International Science and Technology Journal
المجلة الدولية للعلوم والتقنية

Volume 38 العدد
Part 1 المجلد

http://www.doi.org/10.62341/istj-vol38-2-67

Received	2026/02/25	تم استلام الورقة العلمية في
Accepted	2026/03/11	تم قبول الورقة العلمية في
Published	2026/03/12	تم نشر الورقة العلمية في

Decline Curve Analysis for Augila and Zaggut Oil reservoirs

Adel R. Traki[1], Hayat K. Alhaj[2]

a.traki@uot.edu.ly[1] , hayatkhalifa@yahoo.com[2]

1,2- Department of Petroleum Engineering, University of Tripoli, Libya.

*Corresponding author email: a.traki@uot.edu.ly

ABSTRACT

Decline Curve Analysis (DCA) is a tool utilized for the estimation of oil reserves and the prediction of reservoir performance. This study focuses on introducing the fundamental concepts and applications of DCA in determining the remaining reserves and estimating ultimate recoveries. Furthermore, a comprehensive analysis of production history data using Excel spreadsheets is conducted.

Two reservoirs are chosen to represent strong Aquifer drive mechanisms.

Various techniques, such as OFM, MBAL, and the least Sum of Squares method are employed to estimate the decline rate in these reservoirs. Additionally, the recovery factor is determined using correlation equations, including Arps (which incorporates various reservoir parameters like porosity, permeability, viscosity, saturation, etc) and Craze & Buckly correlations (utilizing end-Points Saturation).

Both reservoirs exhibit an exponential decline, with an approximate decline rate of 3.47% per year for Augila and 2.47% per year for the Zaggut reservoir. The most accurate recovery factor correlation for Augila was found to be Isehunwa & Nwankwo, which indicates a 0.9% increase compared to the company's estimation. While the most accurate recovery factor correlation for Zaggut reservoir was Arps correlation, which indicates a 0.17% lower compared to the company's estimation.

http://www.doi.org/10.62341/istj-vol38-2-67

Keywords: Oil reserve, Decline Curve Analysis, Recovery factor.

تحليل منحنى الانحدار الاحصائي لمكمني النفط Auglia و Zaggut

عادل رجب التريكي[1]، حياة خليفة بلحاج[2]
1، 2– قسم هندسة النفط ، جامعة طرابلس ، ليبيا
a.traki@uot.edu.ly

الملخص

تحليل منحنى الانحدار الاحصائي (DCA) هو أداة تُستخدم لتقدير احتياطيات النفط والتنبؤ بأداء المكمن. تُركز هذه الدراسة على طرح المفاهيم والتطبيقات الأساسية لتحليل منحنى الانحدار وذلك لتحديد الاحتياطيات المتبقية وتقدير معدلات الاسترداد النهائية. علاوةً على ذلك، أُجراء تحليل شامل لبيانات تاريخ الإنتاج باستخدام جداول بيانات Excel.

تم اختيار مكمنين لهما ألية دفع مائي مكمني قوي، تم استخدام تقنيات مختلفة مثل OFM و MBAL وطريقة مجموع المربعات الاقل الاحصائية لتقدير معدل الانحدار في هذين المكمنين.

تم حساب معامل الاسترداد باستخدام المعادلات التقريبية، بما في ذلك معادلة Arps (التي تتضمن معايير مكمن مختلفة مثل المسامية والنفاذية واللزوجة والتشبع، إلخ)، ومعادلات Craze & Buckly (التي تستخدم تشبع النقاط النهائية).

حسابات كلا المكمنين اظهرت ان منحنى الانحدار الاحصائي كان على شكل دالة اسُية، بانحداراً تقريبياً يبلغ 3.47٪ سنويًا بالنسبة للمكمن المسمى Augila وانحداراً سنوياً يبلغ 2.47٪ بالنسبة لمكمن Zaggut.

وُجد أن أكثر المعادلات التقريبية دقة لحساب معامل الاسترداد لمكمن Auglia هي معادلات Isehunwa & Nwankwo والتي اظهرت زيادة بنسبة 0.9٪ مقارنة بتقدير الشركة، بينما وُجد أن أكثر المعادلات التقريبية دقة لحساب معامل الاسترداد لمكمن Zaggut هي معادلة Arps والتي اظهرت انخفاظاً بنسبة 0.17٪ مقارنة بحسابات الشركة.

http://www.doi.org/10.62341/istj-vol38-2-67

الكلمات المفتاحية: احتياط النفط، تحليل منحنى الانحدار الاحصائي، معامل الاسترداد النفطي

Introduction

Reserves are estimated volumes of crude oil, condensate, natural gas, natural gas liquid, and associated substances anticipated to be commercially recoverable and marketable from a given forward, under existing economic conditions, by established operating practices, and under current government regulations.

Reserve estimation in the petroleum industry relies on geological and engineering data, alongside consideration of prevailing economic conditions. These estimates are pivotal in decision-making processes, as they determine the feasibility of projects. However, uncertainties persist due to the varying reliability of data, leading to classifications of reserves as proved or unproved, with differing levels of certainty (Determination of oil and gas reserves, 1994).

Estimating oil reserves is one of the most important phases of the work of a petroleum engineer since the solutions to the problems he deals with usually depend on a comparison of the estimated cost in terms of dollars, with the anticipated result in terms of barrels of oil. His recommendations to management regarding the best course of action are therefore normally based on the most favorable balance between these two.

There are a lot of methods are used to determining oil reserves (Determination of oil and gas reserves, 1994). The one of the most popular methods is decline curve method. The decline curve is basic tool for predicting future production rates, estimating oil reserves, and estimating remaining productive life.

The most popular decline curve is that which represent the decline in the oil production rate with time (rate time plot), another common technique is the plot of production rates versus cumulative oil or cumulative gas production, normally termed (rate-cumulative plots).

Decline Curve Analysis (DCA) is a valuable tool employed for estimating oil reserves and predicting reservoir performance. This study aims to provide an introduction to the fundamental concepts

http://www.doi.org/10.62341/istj-vol38-2-67

and practical applications of DCA in determining remaining reserves and estimating ultimate recoveries.

Decline curve analysis (DCA) is a method that uses past production data to predict future hydrocarbon production. While various approaches can be employed to forecast crude oil production, it is important to consider the physical laws governing hydrocarbon extraction from reservoirs to provide realistic outlooks.

Decline curve analysis has long been used as a reliable tool for generating future production forecasts for individual wells or entire oilfields. Extrapolating production history is widely regarded as the most accurate and defensible approach for estimating remaining recoverable reserves from wells and reservoirs as a whole (Chen & Teufel, 2002).

By utilizing decline curve analysis, it becomes possible to describe future oil production at a field-by-field level more effectively. Reliable and reasonable forecasts are indispensable for planning purposes and essential for gaining insights into future global oil production trends (Hook, 2009).

Moreover, calculating the recovery factor using correlation equations is very important part of this study (Oseh, 2014).

Study Objectives

The primary aim of this study is to forecast the future behavior the Augila and Zaggut reservoirs. The specific objectives of the study, for both of reservoirs, are as follows:

a. Using decline curve analysis, we aim to:
   - a.1. Make predictions about oil production
   - a.2. Identify the decline curve type weather is exponential, Hyperbolic or Harmonic
   - a.3. To estimate Decline rate, oil reserves.
   - a.4. Estimated Ultimate Recovery (EUR) for the reservoirs.

b. Use the Recovery factor correlations to estimate the recovery factor and select the best correlation that can be applied to the reservoirs (Oseh, 2014).

Methodology

Two reservoirs are selected to represent robust Aquifer drive mechanisms, then go through the following steps:

http://www.doi.org/10.62341/istj-vol38-2-67

- Production history data were collected and to be used through two softwares OFM, MBAL, which including DCA facilities, these softwares are applied to get a full DCA for both of the reservoirs.
- Another type of data been collected and to be used in calculations of recovery factor through the correlation equations such as Arps (which incorporates essential reservoir parameters like porosity, permeability, viscosity, saturation, and compressibility) and Craze & Buckly correlations (which utilize end-Points Saturation).

Oil Field Manager (OFM) Software

The oilfield manager (OFM) software, which is a well and reservoir analysis software, offers advanced tools for production surveillance and forecasting. It enables oil field managers to effectively manage and enhance field performance throughout the entire life cycle of the field.

The software includes robust production forecasting tools that utilize decline curve analysis, type curve analysis, and other forecasting techniques. These tools help in predicting future production rates, estimating reserves, and supporting decision-making related to field development and production optimization. See figure (1).

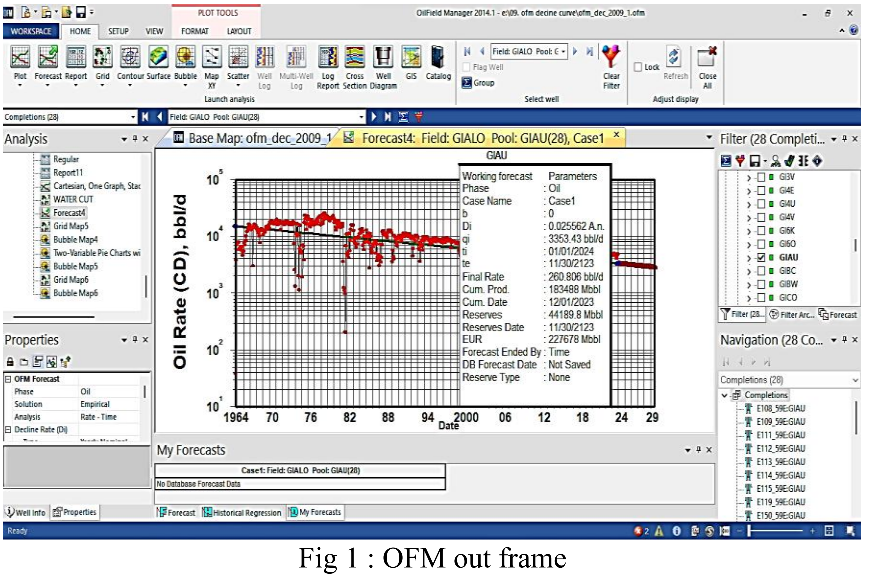

Fig 1 : OFM out frame

http://www.doi.org/10.62341/istj-vol38-2-67

MBAL Software

MBAL software typically incorporates various reservoir and fluid properties, production data, and historical performance data to perform many types of calculations, one of them is decline curve analysis, figures (2&3).

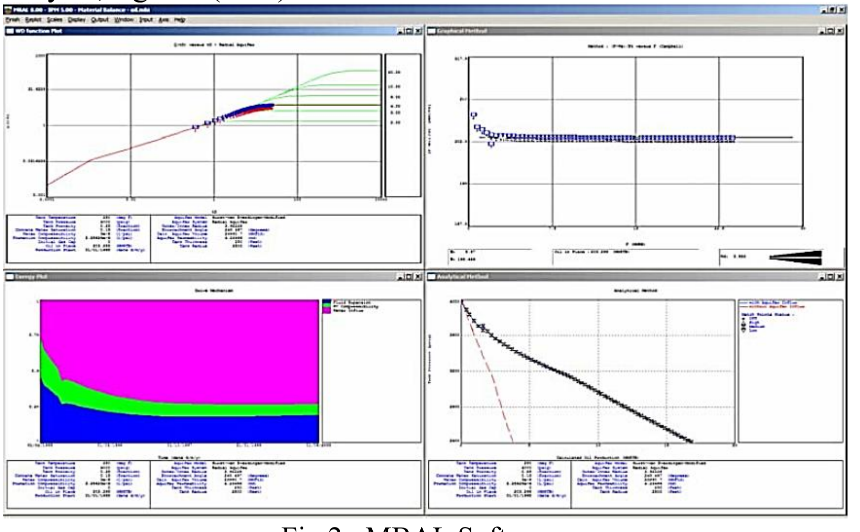

Fig 2 : MBAL Software.

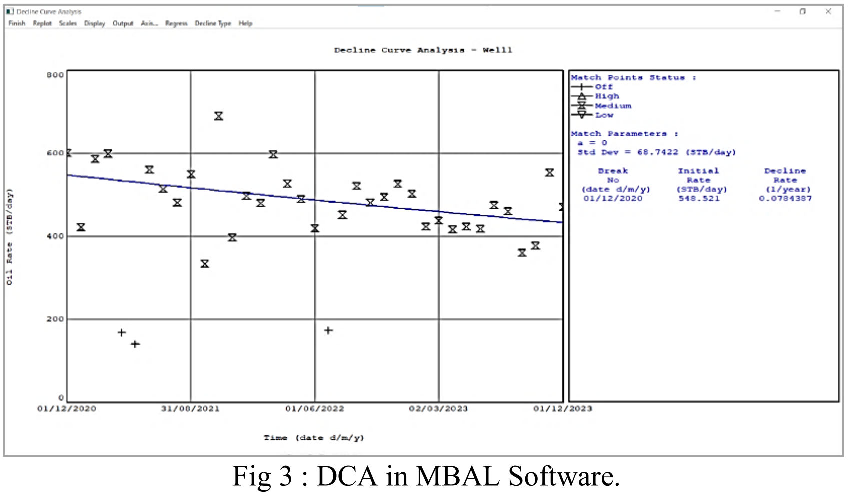

Fig 3 : DCA in MBAL Software.

Overall, MBAL software plays a crucial role in reservoir engineering by providing valuable insights into reservoir performance and aiding in the estimation and management of hydrocarbon reserves.

http://www.doi.org/10.62341/istj-vol38-2-67

Data Processing for reservoirs

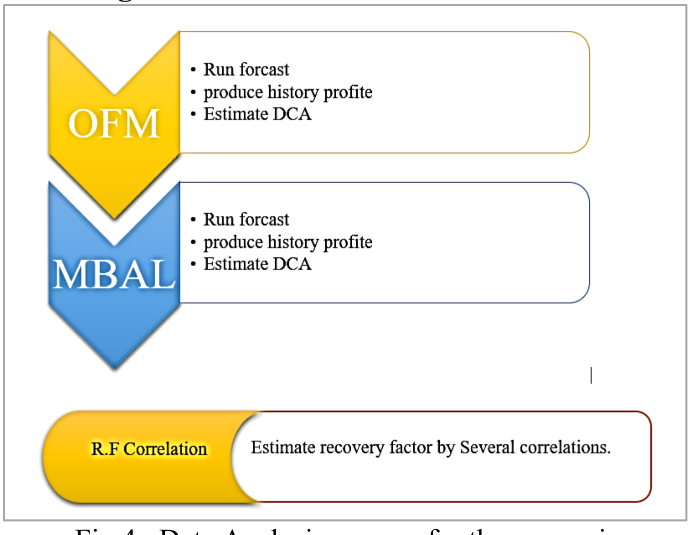

Fig 4 : Data Analysis process for the reservoir.

Results and Discussion

Decline curve analysis for Augila reservoir.

Using OFM Software (Augila reservoir).

After that, set up a decline curve analysis using OFM software, and the model estimated the decline curve and continued extend a forecast curve based in real data and based on the shape of decline curve best fit available as shown in figure (5).

As initial action was performed to understand the recovery factor estimation using decline curve by OFM software, there are some steps were done in advance which are use the final production rate as was provided by the company as of 2000 STBO/Day which is the economic limit with production operation for project revenue. There are some data was excluded in this case study which are clearly off-set values. Ultimate recovery was used as of 100 years. The forecast decline curve will start with the end of best fit decline curve regardless of the final production rate.

http://www.doi.org/10.62341/istj-vol38-2-67

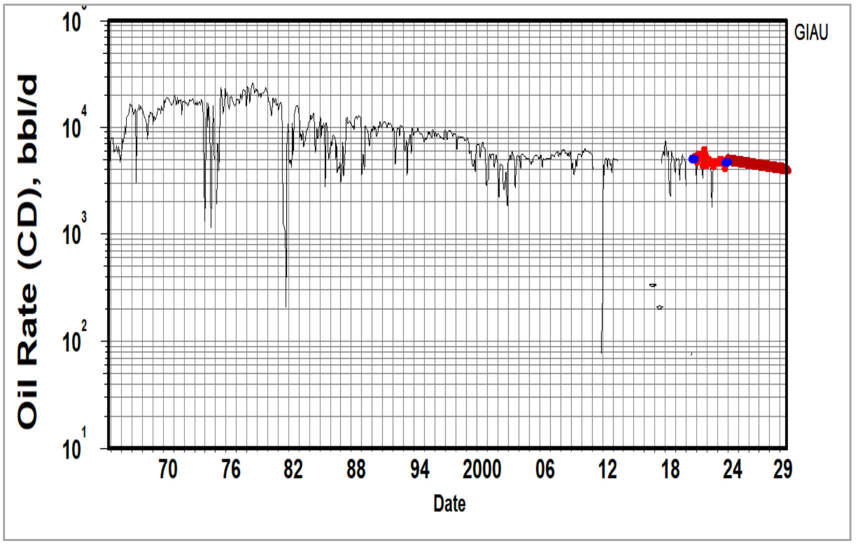

Fig 5 : Augila Reservoir decline curve and oil production forecast.

Table (1) shows that the exponential decline model is being used to forecast the production decline of the reservoir (b = 0). The exponential decline model assumes that the production rate decreases exponentially over time. The forecast was ended by rate which was sat up in the modeling case. After 25 years of production, the ultimate recovery will be 214.251 MMSTB with recovery factor of 54.43 %, table (2).

Table 1 : Augila DCA, OFM Results

Working forecast	Parameters
Phase	Oil
Case Name	Case1
b	0
Di	0.0351942 A.n.
qi	4964.17 STB/d
ti	01/01/2024
te	31/10/2049
Final Rate	1999.95 STB/d
Cum.Prod	183.488 MMSTB
Cum.Date	01/12/2023
Reserves	30.763 MMSTB
Reserves Date	31/10/2049
EUR	214.251 MMSTB
Forecast Ended By	Rate

http://www.doi.org/10.62341/istj-vol38-2-67

Table 2 : Augila production history and reserves, OFM Results.

OFM Results		
Original oil in place (OOIP)	394	MMSTB
The produced oil up to date was	183.488	MMSTB
The current Recovery	46.57%	Percentage
Ultimate Recovery factor	54.43%	Percentage
The Ultimate recoverable reserve	214.251	MMSTB
The Remaining Reserve	30.763	MMSTB
Decline Rate	0.0351942	1/year

Based on OFM results, the value of b was zero, which reflects the effect of exponential decline as a result of strong water aquifer.

Using MBAL software (Augila reservoir)

The same section was used to create model using MBAL software as follow in figure (6).

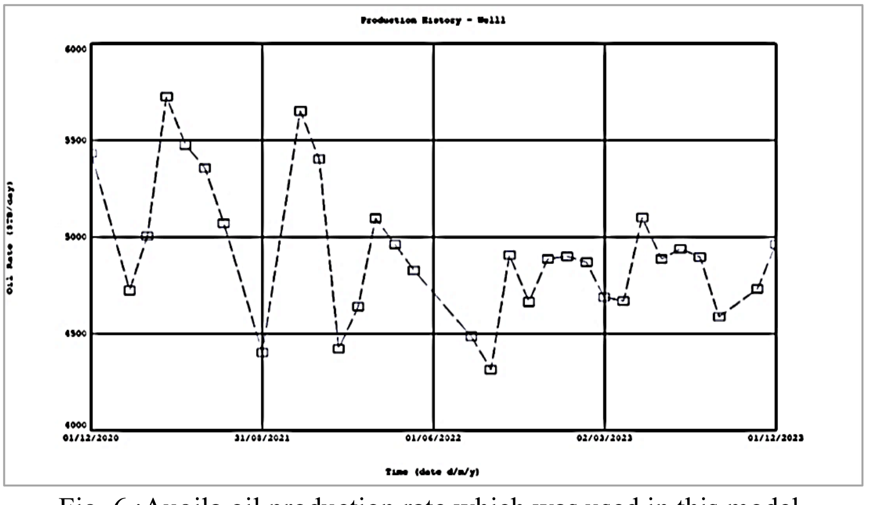

Fig 6 :Augila oil production rate which was used in this model.

The history production was selected to start from 2021 up to 2024. This period is sufficient to mitigate the decline rate as well as recovery factor.

Figure (7) shows the starting production rate for prediction as of 4964.2 STB/Day with annual decline rate about 3.4 %. Best fit was selected to be used with exponential equation with b = 0.

http://www.doi.org/10.62341/istj-vol38-2-67

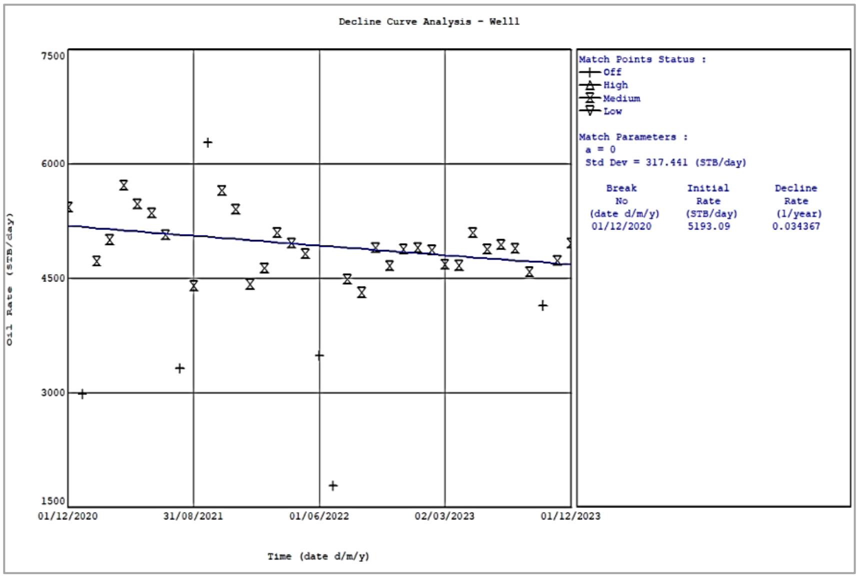

Fig 7 : Decline Curve usin1g exponential for the best fit.

Figure (8) shows that the reservoir remaining reserve of this reservoir is 27.2269 MMSTB.

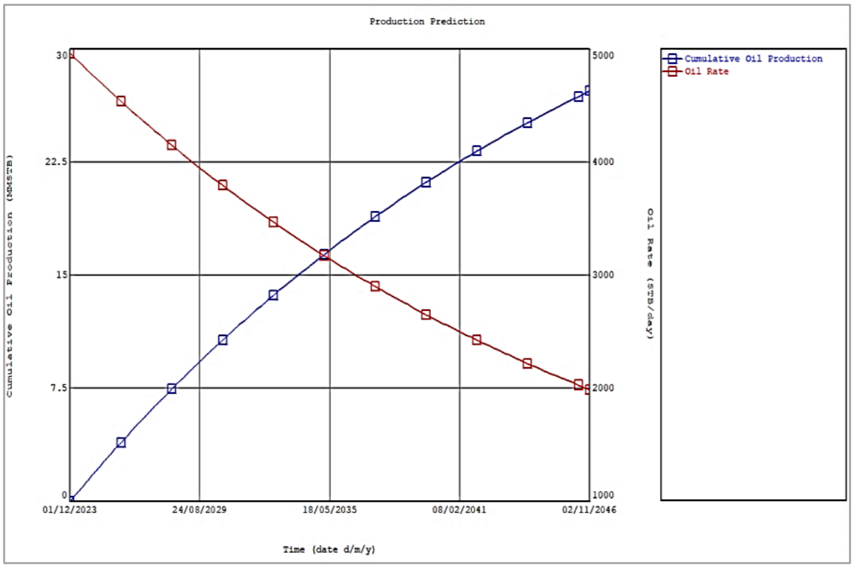

Fig 8 : Production Forecast and estimated remaining reserve.

As shown in the next table, this method shows that this reservoir is exponentially declining:

http://www.doi.org/10.62341/istj-vol38-2-67

Table 3 : Augila production history and reserves, MBAL Results.

MBAL Results		
Original oil in place (OOIP)	**394**	**MMSTB**
The produced oil up to date was	**183.488**	**MMSTB**
The current Recovery	**46.57%**	**Percentage**
Decline Rate	**0.034367**	**1/year**
Final Rate	**2000**	**STB/d**
Reserves Date te	**2/11/2046**	**/**
Ultimate Recovery factor	**53.48%**	**Percentage**
The Ultimate recoverable reserve	**210.715**	**MMSTB**
The Remaining Reserve	**27.2269**	**MMSTB**

Augila Reservoir calculation Summary

Based on the recovery factor estimation, there are some results that are very close to original one and the others are off-set or far away from that for different reasons. From OFM software, it was very close, and this method was used by the company. Also, the result from decline curve analysis using MBAL software shows similarity and got the same result.

Table (4) shows that the best correlation is Isehunwa & Nwankwo; Nevertheless, it uses only saturation parameter. Although using more reservoir parameters, Guthrie & Greenberger correlation was not working for this reservoir, because it does not include pressure effects, this equation is normally used for water drive aquifer with less porosity and less permeability reservoir.

Arps correlation was not working for this reservoir, because it is general correlation and it developed for both sandstone and carbonate reservoirs. Also, Zekri and Nasr correlation is not applicable for this reservoir, because it is developed for carbonate reservoir in Libya. Craze & Buckley correlation is not applicable because it is general correlation, and it requires a decline coefficient for more accurate results.

http://www.doi.org/10.62341/istj-vol38-2-67

Table 4 : Summary of Recovery Factor Correlations results

Correlations	Recovery Factor	Remaining Reserve (MMSTB)	The ultimate recoverable reserve (MMSTB)
Company	54.60%	31.636	215.124
Arps	46.53%	-	-
Guthrie & Greenberger	41.48%	-	-
Craze & Buckley	65.71%	75.41	258.9
Isehunwa & Nwankwo	55.51%	35.242	218.73

Table (5) presents data calculated by OFM / MBAL softwares, these data include: ultimate Recoverable Reserve (MMSTB) which refers to the total estimated amount of oil that can be recovered from a reservoir, the recovery factor which is the percentage of ultimate recoverable reserve to initial oil in place and the remaining reserve that represents the estimated quantity of oil still available in the reservoir for future recovery.

The ultimate recoverable reserves indicate the total estimated amount of oil that can be recovered. OFM has an ultimate recoverable reserve of 214.251 MMSTB, while MBAL has an ultimate recoverable reserve of 210.715 MMSTB, this implies that OFM has a slightly larger estimated total recoverable oil quantity compared to MBAL and was the closer to company calculation.

The remaining reserves represent the estimated quantity of oil that is still available for extraction. OFM has 30.768 million stock tank barrels (MMSTB) of remaining reserves, while MBAL has 27.227 MMSTB of remaining reserves, this suggests that OFM has a slightly higher quantity of oil yet to be extracted compared to MBAL and was the closer to company calculation.

Table 5 : Summary of Recovery Factor Results Using OFM and MBAL softwares

Parameters	Company	OFM	MBAL
Recovery Factor	54.60%	54.43%	53.48%
The ultimate recoverable reserve (MMSTB)	215.1	214.251	210.715
Remaining Reserve (MMSTB)	31.64	30.763	27.227

http://www.doi.org/10.62341/istj-vol38-2-67

Table (6) presents data calculated by OFM / MBAL softwares, these data include: the parameter "Di" which represents the decline rate per year, indicating the rate at which the oil production rate decreases over a year time, the parameter "qi" represents the initial oil production rate, indicating the rate at which oil is initially being produced

OFM has a decline rate of 3.51942% per year, while MBAL has a slightly lower decline rate of 3.4367% per year, this suggests that both softwares experience a gradual decline in their oil production rates, with OFM having a slightly higher rate of decline.

Both OFM and MBAL have the same initial oil production rate of 4964.17 stock tank barrels per day (STB/D), this indicates that both methods start their production with the same level of output.

Table 6 : comparison in results between OFM-software and MBAL-software

Parameters	OFM	MBAL
Di (1/year)	3.51942%	3.4367%
qi (STB/D)	4964.17	4964.17
Reserves Date te	31/10/2049	2/11/2046

Zaggut Reservoir

Decline curve analysis for Zaggut reservoir.

Using OFM software (Zaggut reservoir)

After that, set up a decline curve analysis using OFM software, and the model estimated the decline curve and continue extend a forecast curve based in real data and based on the shape of decline curve best fit available as shown in figure (9).

As initial action was performed to understand the recovery factor estimation using decline curve by OFM software, there are some steps were done in advance which are use the final production rate as was provided by the company as of 2000 STBO/Day which is the economic limit with production operation for project revenue. There are some data was excluded in this case study which are clearly off-set values. Ultimate recovery was used as of 100 years. The forecast decline curve will start with the end of best fit decline curve regardless of the final production rate.

http://www.doi.org/10.62341/istj-vol38-2-67

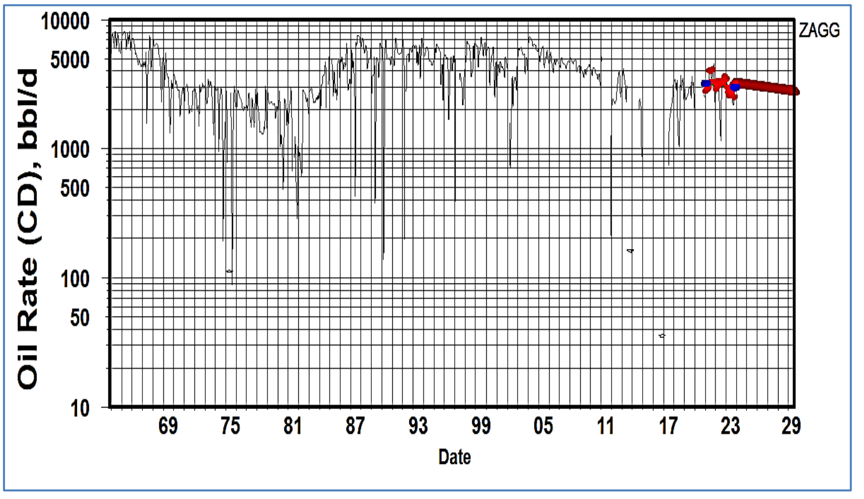

Fig 9 :Zaggut Reservoir decline curve and oil production forecast.

Table (7) shows that the exponential decline model is being used to forecast the production decline of the reservoir (b = 0). The exponential decline model assumes that the production rate decreases exponentially over time. The forecast was ended by rate which was sat up in the modeling case. After 57 years of production, the ultimate recovery will be 131.570 MMSTB with recovery factor of 31.7%, table (8).

Table 7 : Zaggut DCA, OFM Results

Working forecast	Parameters
Phase	Oil
Case Name	Case4
b	0
Di	0.0253628 A.n.
qi	3255.55 STB/d
ti	01/12/2023
te	28/02/2081
Final Rate	1999.97 STB/d
Cum.Prod	77.6879 MMSTB
Cum.Date	01/12/2023
Reserves	53.882 MMSTB
Reserves Date	28/02/2081
EUR	131.570 MMSTB
Forecast Ended By	Rate

http://www.doi.org/10.62341/istj-vol38-2-67

Table 8 : Zaggut production history and reserves, OFM Results.

OFM Results		
Original oil in place (OOIP)	**415**	**MMSTB**
The produced oil up to date was	**77.6879**	**MMSTB**
The current Recovery	**18.72%**	**Percentage**
Ultimate Recovery factor	**31.69%**	**Percentage**
The Ultimate recoverable reserve	**131.570**	**MMSTB**
The Remaining Reserve	**53.882**	**MMSTB**
Decline Rate	**0.0253628**	**1/year**

Based on OFM results, the value of b was zero, which reflect the effect of exponential decline because of strong water aquifer.

Using MBAL software (Zaggut reservoir)

The same section was used to create model using MBAL software as follow in figure (10).

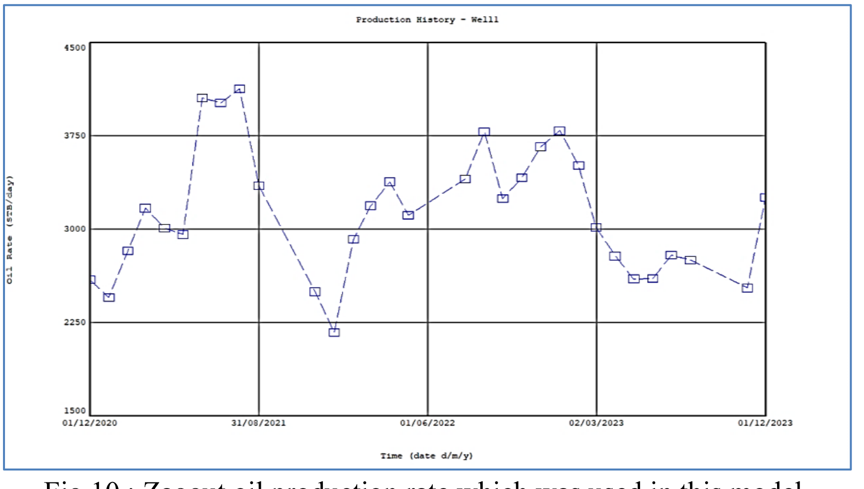

Fig 10 : Zaggut oil production rate which was used in this model.

The history production was selected to start from 2021 up to the 2024. This period is sufficient to mitigate the decline rate as well as recovery factor.

Figure (11) shows the starting production rate for prediction as of 3255.5 STB/Day with annual decline rate of about 2.4 %. Best fit was selected to be used with exponential equation with b = 0.

http://www.doi.org/10.62341/istj-vol38-2-67

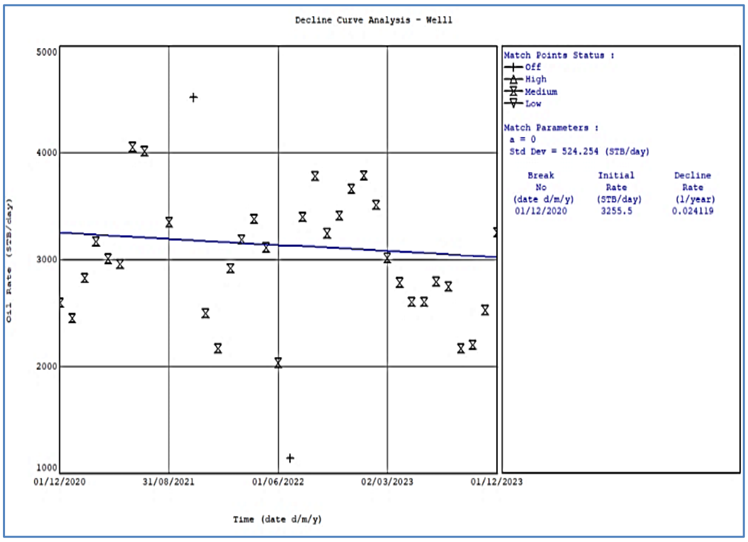

Fig 11 : Decline Curve using exponential for the best fit for Zaggut**.**

Figure (12) shows that the reservoir remaining reserve of this reservoir is 56.7141 MMSTB, which is similar to the OFM reserve.

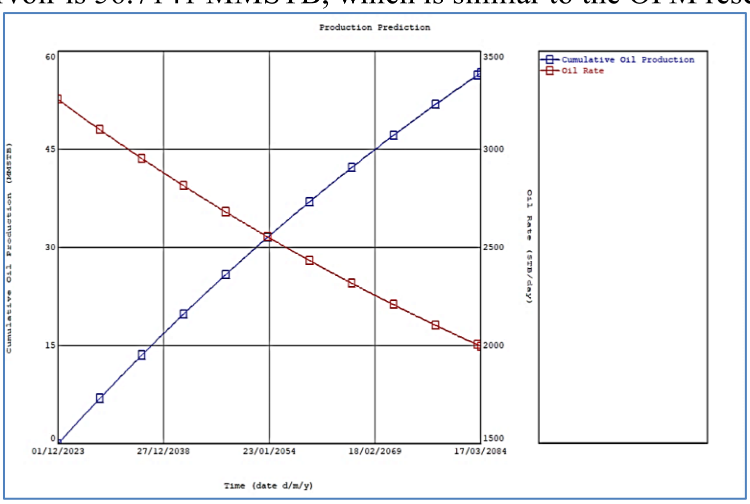

Fig 12 : Zaggut Production Forecast and estimated remaining reserve**.**

As shown in the next table. This method shows that this reservoir is exponentially declining.

http://www.doi.org/10.62341/istj-vol38-2-67

Table 9 : Zaggut production history and reserves. MBAL results.

MBAL Results		
0riginal oil in place (OOIP)	415	MMSTB
The produced oil up to date was	77.6879	MMSTB
The current Recovery	18.72%	Percentage
Decline Rate	0.024119	1/year
Final Rate	2000	STB/d
Reserves Date te	17/3/2084	/
Ultimate Recovery factor	32.38%	Percentage
The Ultimate recoverable reserve	134.402	MMSTB
The Remaining Reserve	56.7141	MMSTB

The incremental increase in recovery factor is very small and Zaggut reservoir reserve depending on MBAL software is about 56.7141 MMSTB.

Zaggut Reservoir calculation Summary

Based on the recovery factor estimation, there are some results are very close to original one and the others are off-set or far away from that for different reasons. From OFM software, it was very close, and this method was used by the company. Also, the result from decline curve analysis using MBAL software shows similarity and got the same result.

Table (10) shows that the Guthrie & Greenberger equation is not applicable for this reservoir. On the other hand, the Zekri & Nasr equation shows a recovery factor of 30% with remaining reserves of 47.02 MMSTB. The Craze & Buckly equation demonstrates a higher recovery factor of 65.71% with a remaining reserves of 195.07 MMSTB, ultimate recoverable reserve of 271.76 MMSTB. Also, the Isehunwa & Nwankwo equation shows a higher a recovery factor of 55.51% with a remaining reserves of 152.75 MMSTB, ultimate recoverable reserve of 230.44 MMSTB.

http://www.doi.org/10.62341/istj-vol38-2-67

Table 10 : Summary of Recovery Factor Correlations results

Correlations	Recovery Factor	Remaining Reserve (MMSTB)	The ultimate recoverable reserve (MMSTB)
Company	33.25%	61.06	137.75
Arps	33.08%	59.625	137.3215
Zekri & Nasr	30.04%	47.02	124.71
Craze & Buckly	65.71%	195.07	271.76
Isehunwa & Nwankwo	55.51%	152.75	230.44

Table (11) presents data calculated by OFM / MBAL softwares, these data include: ultimate Recoverable Reserve (MMSTB) which refers to the total estimated amount of oil that can be recovered from a reservoir, the recovery factor which is the percentage of ultimate recoverable reserve to initial oil in place and the remaining reserve that represents the estimated quantity of oil still available in the reservoir for future recovery.

From Table (11), the ultimate recoverable reserve for Zaggut field as follows: the Company calculations has an ultimate recoverable reserve of 137.75 (MMSTB), OFM has 131.570 MMSTB, and MBAL has 134.402 MMST which a slightly higher ultimate recoverable reserve calculated by OFM. This implies that MBAL has a slightly larger estimated total recoverable oil quantity from the Zaggut field compared to OFM.

From Table (11), the remaining reserve for Zaggut field as follows: the Company company calculations has 61.06 MMSTB of remaining reserve, OFM has 53.882 MMSTB, and MBAL has 56.7141 MMSTB.

From Table (11), the recovery factor represents for Zaggut field as follows: the Company has a recovery factor of 33.25%, while OFM and MBAL have recovery factors of 31.69% and 32.38%, respectively.

Table 11 : Summary of recovery factor results using OFM and MBAL software.

Parameters	Company	OFM	MBAL
Recovery Factor	33.25%	31.69%	32.38%
The ultimate recoverable reserve (MMSTB)	137.75	131.570	134.402
Remaining Reserve (MMSTB)	61.06	53.882	56.7141

The table (12) provides information about two entities, OFM and MBAL, and their associated parameters for the Zaggut field. The parameter "Di" represents the decline rate per year, indicating the rate at which the oil production rate decreases over a year time. For the Zaggut field, OFM has a decline rate of 2.5% per year, while MBAL has a slightly lower decline rate of 2.4% per year. This suggests that both entities experience a relatively moderate decline in the oil production rate of the Zaggut field.
From table (12), the parameter "qi" represents the initial oil production rate, indicating the rate at which oil is initially being produced. For the Zaggut field, both OFM and MBAL have the same initial oil production rate of 3255 stock tank barrels per day (STB/D). This indicates that both entities start the production of the Zaggut field with the same level of output.

Table 12 : comparison in results between OFM-software and MBAL-software

Parameters	OFM	MBAL
Di(1/year)	2.53628%	2.4119%
qi (STB/D)	3255.5	3255.5
Reserves Date te	28/02/2081	17/3/2084

.
In summary, the tables reveal that both OFM and MBAL experience a relatively moderate decline in the oil production rate of the Zaggut reservoir over time, with MBAL showing a slightly lower decline rate. The initial oil production rate is the same for both entities. MBAL has a slightly larger quantity of remaining reserves and a higher estimated amount of ultimate recoverable reserves compared to OFM for the Zaggut reservoir. These parameters provide insights into the production dynamics and potential recoverable reserves for the Zaggut reservoir in the context of the two entities.

Conclusion

a) There are two reservoirs were selected to perform this study, which are representing strong Aquifer drive mechanisms.
b) For the first reservoir “Augila”, we had the following:
- The decline rate was estimated using OFM, MBAL, and all of them shows the results similar to the value provided by the company.

http://www.doi.org/10.62341/istj-vol38-2-67

- Further investigation was performed using correlations to determine the recovery factor, such correlations are: Arps (which incorporates various reservoir parameters like porosity, permeability, viscosity, saturation, etc) and Craze & Buckly correlations that utilizing end-Points Saturation (initial and Residual Saturation).

c) For the second reservoir "Zaggut", we had the following:

- Both of OFM and MBAL results showed a slightly deviation in decline rate, this could be as a result of injection water effect.
- For this reservoir most of correlation equations show incorrect values of recovery factor apart from Arps and Zekri and Nasr correlations, which shows very close value.

d) The benefit from decline curve analysis is to figure out the future production, that's to optimize and develop the field before it reaches the abandonment point.

Recommendations

- It is recommended that the Arps Equation to be corrected to Libyan Sandstone Reservoirs. Zekri and Nesr provide a general correlation for both carbonate and sandstone. However, Correlation should be developed to mitigate sandstones formula and Carbonate equation.
- There are limitations for both software (OFM and MBAL) to determine the ultimate recovery. OFM has the maximum time forecast is 100 years only; While, MBAL has time up to 2099 only. This should be considered when using them.
- Daily Production rate which was used for this study was obtained from OFM. However, these values are calculated via OFM. The raw data is cumulative monthly production. Thereafter, a correction for oil production rate should be performed in such calculations.
- It is recommended to install sensors on the wells to record production parameters correctly to avoid and human errors.
- It is recommended that operation condition are not subjects to be changed for a certain period in order to be used for determining decline rate.

http://www.doi.org/10.62341/istj-vol38-2-67

- This study focus only on the future perdition of the field without considering the economic side, so it's recommended that (incase a new study made), economic can be taken into consideration.

References

American petroleum institute. (1966). Sampling petroleum reservoir fluids, API RP 44. Washington DC.

Carter, R. (1985). Type curves for finite radial and linear flow system. SPE J719-728 .

Chen, H., & Teufel, L. (2002). Estimating gas decline exponent before decline curve analysis. SPE 75693. Calgary, Alberta, Canada: SPE gas technology symposium.

Craze, R., & Buckley, S. (1945). A factual analysis of the effect of well spacing on oil recovery. In proceedings of the drilling and production practice. American petroleum institute, Washington DC, USA.

Determination of oil and gas reserves. (1994). Calgary, Canada: The petroleum society of the Canadian, Institute of mining metallurgy and petroleum, petroleum society monograph No. 1.

Hook, M. (2009). Depletion and decline curve analysis in crude oil production. Sweden: Uppsala University.

Isehunwa, S., & Nwanko, S. (1994). Correlation of oil recovery factors for water drive reservoir in the Niger Delta. Ibadan, Nigeria: University of Ibadan.

Joe, & Voelker. (2004). Determination of Arp's decline exponenr form gas reservoir properties. SPE annual technical conference and exhibition. 10.2118/90649-MS.

John, L. (1996). Well testing handbook. USA: the Society of petroleum engineering.

Nasr, M., & Zekri, A. (1992). Estimation of recovery factor of Libyan carbonate oil reservoirs. Tripoli, Libya: Petroleum research centre.

Oseh, J. (2014). Recovry factor model study in the Niger Delta oil reservoir for water drive mechanism. Ekiti state, Nigeria: Afe Babalola University.

S. O. company. (2014). Oil field manager manual. Houston.

Urayet, A. (1998). Oil property evaluation. University of Tripoli. Tripoli, Libya.

http://www.doi.org/10.62341/istj-vol38-2-67

Whiting, R., & Amyx, J. (1960). Petroleum reservoir engineering. McGraw-Hill, New York, USA. .

William, L. (1996). Standard handbook of petroleum and natural gas engineering (Vol. 2). Houston: Gulf Publishing Company, TX.