (gas expansion at the beginning of exploitation), and later, a weak aquifer responded to the pressure drop by giving a pressure support to maintain in time the quasi-constant pressure.

Considering the behavior showed in Figure 3, material balance equation (MBE) for the volumetric reservoir (plot p/z vs G_p) is not applicable in case of reservoir “a” as will give errors in estimating the OGIP (original gas in place). However, the MBE plotting technique is useful in detection of the drive mechanism and, as it can be observed, for some gas water drive reservoir deviation from p/z vs G_p is not detected until much later, therefore, at some point during the life cycle of the reservoir we can assume wrongly the drive mechanism.

To predict the performance behavior of the gas reservoir “a” and of the aquifer was chosen the Fetkovich analytical simulation model because is an accessible and fast reservoir management tool and uses the production history in all calculation. As any other prediction method, Fetkovich model has some disadvantages by the existing uncertainties when we provide the initial assumptions related to original gas in place, water encroached from aquifer and productivity index of aquifer.

Material Balance for Gas Reservoirs (p/Z vs. G_p)
Reservoir "a" - Mixed drive mechanism

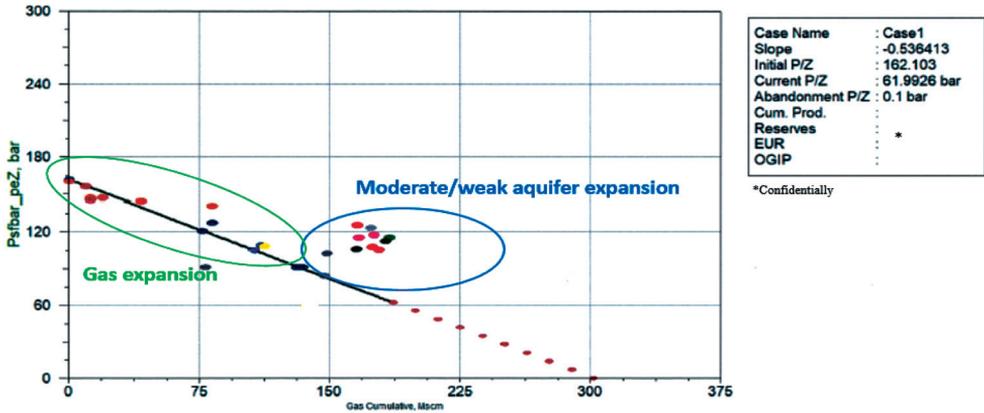


Fig. 3. Graphical plot p/z vs G_p for reservoir "a"

Using the Fetkovich semisteady-state aquifer model we assume that the aquifer rate and pressure will change with time therefore, we are looking for reasonable pressure history match in time. This means that the aquifer productivity index (J) and reservoir pressure gives the influx rate at any point in time.

In case of reservoir "a" pressure history matching was done as it is shown in Figure 4 through iteration until calculated and observed pressure were agreed.

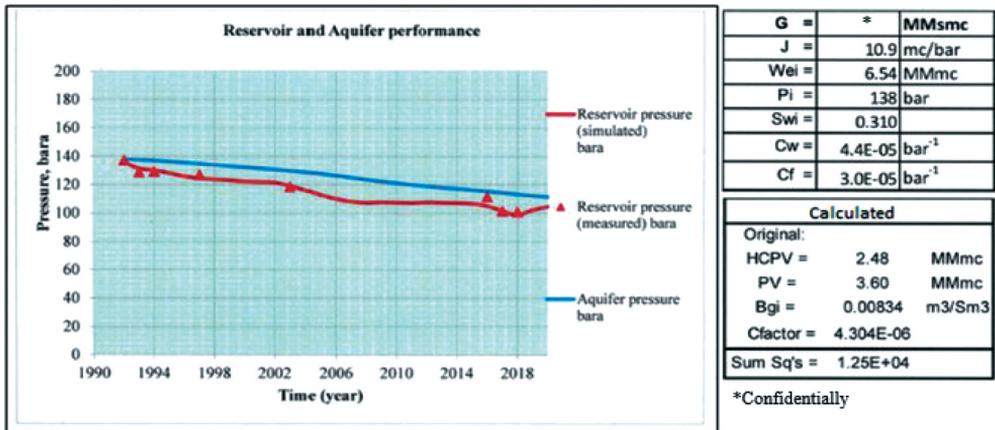


Fig. 4. Pressure history matching for reservoir "a"

In Figure 4 is shown the pressure history matching which was obtained by changing the variables G , J , W_{ei} . This indicates that we have a moderate water drive mechanism.

The analytical simulation started from volumetric OGIP and from initial reservoir pressure of 138 bara.

If we are to use the p/z vs Gp method in a gas mixed reservoir, we can get an acceptable volume of initial resources, excepting that we cannot predict the aquifer performance and the reserves estimation. However, if we compare the results obtained from the two methods (Fetkovich model and p/z vs Gp plot) and these are reasonable, we can assume that we are much closer to reality. The deviation point on the p/z vs Gp graph means that there will be a water encroachment in the near future which must be considered in production forecast of reservoir “a”.

Table 2

Results obtained from material balance analysis-Fetkovich method – reservoir “a”

Year	Comutative [days]	Reservoir pressure (measured) [bara]	Reservoir pressure (simulated) [bara]	W_e [m ³]	Aquifer pressure [bara]	Q_{acv} [m ³ /zi]
1992	0	–	138.00	0.00	138.00	–
1992	31	137.35	136.14	312.58	137.99	20.17
1993	396	128.74	131.29	16 602.88	137.65	65.15
1994	761	129.32	130.04	43 181.24	137.08	76.57
1995	1 126	–	128.02	73 838.25	136.43	91.51
1996	1 491	–	125.78	110 131.25	135.65	107.47
1997	1 856	126.97	124.43	150 299.11	134.80	112.76
1998	2 221	–	123.67	191 309.96	133.92	112.10
1999	2 586	–	123.07	231 587.68	133.06	108.74
2000	2 951	–	122.20	271 306.48	132.22	109.03
2001	3 316	–	121.84	310 149.34	131.39	103.93
2002	3 681	–	121.39	347 380.47	130.59	100.19
2003	4 046	118.62	119.04	386 910.44	129.75	116.54
2004	4 411	–	116.14	433 224.94	128.76	137.39
2005	4 776	–	112.78	487 717.75	127.60	161.35
2006	5 141	–	109.99	547 482.45	126.29	177.32
2007	5 506	–	108.12	615 101.95	124.89	182.46
2008	5 871	–	107.35	680 118.77	123.50	175.66
2009	6 236	–	107.63	741 359.96	122.20	158.47
2010	6 601	–	107.43	797 214.15	121.01	147.77
2011	6 966	–	107.22	849 319.37	119.89	137.91
2012	7 331	–	107.58	896 897.05	118.88	122.94

Table 2 cont.

2013	7 696	–	107.38	940 308.87	117.95	115.07
2014	8 061	–	107.23	980 860.07	117.09	107.26
2015	8 426	–	106.67	1 019 479.30	116.27	104.48
2016	8 791	111.57	105.06	1 059 095.25	115.42	112.72
2017	9 156	101.62	101.59	1 105 157.99	114.44	139.83
2018	9 521	100.97	98.83	1 159 358.87	113.29	157.34
2019	9 886	–	102.10	1 208 186.45	112.24	110.36
2020	10 251	–	104.52	1 242 216.93	111.52	76.21
2021	10 616	–	106.24	1 265 607.20	111.02	52.03
2022	10 981	–	107.44	1 281 519.61	110.68	35.22
2023	11 346	–	108.28	1 292 255.67	110.45	23.65
2024	11 711	–	108.85	1 299 439.25	110.30	15.74

In Table 2 are presented the results of material balance analysis – Fetkovich model, as it follows:

- Reservoir pressure (measured bottom hole pressure).
- Simulated reservoir pressure starting from the initial reservoir pressure of the reservoir and matching with measured pressure.
- Water influx (water encroachment) and aquifer pressure.
- Performance prediction of the active production gas wells until the entire gas reservoir will be encroach by water and will be flooded.

Final recovery factor is about 62%, which is reasonable for a mixed drive reservoir (Fig. 5).

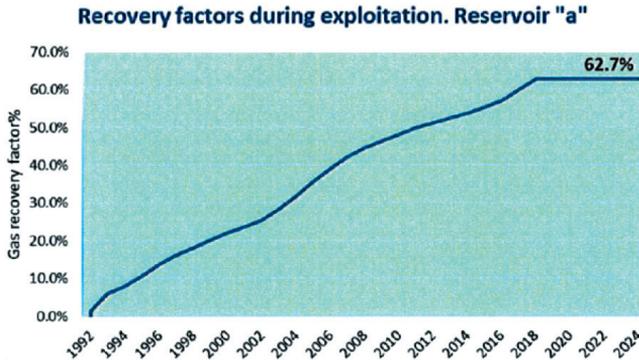


Fig. 5. Gas recovery factor during exploitation

Case study 2 (Tab. 3)

Table 3
Water drive mechanism

Input parameters for reservoir “b”	Value	Source
Reservoir pressure [bara]	214	Well testing data
Reservoir temperature [°C]	74	Well testing data
Permeability [mD]	800	Cores, well testing
Porosity [%]	25	Cores, logs
Salinity [% wt.]	11.6	Lab analysis
Assumed aquifer model	Linear	Geological maps and production history of the wells
Lithology	Sandstone	Logs and drilling reports
Initial aquifer model properties		
Thickness: 8 m	Water viscosity: 0.49 cP	
Permeability: 800 mD	Productivity index J : 5 m ³ /bar	
Width: 4 200 m	W_{ei} : 1 MMm ³	
Length: 5 000 m	Initial water saturation: 0.2	

Reservoir “b” was produced since 1976 through 5 wells and currently the reservoir “b” is produced by one well. The production history is presented in Figure 6 where no pressure decline is observed during the exploitation which indicates the presence of an aquifer that maintain the reservoir pressure closer to the initial reservoir pressure.

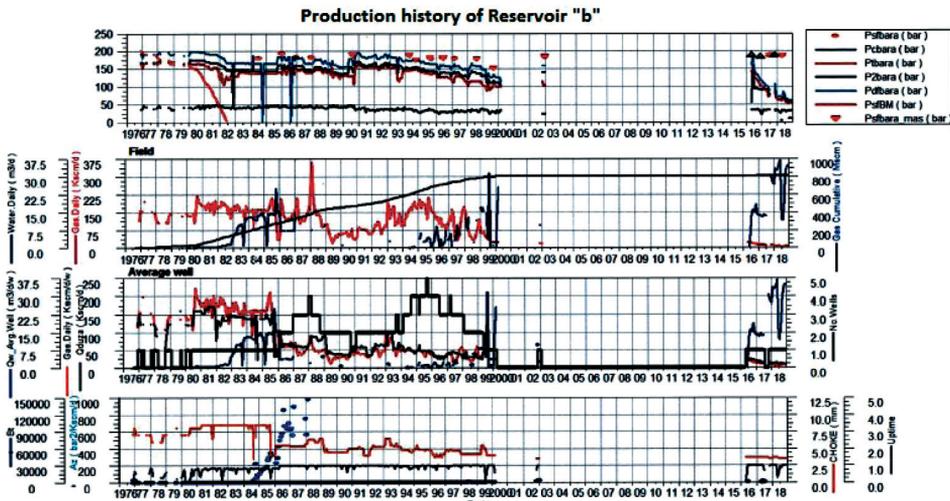


Fig. 6. Case study 2 – Production history of natural gas reservoir “b”

Starting from classical MBE, the plot of p/z vs Gp (Fig. 7) shows that the water drive mechanism is the predominant form of energy in reservoir “b”, therefore the OGIP and reserves must be estimated to an alternative method.

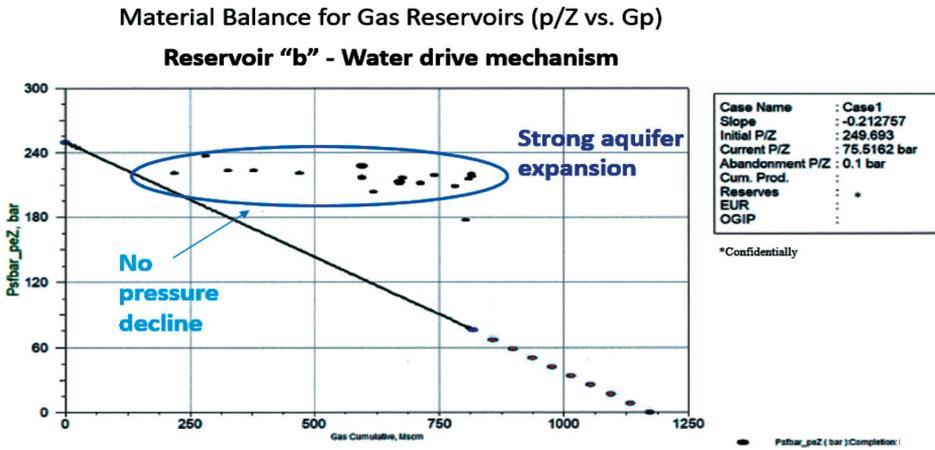


Fig. 7. Graphical plot p/z vs Gp for reservoir “b”

Fetkovich method was chosen as being the reliable approach in analyzing and forecasting the performance of the gas reservoir “b”, of the adjacent aquifer, because the method is based on the production data, and is a powerful tool that helps to determine the initial gas resources.

In Figure 8 is represented the history matching of reservoir pressure with aquifer pressure during the exploitation starting from the initial measured pressure of 214 bara. As it can be observed in Figure 8 the reservoir pressure drop is negligible due to the aquifer pressure that compensate the expansion energy of the natural gas.

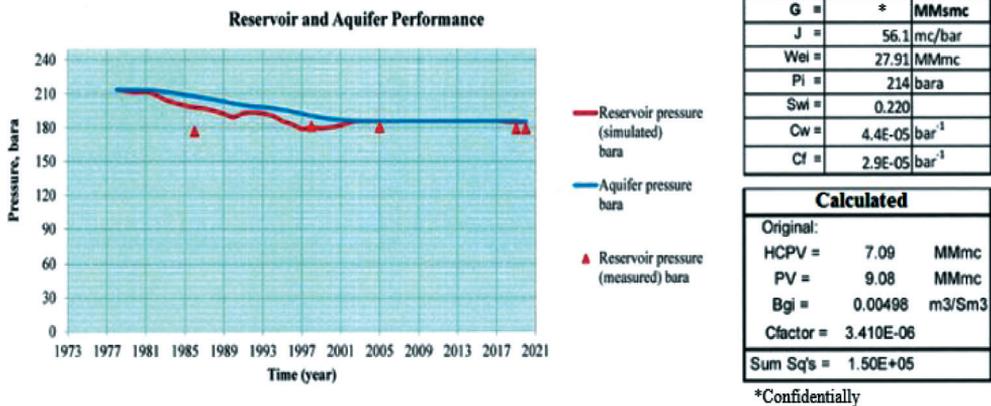


Fig. 8. Pressure history matching for reservoir “b”

History matching is performed through an iterative process by adjusting the values of G (initial gas resource), J (productivity index of the aquifer) and W_{ei} (water influx/encroachment) in accordance with reservoir parameters. The initial assumptions of the three parameters were based on the existing data (volumetric resource, history data), and then adjustments were made until a good fit of pressure vs. time was obtained. This behavior and resulted parameters indicates the presence of a strong aquifer adjacent to gas reservoir “b”.

Considering the results obtained through Fetkovich method for reservoir “b” is absolutely necessary to forecast the gas production and predict the aquifer performance before the water encroach the entire reservoir.

Evaluation of the operating strategies in order to get an attractive final recovery is the normal approach for water drive reservoir, therefore a more in depth analysis has been made to predict the water influx. In Figure 9 is represented the waterflood factor evolution considering the initial fluid saturation (gas saturation $s_g \sim 80\%$, water saturation $s_w \sim 20\%$) and initial GWC (gas-water contact).

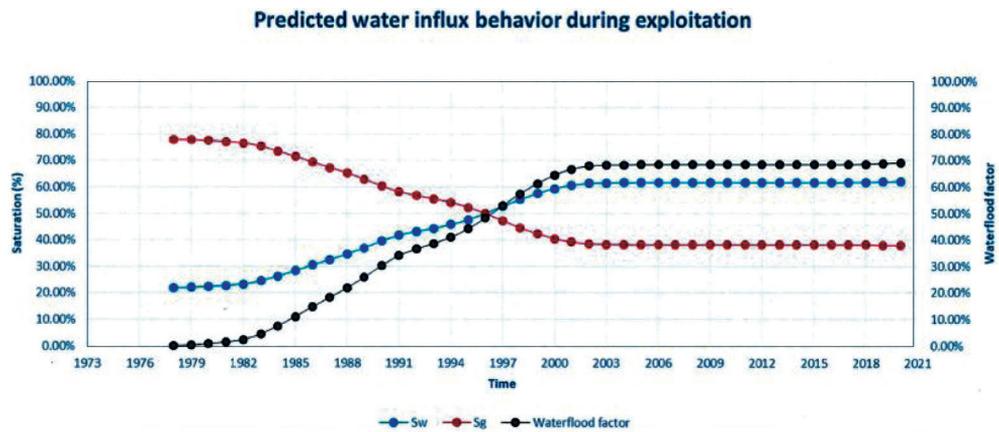


Fig. 9. Prediction of water influx into reservoir “b” over exploitation

As it can be observed, along with gas production over time, there has been a change in fluid saturation due to the water flow into the reservoir from the adjacent aquifer. Taking into account that the current water saturation (s_w) is around 60%, the exploitation of the reservoir “b” will end up with an estimated final recovery factor of 57% (Fig. 10).

The performance prediction using Fetkovich method is considered to be close to the reality for reservoir “b”, however taking into account the related uncertainties, it is necessary to carry out a sensitivity analysis using regression model to examine the relationship between the three variable of interest (G, J, W_{ei}) and check how close our calculations are to reality.

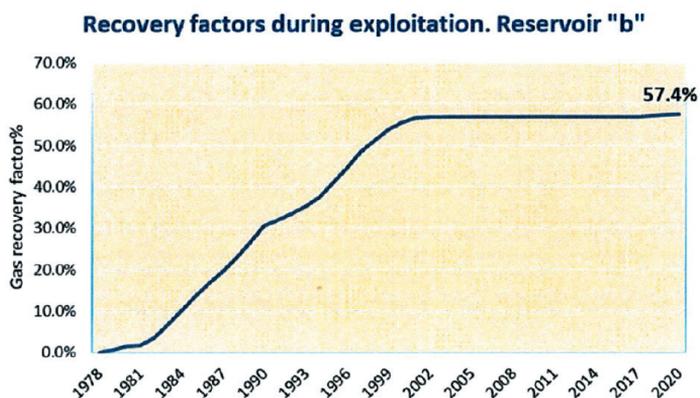


Fig. 10. Estimated final recovery factor for reservoir “b”

In Table 4 are presented the results of material balance analysis – Fetkovich model.

Finally, the results presented for the case studies obtained through Fetkovich model, if is required, should be validated by reservoir simulation in order to develop operational and technical production strategies to increase the recovery of reserves.

Table 4

Results obtained from material balance analysis-Fetkovich method-reservoir “b”

Year	Comutative [days]	Reservoir pressure (measured) [bara]	Reservoir pressure (simulated) [bara]	W_e [m ³]	Aquifer pressure [bara]	Q_{acv} [m ³ /zi]
1978	0	–	213.74	0.00	213.74	–
1978	61	–	213.68	179.83	213.74	2.95
1979	426	–	212.60	11 411.93	213.65	58.72
1980	791	–	211.49	41 780.35	213.42	108.02
1981	1 156	–	211.96	73 876.12	213.17	68.21
1982	1 521	–	209.22	122 840.50	212.80	200.64
1983	1 886	–	204.70	233 456.53	211.95	406.71
1984	2 251	–	201.90	397 299.83	210.69	492.90
1985	2 616	–	199.76	584 086.23	209.26	532.69
1986	2 981	197.09	197.93	781 413.74	207.75	550.77
1987	3 346	–	197.02	976 131.39	206.26	518.36
1988	3 711	–	195.03	1 170 081.03	204.78	546.56
1989	4 076	–	192.29	1 380 683.56	203.16	609.79
1990	4 441	–	189.35	1 614 518.22	201.37	674.12

Table 4 cont.

Year	Comutative [days]	Reservoir pressure (measured) [bara]	Reservoir pressure (simulated) [bara]	W_e [m ³]	Aquifer pressure [bara]	Q_{acv} [m ³ /z _i]
1991	4 806	–	192.55	1 811 908.57	199.86	409.69
1992	5 171	–	193.50	1 941 392.42	198.87	301.27
1993	5 536	–	192.41	2 053 485.13	198.01	314.20
1994	5 901	–	190.39	2 178 720.72	197.05	373.43
1995	6 266	–	185.94	2 347 019.74	195.76	550.64
1996	6 631	–	183.01	2 560 828.82	194.12	623.31
1997	6 996	–	178.87	2 810 590.53	192.21	748.05
1998	7 361	181.47	179.77	3 054 750.66	190.34	592.55
1999	7 726	–	179.31	3 259 292.23	188.77	530.52
2000	8 091	–	180.07	3 431 373.38	187.46	414.32
2001	8 456	–	181.93	3 553 737.45	186.52	257.54
2002	8 821	–	184.61	3 615 370.89	186.05	80.87
2003	9 186	–	185.59	3 633 324.07	185.91	17.70
2004	9 551	–	185.59	3 639 325.95	185.86	15.25
2005	9 916	180.72	185.67	3 643 750.82	185.83	9.04
2006	10 281	–	185.78	3 645 752.28	185.81	1.95
2007	10 646	–	185.80	3 646 182.51	185.81	0.42
2008	10 011	–	185.81	3 646 274.84	185.81	0.09
2009	11 376	–	185.81	3 646 294.78	185.81	0.02
2010	11 741	–	185.81	3 646 299.08	185.81	0.00
2011	12 106	–	185.81	3 646 299.88	185.81	0.00
2012	12 471	–	185.81	3 646 299.93	185.81	0.00
2013	12 836	–	185.81	3 646 299.97	185.81	0.00
2014	13 201	–	185.81	3 646 300.00	185.81	0.00
2015	13 566	–	185.81	3 646 300.03	185.81	0.00
2016	13 931	–	185.81	3 646 300.06	185.81	0.00
2017	14 296	–	185.81	3 646 300.08	185.81	0.00
2018	14 661	180.79	184.87	3 655 208.95	185.74	48.91
2019	15 026	–	184.66	3 673 746.17	185.60	52.87
2020	15 391	–	184.65	3 690 399.76	185.47	38.57

5. CONCLUSIONS

1. The material balance method is a powerful tool that helps to determine the reserves, the recovery factor and drive mechanism and can be applied to a variety of reservoirs, either with or without water influx.
2. Forecasting and analyzing the performance of mixed and water drive reservoirs using the Fetkovich method (as shown for reservoir “a” and “b”) proven to be an accessible and fast method, providing a good estimation of OGIP and aquifer performance.
3. Fetkovich method is accurate enough for engineering purposes, especially for implementing suitable production techniques and strategies in order to increase the recovery factors.
4. The reliability of the Fetkovich method is increased by the production data which are used in all calculation.
5. In the presented case studies, the Fetkovich model was the best fit-for-purpose method considering the available data.
6. Truly “rigorous” treatment of aquifer influx requires reservoir simulation.

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