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Estimation of driving mechanisms for oil reservoir using Material Balance (MBAL Software) "A Case Study of Libyan Oil Field

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MBAL Software
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ABSTRACT

Material Balance (MBAL Software) is a software used for efficient reservoir development and helps the engineer better define reservoir drive mechanisms and hydrocarbon volumes. Oil and gas are pushed from the reservoir to the bottom of the well and then to the surface by the natural forces of the reservoir. In this paper, the types of natural drive of the reservoir are estimated and compared by using a program is called MBAL software after matching the production history data with the model results. The purpose of this paper is to estimate water influx with identifying water influx model parameter and to estimate reservoir drive mechanism for (8) eight Libyan oil reservoirs. The results of the paper can be seen to match the real data of the reservoir with the results of the program using a MBAL software. The simulator results show the reservoir pressure history curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The driving mechanism for all those reservoirs it comes from three natural forces, which are fluid expansion, PV compressibility, and water influx.

تقدير آليات المكامن النفطية باستخدام نمذجة الإنتاج المتكاملة (برنامج MBAL) "دراسة حالة لحقول النفط الليبية".

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الكلمات المفتاحية:
برامج MBAL
اليات الدفع الطبيعى للخزان
حقول النفط الليبية
طريقة مزانة المواد

الملخص

برنامج موازنة المواد (MBAL Software) هو برنامج يستخدم لتطوير المكامن بكفاءة ويساعد المهندس على تحديد آليات دفع الطبيعى الخزان وأحجام الهيدروكربونات بشكل أفضل. القوى الطبيعية في الخزان التي تزيح الهيدروكربونات من الخزان إلى قاع البئر وإلى السطح. تقدر هذه الورقة وتقارن آليات الدفع الطبيعى باستخدام المحاكاة الديناميكية في برنامج MBAL وطريقة توازن المواد التنبؤية بعد مطابقة التاريخ لكل من هذا النموذج. تظهر النتائج من هذه الورقة وظائف MBAL من حيث مطابقة السجل وتوقع الأداء. الهدف من هذه الورقة هو تقدير تدفق المياه مع تحديد معامل نموذج تدفق المياه وتقدير آلية دفع الخزان لـ (8) ثمانية خزانات نفطية ليبية. تظهر نتائج المحاكاة أن منحنى سجل ضغط الخزان يتوافق مع منحنى التحفيز ، وهذا يعطي مؤشرًا جيدًا لبيانات الإدخال التي تم إدخالها إلى النموذج. تأتي آلية القيادة لجميع تلك الخزانات من ثلاث قوى طبيعية ، وهي تمدد السوائل ، وانضغاطية حجم المسام ، وتدفق المياه.

1. Introduction

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Okotie et al (2015) (1) mention that, the forecasting reservoir performance helps engineers estimate reserves, plan development which requires a detailed comprehension of reservoir properties and optimize production processes, and most importantly, develop an arithmetical model that adequately depicts the physical procedures happening in the reservoir so that the outcome of any action can be expected within a reasonable fault tolerance. The material balance equation (MBE) supports reservoir engineers to optimize hydrocarbon recovery by forecasting future tank performance, Tarek (2006) (2).

The MBE with the fluid flow concepts would enable to predict the reservoir future production performance vs time Odeh & Havlena (1963) (3). It require to plot the inconstant group against another inconstant group selected. If the linear relationship isn't present, this deviation shows that the tank isn't operating as expected and there are other mechanisms involved that were not accounted for but once the linearity was achieved, based on the matching of pressure and production data, a mathematical model was achieved. This application can be used to predict the production and lifecycle of oil and gas reservoir.

Previous studies explained and stated that there are several methods used in predicting oil reservoirs with gas dissolved gas propellant in oil related to a reduction in the oil to gas ratio and the volume of oil extracted from the tank. There are also studies that suggested that, there is an iterative technique to forecast the performance of depletion (gas solution) - thrust tanks under the internal gas engine mechanism, using the properties of rocks and liquids, Mohammed et al., (2017) (4). Hawkins Tracy (1955) (5) mention that, the model developed for tank performance forecast didn't reflect for under saturated oil reservoir. The prediction is must be started at the bubble-point pressure and choose the future pressures at which performance is wanted. Unfortunately, the groundwater area (aquifer) was not considered in the application, and therefore this water was included in Tamer's method for calculating the performance forecast of solution gas drive. There are (3) aquifer models which:

1. Hurst Van Everdingen (1949) model (6)
2. Carter-Tracy (1960) model (5)
3. Fetkovich (1971) model (7)

These models are programmed to allow flexibility, classical analytical models of aquifers are relatively easy to program in computer spreadsheets, provided the equation is correctly estimated.

Primary Recovery Mechanisms:

During the oil and gas production life, there are (6) driving mechanisms that can transfer hydrocarbon from reservoir to wellbore to the surface, which:

1. Rock and Liquid Expansion Driving Mechanism:

For example, when the oil or gas are produced from the reservoir and the initial reservoir pressure is higher than the saturation pressure, this reservoir is called an under-saturated oil reservoir. In this condition, as the production increases, and the tank pressure drops, then the rock and fluids expand due to their different compressibility (Ahmed. T., 2006). (8)

2. Depletion Driving Mechanism:

Sometimes the gas is dissolved in the oil at very high pressures. This pressure helps push the oil from the tank to the bottom of the well. By way of the pressure continues to drop inside the reservoir, the gas bubbles will expand and release these bubbles from the rocky pores. These bubbles and pores continue to increase and push the oil from the pores of the rocks to the pores larger than it. (Ahmed. T., 2006).(8)

3. Gas Cap Driving Mechanism:

These reservoir are categorized by the existence of free gas above oil and water. When production starts from the oil region, the gas cap will expand, causing the oil gas to push from the reservoir to the lowest of the well. (Ahmed. T., 2006).(8)

4. Water Driving Mechanism:

These reservoirs are categorized by the existence of strong water in the tank. The capacity of this water is more than ten times the capacity of oil and gas. When oil is produced from its area, it will expand to the water area, resulting in the oil being pushed from the tank to the bottom of the well. (Frank Jahn., 2008).(9)

5. Gravity Drainage Driving Mechanism:

The oil production in these reservoirs is owing to the difference in density between the tank fluids and the gravitational forces. (Ahmed. T., 2006).(8)

6. Combination Driving Mechanism:

Some oil and gas reservoirs contain more than one natural propulsion mechanism. The two most influential alleles are the power of the gas cap and the power of groundwater. (Frank Jahn., 2008).(9)

Objectives:

Studying the natural forces that help push oil and gas from the reservoir to the bottommost of the well helps to understand the tank and its behavior. There is a program called .Integrated Production Modelling (MBAL Software), used to understand and study these forces and their development. It also helps to determine:

1. The type of natural force of the reservoir
2. Total reservoir volume of hydrocarbons

In this study, the (MBAL) software was used to estimate the driving mechanisms for (8) eight Libyan oil reservoirs.

Methods:

Figure 1 shows the methodology of driving mechanism as showing in the following flow chart:

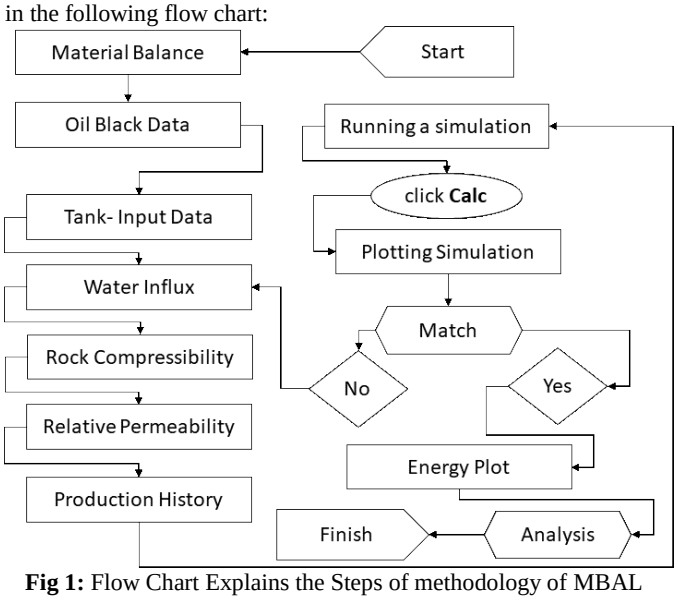

Fig 1: Flow Chart Explains the Steps of methodology of MBAL used in this Study

INPUT DATA:

Table 1 shows the oil black properties, table 2 shows reservoir data.

Results and Discussion:

1. LIBYA#001 Reservoir:

Figure 2 shows the reservoir pressure history and simulation vs time for aquiver volume is 37000 mmft^3. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. By running the simulator with historical production and comparing with actual reservoir performance, the reservoir pressure is matching when the reservoir aquiver volume has been adjusted to 37000 mmft^3.

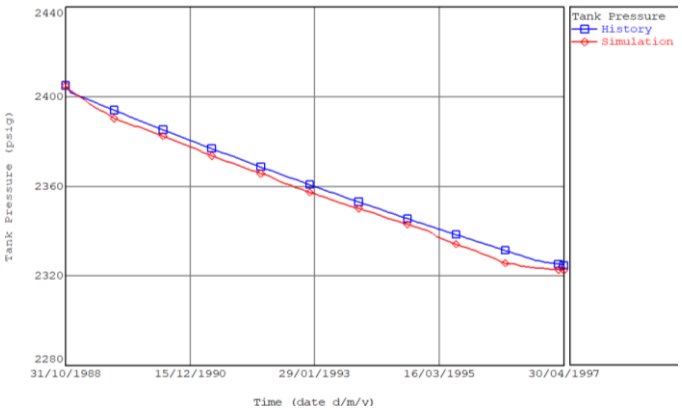

Fig 2: Production History with Time VS Pressure for LIBYA#001 with Reservoir Thickness 37000 mmft^3.

Figure 3 shows the comparative contributions of the main source of energy in the reservoir and aquifer system vs time. From 30/11/1988 to 30/04/1997, this reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.40, with the PV compressibility from 0.40 to 0.70, and with the water influx from 0.70 to 1 is water influx.

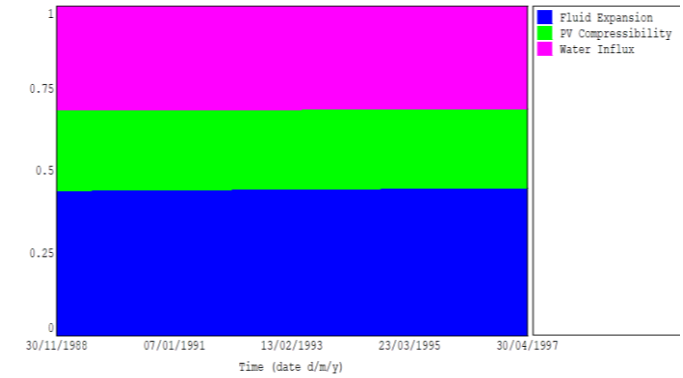

Fig 3: Libya#001 Driving Mechanism with Reservoir Thickness is 42000ft^3

Figure 4 shows the reservoir pressure history and simulation vs time for diffusivity is 30RP/Psi/day. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir diffusivity has been adjusted to 30RP/Psi/day.

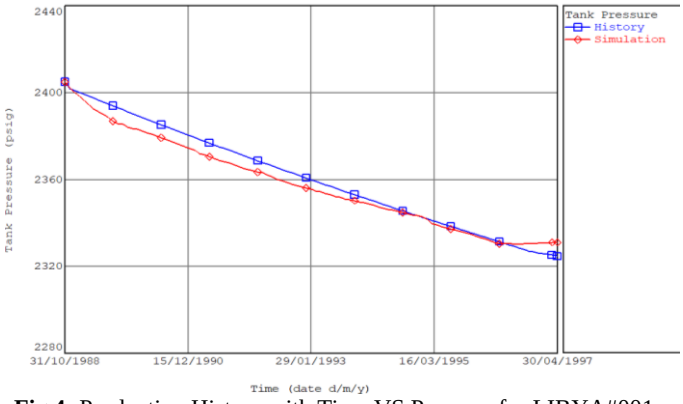

Fig 4: Production History with Time VS Pressure for LIBYA#001 with Diffusivity is 30RP/Psi/day

Figure 5 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 30/11/1988 to 30/04/1997, this reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.60, with the PV compressibility from 0.60 to 0.80, and with the water influx from 0.80 to 1 is water influx.

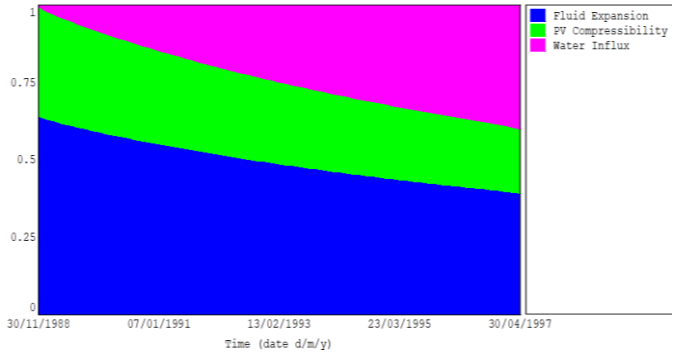

Fig. **5**: Libya#001 Driving Mechanism with Diffusivity is 30RP/Psi/day

Figure 6 shows the reservoir pressure history and simulation vs time for reservoir thickness is 42000ft^3. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir thickness has been adjusted to 42000ft^3.

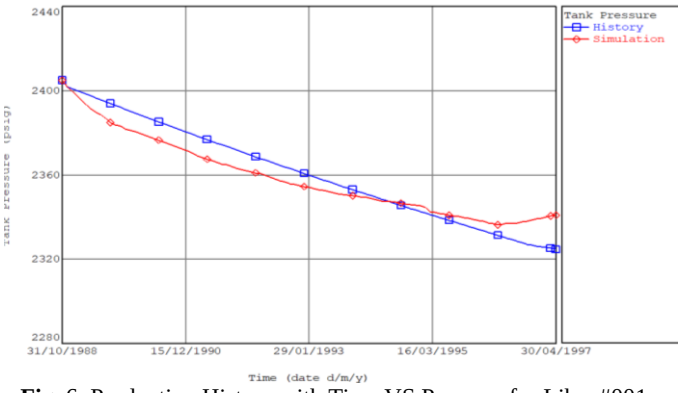

Fig. 6: Production History with Time VS Pressure for Libya#001 with Reservoir Thickness is 42000ft^3

Figure 7 shows the relative contributions of the main source of energy in the Reservoir and aquifer system vs time. From 30/11/1988 to 30/04/1997, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.65, with the PV compressibility from 0.65 to 0.90, and with the water influx from 0.90 to 1 is water influx.

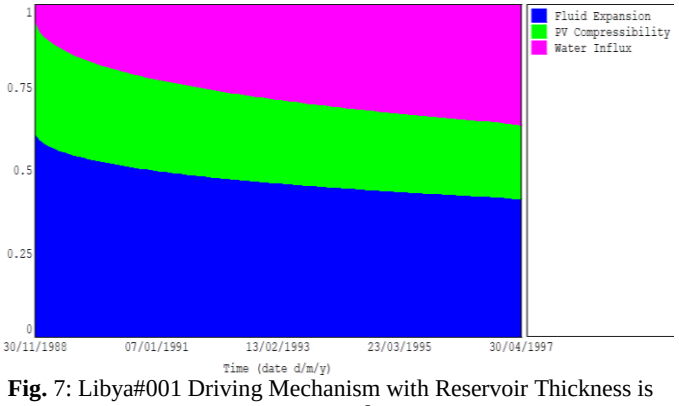

Fig. 7: Libya#001 Driving Mechanism with Reservoir Thickness is 42000ft^3

2. LIBYA#002 Reservoir:

Figure 8 shows the Reservoir pressure history and simulation vs time for aquiver volume is 20000 mmft^3. The history Reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The Reservoir pressure is matching when the Reservoir aquiver volume has been adjusted to 20000 mmft^3.

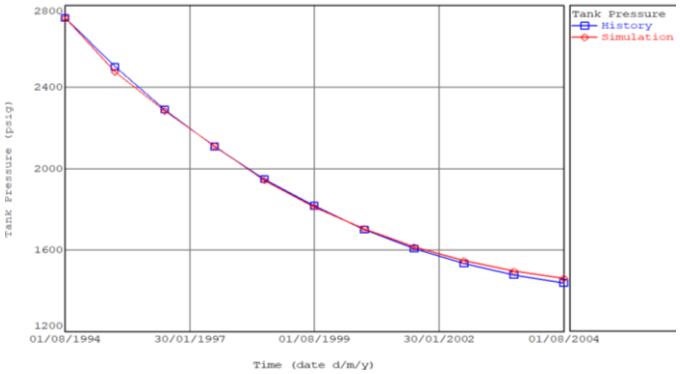

Fig. 8: Libya#002 Reservoir Pressure with Aquiver Volume is 20000 mmft^3

Figure 9 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/08/1995 to 01/08/2004, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.50, with the PV compressibility from 0.50 to 0.55, and with the water influx from 0.55 to 1 is water influx.

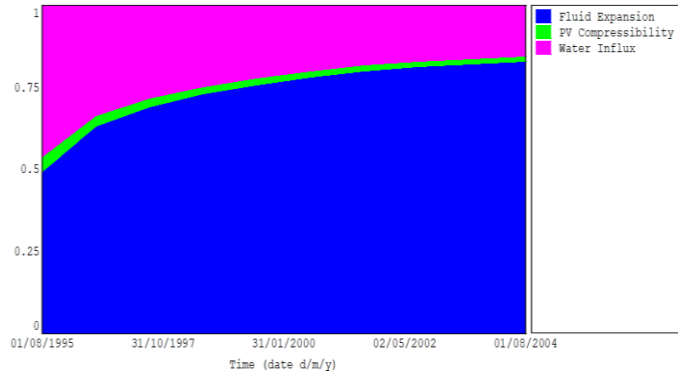

Fig. 9: Libya#002 Driving Mechanism with Aquiver volume is 20000 mmft^3

Figure 10 shows the reservoir pressure history and simulation vs time for diffusivity is 17.7 RP/Psi/day. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir diffusivity has been adjusted to 17.7 RP/Psi/day.

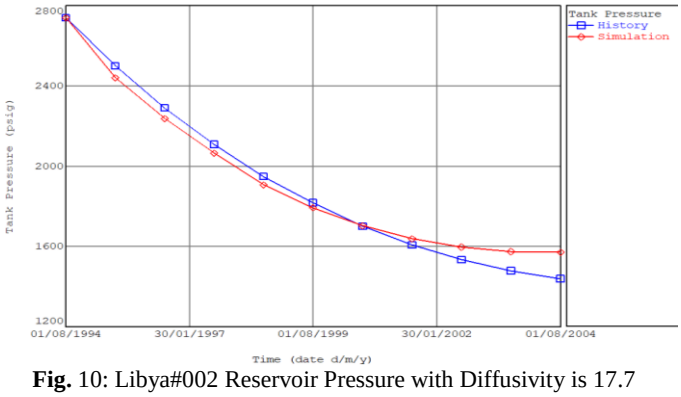

Fig. 10: Libya#002 Reservoir Pressure with Diffusivity is 17.7 RB/Psi/day

Figure 11 shows the relative contributions of the main source of energy in the Reservoir and aquifer system vs time. From 01/08/1995 to 01/08/2004 this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.65, with the PV compressibility from 0.65 to 0.75, and with the water influx from 0.75 to 1 is water influx.

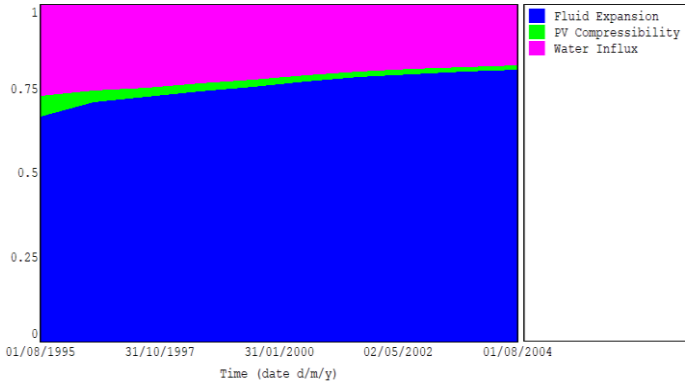

Fig. 11: Libya#002 Driving Mechanism with Diffusivity is 17.7 RB/Psi/day

Figure 12 shows the Reservoir pressure history and simulation vs time for Reservoir thickness is 480 ft^3. The history Reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The Reservoir pressure is matching when the Reservoir thickness has been adjusted to 480 ft^3.

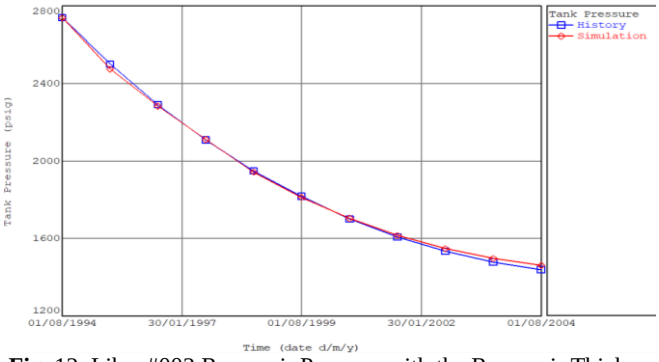

Fig. 12: Libya#002 Reservoir Pressure with the Reservoir Thickens is 480ft^3

Figure 13 shows the relative contributions of the main source of energy in the Reservoir and aquifer system vs time. From 01/08/1995 to 01/08/2004, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.75, with the PV compressibility from 0.75 to 0.80, and with the water influx from 0.80 to 1 is water influx.

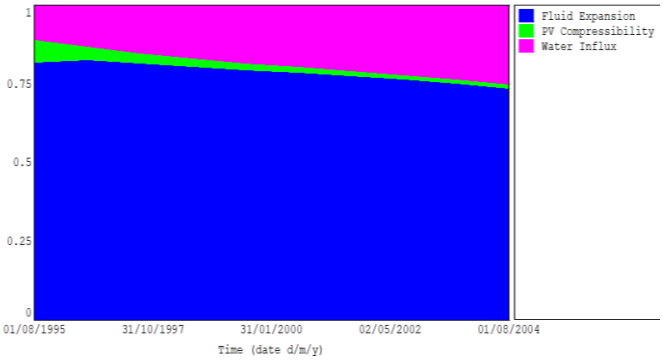

Fig. 13: Libya#002 Driving Mechanism with the Reservoir Thickens is 480 ft^3

3. LIBYA#003 Reservoir:

Figure 14 shows the Reservoir pressure history and simulation vs time for aquiver volume is 1000 mmft^3. The history Reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir aquiver volume has been adjusted to 1000 mmft^3.

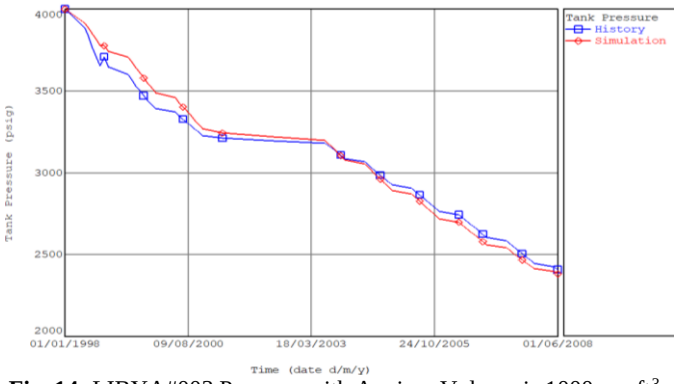

Fig. 14: LIBYA#003 Pressure with Aquiver Volume is 1000 mmft^3

Figure 15 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/06/1998 to 01/06/2008, this reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.24, with the PV compressibility from 0.24 to 0.75, and with the water influx from 0.75 to 1 is water influx.

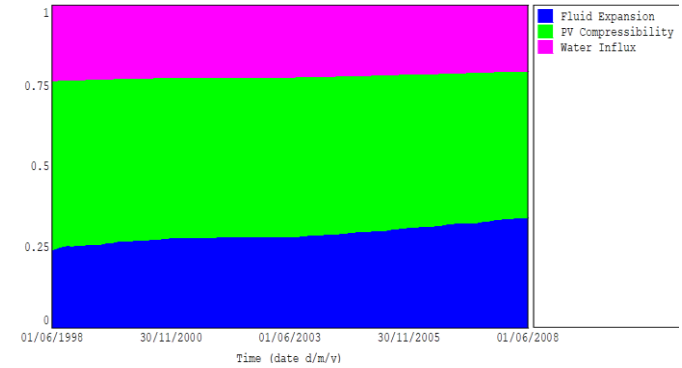

Figure 15: LIBYA#003 Pressure Driving Mechanism with Aquiver Volume is 1000 mmft^3

Figure 16 shows the reservoir pressure history and simulation vs time for reservoir thickness is 500 ft^3. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir thickness has been adjusted to 500 ft^3. U9

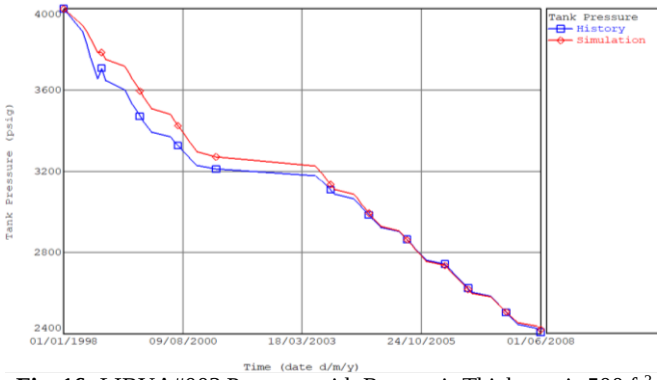

Fig. 16: LIBYA#003 Pressure with Reservoir Thickness is 500 ft^3

Figure 17 shows the relative contributions of the main source of energy in the Reservoir and aquifer system vs time. From 01/06/1998 to 01/06/2008, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.24, with the PV compressibility from 0.24 to 0.75, and with the water influx from 0.75 to 1 is water influx.

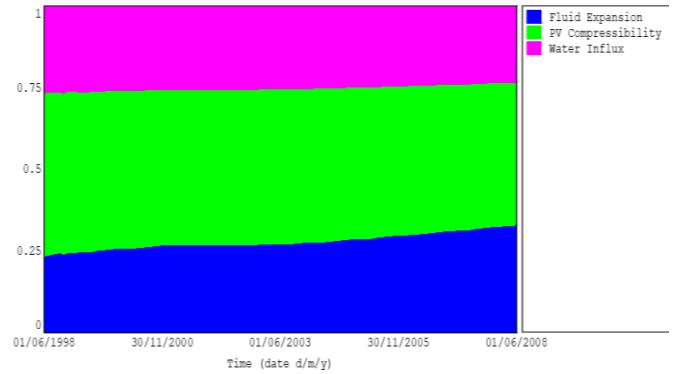

Fig. 17: LIBYA#003 Pressure Driving Mechanism with Reservoir Thickness is 500 ft^3

Figure 18 shows the reservoir pressure history and simulation vs time for diffusivity is 1 RP/Psi/day. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir diffusivity has been adjusted to 1 RP/Psi/day.

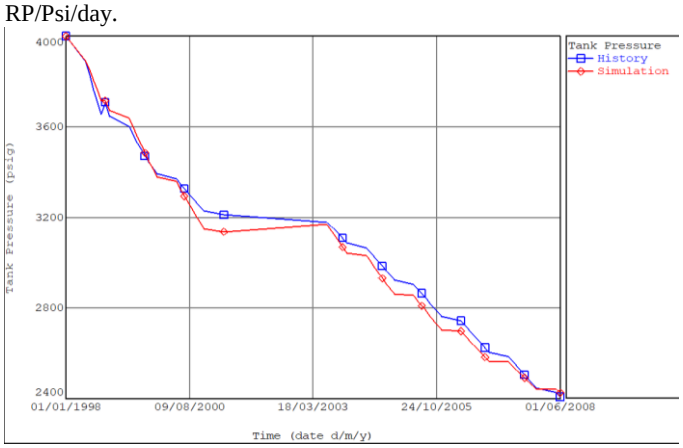

Figure 18: LIBYA#003 Pressure with Diffusivity is 1 Rb/psi/day

Figure 19 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/06/1998 to 01/06/2008. This reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.30, with the PV compressibility from 0.30 to 0.80, and with the water influx from 0.80 to 1 is water influx.

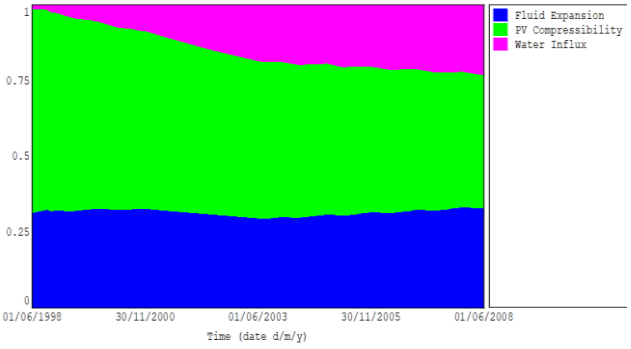

Fig. 19: LIBYA#003 Driving Mechanism with Diffusivity is 1 Rb/psi/day

4. LIBYA#004 Reservoir:

Figure 20 shows the reservoir pressure history and simulation vs time for aquiver volume is 750 mmft^3. The history Reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir aquiver volume has been adjusted to 750 mmft^3.

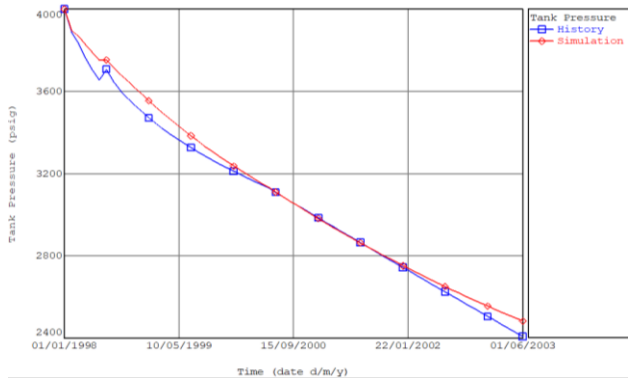

Fig. 20: LIBYA#004 Reservoir Pressure with Aquiver volume is 750 mmft^3

Figure 21 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/02/1996 to 01/06/2003, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.50, with the PV compressibility from 0.50 to 0.80, and with the water influx from 0.80 to 1 is water influx.

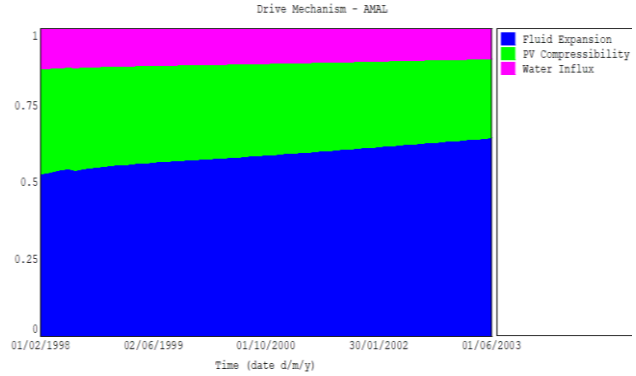

Fig. 21: LIBYA#004 Reservoir Driving Mechanism with Aquiver volume is 750 mmft^3

Figure 22 shows the reservoir pressure history and simulation vs time for reservoir thickness is 150 ft^3. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir thickness has been adjusted to 150 ft^3.

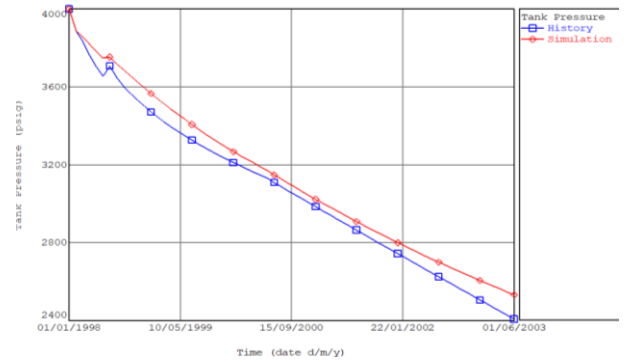

Fig. 22: LIBYA#004 Reservoir Pressure with Reservoir Thickness is 150 ft^3

Figure 23 shows the relative contributions of the main source of energy in the Reservoir and aquifer system vs time. From 01/02/1996 to 01/06/2003, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.60, with the PV compressibility from 0.60 to 0.80, and with the water influx from 0.80 to 1 is water influx.

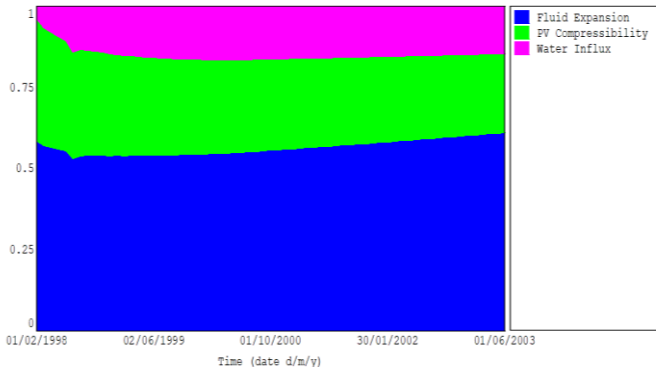

Fig. 23: LIBYA#004 Reservoir Driving Mechanism with Reservoir Thickness is 150 ft^3

Figure 24 shows the reservoir pressure history and simulation vs time for diffusivity is 1 RP/Psi/day. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir diffusivity has been adjusted to 1 RP/Psi/day.

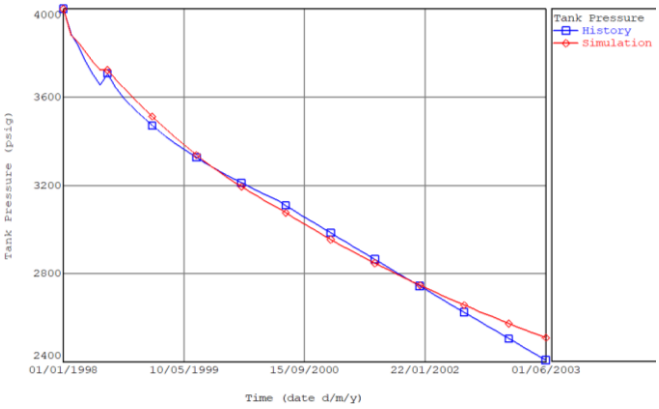

Fig. 24: LIBYA#004 Reservoir Pressure with Diffusivity is 1 RB/Psi/day

Figure 25 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/02/1998 to 01/06/2003, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.65, with the PV compressibility from 0.65 to 1.

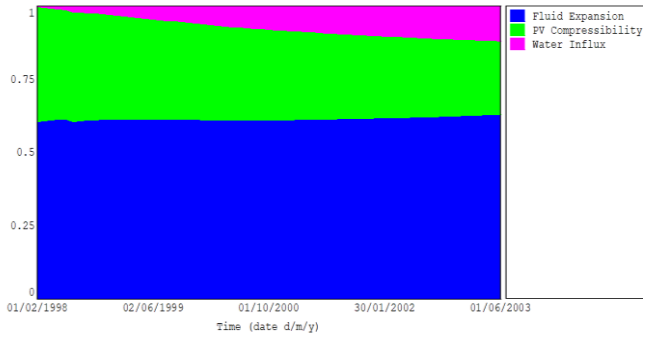

Fig. 25: LIBYA#004 Reservoir Driving Mechanism with Diffusivity is 1 RB/Psi/day

5. LIBYA#005 Reservoir:

Figure 26 shows the reservoir pressure history and simulation vs time for aquiver volume is 850 mmft^3. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir aquiver volume has been adjusted to 850 mmft^3.

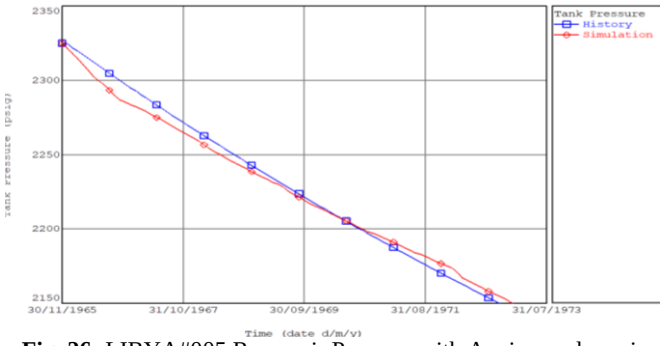

Fig. 26: LIBYA#005 Reservoir Pressure with Aquiver volume is 850 mmft^3

Figure 27 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 31/12/1965 to 31/07/1973, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.70, with the PV compressibility from 0.70 to 0.90, and with the water influx from 0.90 to 1 is water influx.

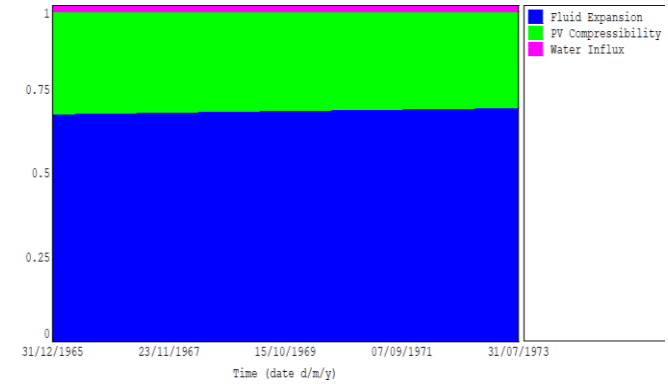

Fig. 27: LIBYA#005 Reservoir Driving Mechanism with Aquiver volume is 850 mmft^3

Figure 28 shows the reservoir pressure history and simulation vs time for diffusivity is 1.35 RP/Psi/day. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir diffusivity has been adjusted to 1.35 RP/Psi/day.

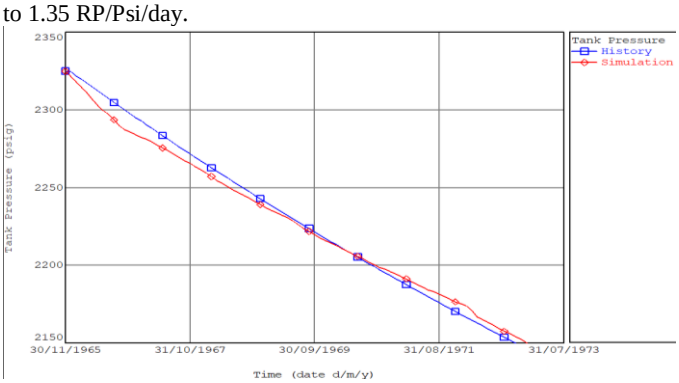

Fig. 28: LIBYA#005 Reservoir Pressure with Diffusivity is 1.35 RB/PSI/day

Figure 29 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 31/12/1965 to 31/07/1973, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.70, with the PV compressibility from 0.70 to 0.90, and with the water influx from 0.90 to 1 is water influx.

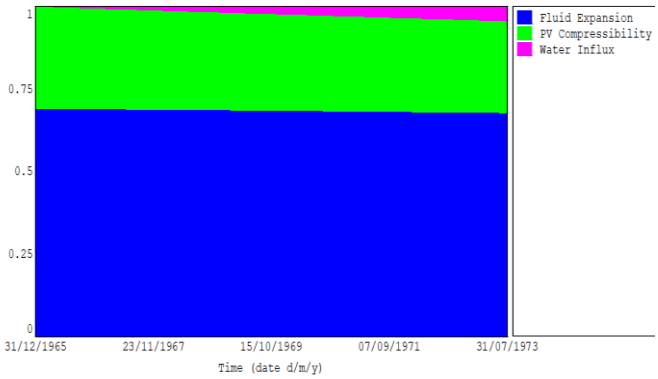

Fig. 29: LIBYA#005 Reservoir Driving Mechanism with Diffusivity is 1.35 RB/PSI/day

Figure 30 shows the reservoir pressure history and simulation vs time for Reservoir thickness is 5000 ft3. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir thickness has been adjusted to 5000 ft^3.

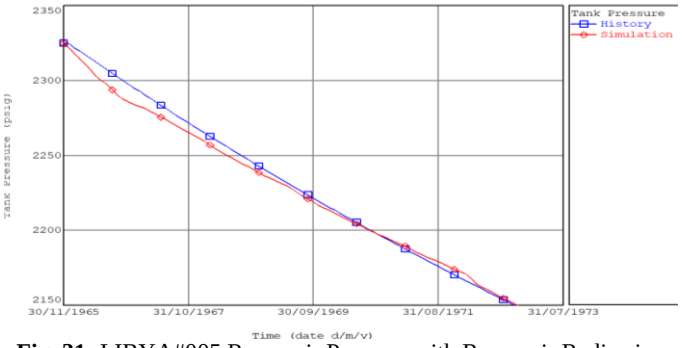

Fig. 31: LIBYA#005 Reservoir Pressure with Reservoir Radius is 5000 ft^3

Figure 32 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 31/12/1965 to 31/07/1973, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.70, with the PV compressibility from 0.70 to 0.90, and with the water influx from 0.90 to 1 is water influx.

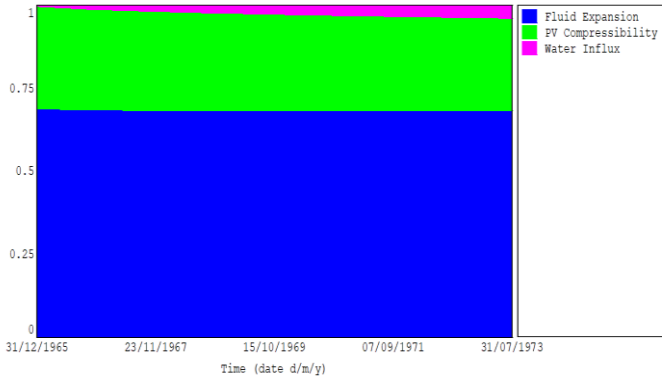

Fig. 33: LIBYA#005 Reservoir Driving Mechanism with Reservoir radius is 5000 ft^3

6. LIBYA#006 Reservoir:

Figure 34 shows the reservoir pressure history and simulation vs time for aquiver volume is 1700 mmft^3. The history Reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir aquiver volume has been adjusted to 1700 mmft^3.

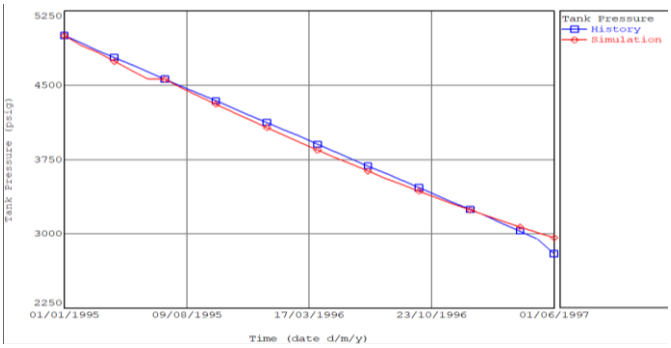

Fig. 35: LIBYA#006 Reservoir Pressure with Aquiver volume is 1700 mm ft^3

Figure 36 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/02/1995 to 31/06/1997, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.20, with the PV compressibility from 0.20 to 0.55, and with the water influx from 0.55 to 1 is water influx.

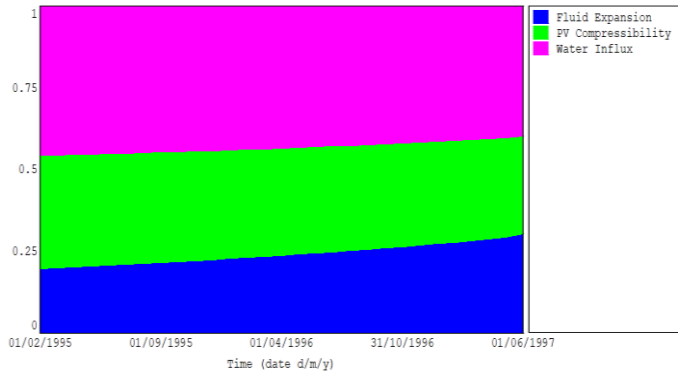

Fig. 36: LIBYA#006 Reservoir Driving Mechanism with Aquiver volume is 1700 mmft^3

Figure 37 shows the reservoir pressure history and simulation vs time for reservoir radios is 6000 ft. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir thickness has been adjusted to 6000 ft.

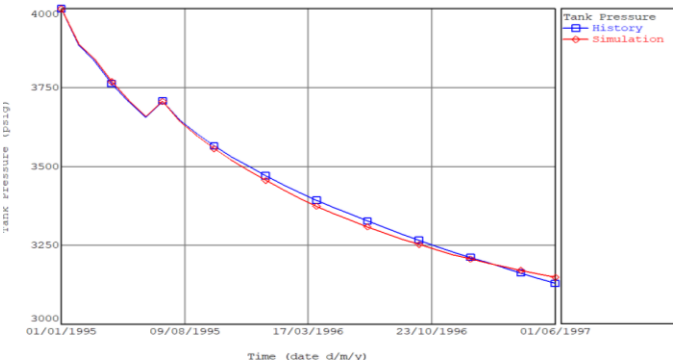

Fig. 37: LIBYA#006 Reservoir Reservoir Pressure with Reservoir radios is 6000 feet

Figure 38 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/02/1995 to 01/06/1997, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.30, with the PV compressibility from 0.30 to 0.70, and with the water influx from 0.70 to 1 is water influx.

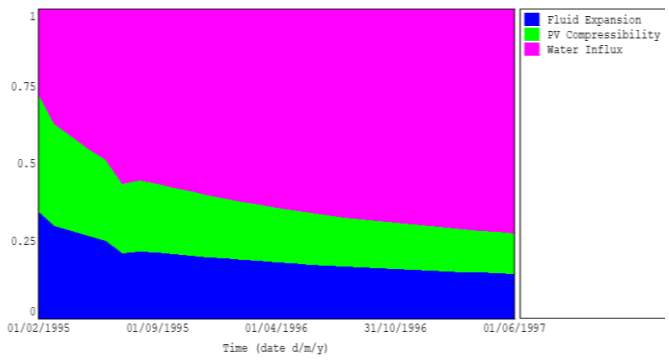

Fig. 38: LIBYA#006 Reservoir Driving Mechanism with Reservoir radios is 6000 feet

Figure 39 shows the reservoir pressure history and simulation vs time for diffusivity is 12 RP/Psi/day. The history Reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir diffusivity has been adjusted to 12 RP/Psi/day.

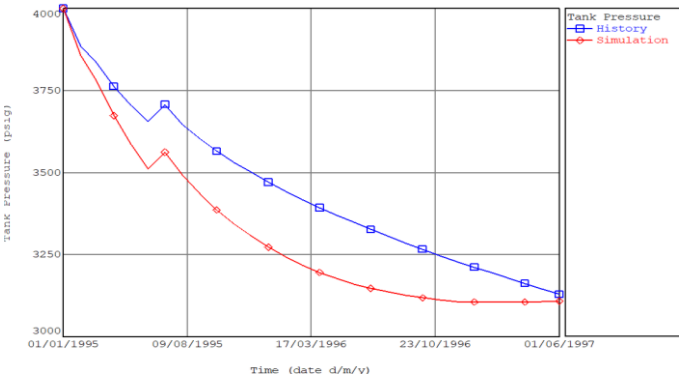

Fig. 39: LIBYA#006 Reservoir Pressure with Diffusivity is 12 Rb/psi/day

Figure 40 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/0/1995 to 01/06/1997, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.45, with the PV compressibility from 0.45 to 0.90, and with the water influx from 0.90 to 1 is water influx.

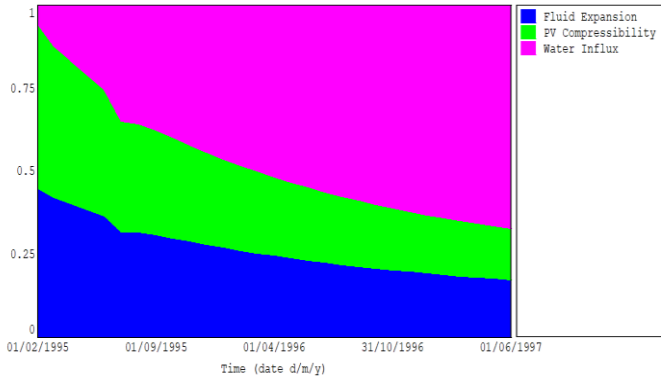

Fig. 40: LIBYA#006 Reservoir Driving Mechanism with Diffusivity is 12 Rb/psi/day

7. LIBYA#007 Reservoir:

Figure 41 shows the reservoir pressure history and simulation vs time for aquiver volume is 1300 mmft^3. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir aquiver volume has been adjusted to 1300 mmft^3.

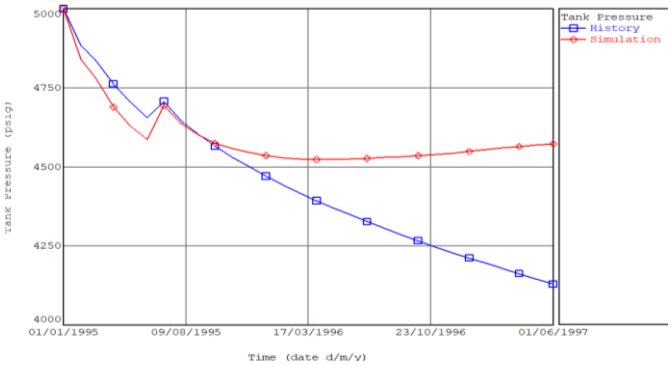

Fig. 41: LIBYA#007 Reservoir Pressure with Aquiver volume is 1300 mmft^3

Figure 42 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/02/1995 to 01/06/1997, this reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.27, with the PV compressibility from 0.27 to 0.65, and with the water influx from 0.65 to 1 is water influx.

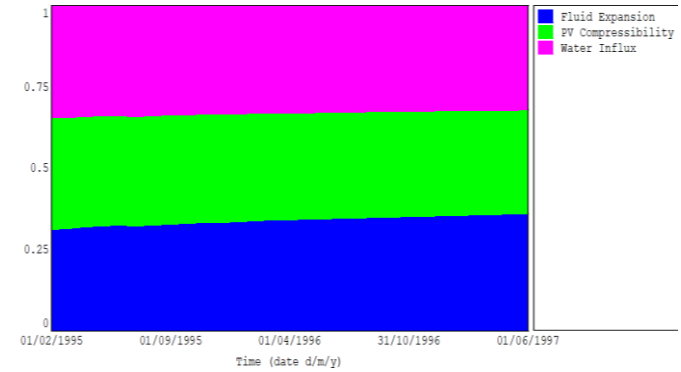

Fig. 42: LIBYA#007 Reservoir Driving Mechanism with Aquiver volume is 1300 mmft^3

Figure 43 shows the reservoir pressure history and simulation vs time for reservoir radios is 6500 ft. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir thickness has been adjusted to 6500 ft.

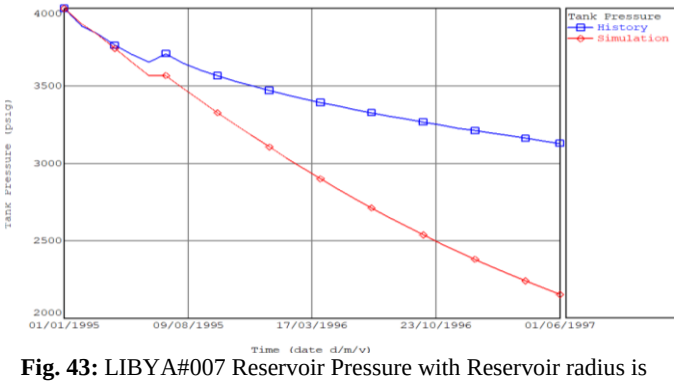

Fig. 43: LIBYA#007 Reservoir Pressure with Reservoir radius is 6500 feet

Figure 44 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/02/1995 to 01/06/1997, this reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.25, with the PV compressibility from 0.25 to 0.70, and with the water influx from 0.70 to 1 is water influx.

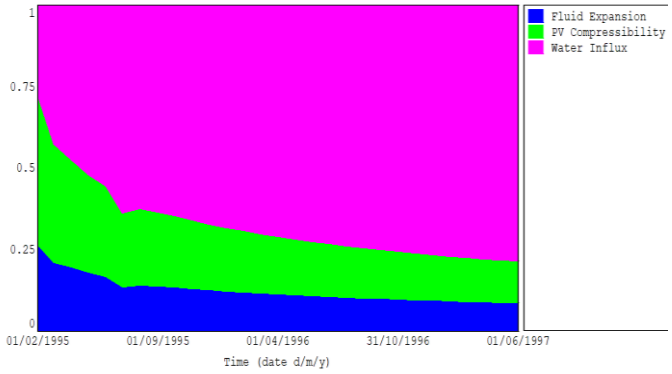

Fig. 44: LIBYA#007 Reservoir Driving Mechanism with Reservoir radius is 6500 feet

Figure 45 shows the reservoir pressure history and simulation vs time for diffusivity is 25 RP/Psi/day. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir diffusivity has been adjusted to 25 RP/Psi/day.

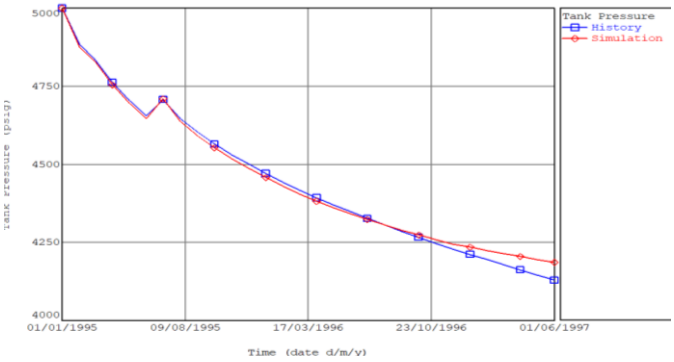

Fig. 45: LIBYA#007 Reservoir Pressure with Diffusivity is 25 RB/psi/day

Figure 46 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/02/1995 to 01/06/1997, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.26, with the PV compressibility from 0.26 to 0.85, and with the water influx from 0.85 to 1 is water influx.

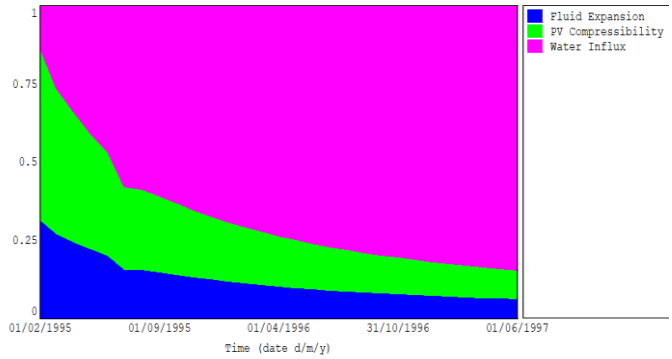

Fig. 46: LIBYA#007 Reservoir Driving Mechanism with Diffusivity is 25 RB/psi/day

8. LIBYA#008 Reservoir:

Figure 47 shows the reservoir pressure history and simulation vs time for aquiver volume is 35000 mmft^3. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir aquiver volume has been adjusted to 35000 mmft^3.

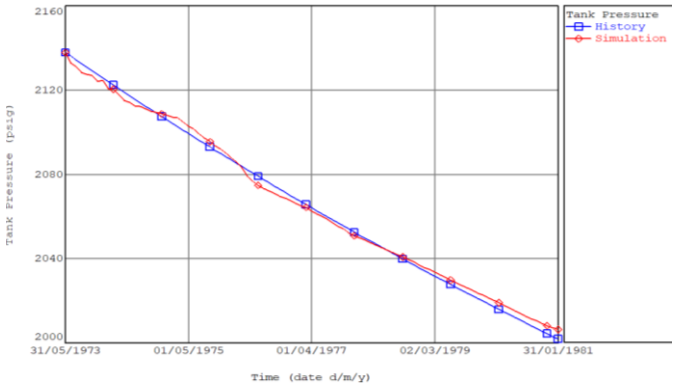

Figure 47: LIBYA#008 Reservoir Pressure with Aquiver volume is 35000 mmft^3

Figure 48 shows the relative contributions of the main source of energy in the Reservoir and aquifer system vs time. From 30/06/1973 to 31/01/1981, this Reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.05, with the PV compressibility from 0.05 to 0.15, and with the water influx from 0.15 to 1 is water influx.

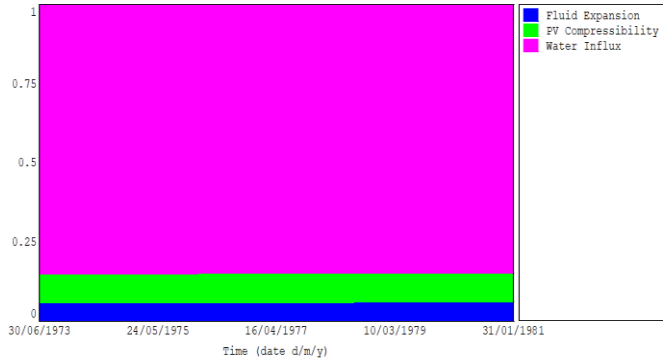

Figure 48: LIBYA#008 Reservoir Driving Mechanism with Aquiver volume is 35000 mmft^3

Figure 49 shows the reservoir pressure history and simulation vs time for reservoir radios is 5000 ft. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir thickness has been adjusted to 5000 ft.

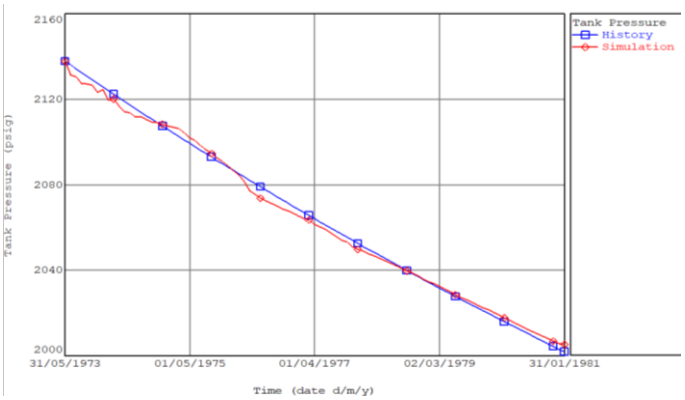

Fig. 49: LIBYA#008 Reservoir Pressure with Reservoir readies is 5000 ft

Figure 50 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/06/1998 to 01/06/2008, this reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.07, with the PV compressibility from 0.7 to 0.20, and with the water influx from 0.20 to 1 is water influx.

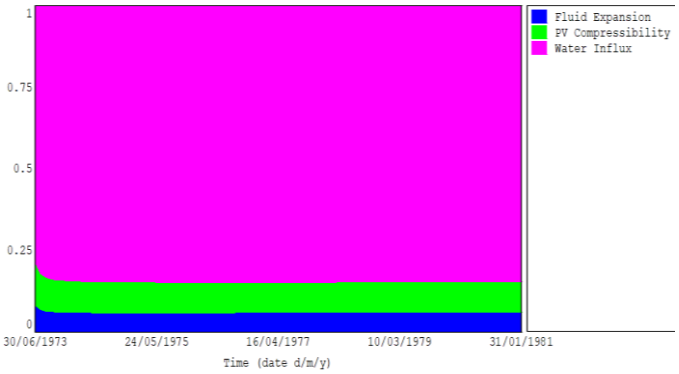

Fig. 50: LIBYA#008 Reservoir Driving Mechanism with Reservoir readies is 5000 ft

Figure 51 shows the reservoir pressure history and simulation vs time for diffusivity is 1 RP/Psi/day. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model. The reservoir pressure is matching when the reservoir diffusivity has been adjusted to 17.7 RP/Psi/day.

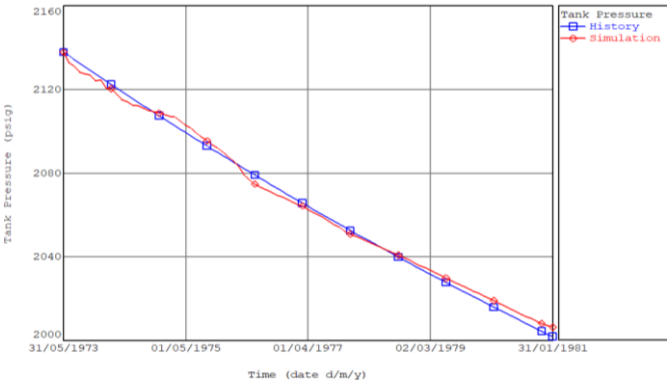

Fig. 51: LIBYA#008 Reservoir Pressure with Diffusivity is 17.7 RB/psi/day

Figure 52 shows the relative contributions of the main source of energy in the reservoir and aquifer system vs time. From 01/06/1998 to 01/06/2008, this reservoir has been producing under three driving mechanisms. It has been started with the fluid expansion from 0 to 0.40, with the PV compressibility from 0.40 to 0.95, and with the water influx from 0.95 to 1 is water influx.

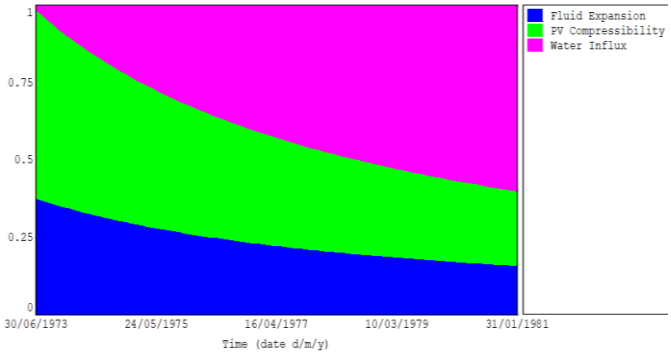

Fig. 52: LIBYA#008 Reservoir Driving Mechanism with Diffusivity is 17.7 RB/psi/day

In the Libya#001 reservoir the aquiver volume it is high with 37000 mmft^3, while is very small in the Libya#008 reservoir with 750 mmft^3. The diffusivity it's high in Libya#001 reservoir with 30 Rb/psi/day, while it's equal to 1 Rb/psi/day in (Libya#005 reservoir, Libya#004 reservoir, Libya#003 reservoir. In the Libya#001 reservoir thickness it's very high with 42000 ft.

Conclusion

A study to estimation the reservoir driving mechanisms for of Libyan oil fields. In this study, we concluded some conclusion as shown below:

1. This study depended on MBAL software to estimate the reservoir driving mechanisms to know the past and the future performance of the reservoir.
2. It helps us to understand reservoirs, and the mechanism of this reservoir work during the well life.
3. The history reservoir pressure curve is matching to the stimulation curve, this gives a good allusion of the input data that has been entered to the model.
4. The driving mechanism for all those reservoirs it comes from three natural forces. Fluid expansion, PV Compressibility, and Water influx.
5. Matching was achieved with high percentage in compared with measured pressure, and this is an important indicator that the modelling with MBAL is precise and simulates reality.
6. Aquifer volume model was selected and we got quite good match in the historical pressure data.

Recommendations

1. MBAL software is good and reliable software in estimating the reservoir driving mechanisms and predicting the performance of the reservoir in the future.
2. When using software it is preferable to choose more than one reservoir and also choose more than one reservoir in order to compare the characteristics of the reservoirs and the different companies.
3. Al least three models should be used to confirm the results and compare them with each other.
4. In the event that more than one reservoir is used, the results must be separated and stored from each other to compare each reservoir and determine the best reservoir.

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