Development of a New Tool as a Qualitative Screening Criteria for EOR Methods

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الملخص

تمر عملية إنتاج النفط بثلاثة مراحل رئيسية. المرحلة الاولى حيث يبدا تدفق الانتاج بشكل طبيعي. ومع مرور الوقت ينخفض الانتاج مما يستوجب التدخل بما يعرف بالمرحلة الثانية والتي عن طريقها يتم حقن مائع مثلا عبر منظومات خاصة للحفاظ على الضغط ورفع الانتاج للمستويات السابقة. مع مرور الوقت واستمرار الانتاج يحصل انخفاظ اخر في الانتاج وتصبح الحاجة ملحة لتطبيق المرحلة الثالثة والتي تعرف بالاسترداد الاضافي للنفط (EOR). ونتيجة لوجود طرق عديدة للاسترداد الاضافي للنفط فان هذه المرحلة تتطلب تحليلات عميقة لتحديد مدى ملائمة اي من الطرق المختلفة للمكامن النفطية. وحيث ان نتائج تطبيق اي عملية من عمليات الاسترداد الاضافي لاتظهر الا بعد مرور فترة زمنية طويلة من التطبيق فان مرحلة الاختيار تعتبر من اصعب المهام لشركات النفط والغاز. احد اهم الطرق المستخدمة للاختيار تتركز على الابحاث والنتائج السابقة التي تم تطبيقها واعطت نتائج مقبولة من حيث كمية النفط المسترد تبعا لمعلومات النفط والمكمن. في هذا البحث تم تصميم اداة لمحاكاة طرق الاسترداد الاضافي للنفط تسمى EOR Azzaytuna Analysis. تم التصميم لهذه الطريقة باستخدام Visual Basic studio وتم الاستناد إلى ماتم نشره لمشاريع الاسترداد الاضافي للنفط الحديثة والتي اعطت نتائج جيدة. تم تجميع وتسجيل البيانات الخاصة لكل عملية ناجحة على قاعدة بيانات ومحاكاة الظروف المحيطة بهذه العملية على المكامن المراد اختبارها والتي تملك نفس الظروف واعتماد هذه الطريقة كامثل طريقة يمكن تطبيقها في هذه الحالة. تمت

تجميع بيانات بعض الحقول التي تستخدم تقنية الاسترداد الاضافي للنفط ومقارنة النتائج التي تم الحصول عليها من هذا البرنامج بالنتائج الموجودة على ارض الواقع لتاكيد مدى نجاح هذا الطريقة.

الكلمات المفتاحية: الاسترداد الاضافي للنفط، مكامن النفط، معايير اختيار طرق الاسترداد الاضافي، حقول النفط.

Abstract

Oil production from reservoirs undergo three stages. They are primary, secondary and tertiary stages. In the tertiary (EOR) stage, several methods and technologies are used to increase or uphold recovery from existing fields. These methods often involve the injection of fluid(s) and recently microbes into a reservoir. The variety in principle for EOR methods suggests the need for proper selection, design, and implementation technique. One of the most used method for quick screening is considering the successful previous experiences from the methods that have been applied in other fields. In this paper, an EOR screening tool, named "EOR Azzaytuna Analysis", has been designed using visual basic studio. The database of the tool is based on the updated screening criteria by Al Adasani and Bai which was published in 2010. The published data from some oil fields which have already applied the EOR methods, were acquired. The tool screened these fields and the obtained results were compared with the already given one to confirm the success of the development of "EOR Azzaytuna Analysis" as a screen tool.

1. Introduction

The production of oil and gas from hydrocarbon fields are divided into stages. In the initial stage, oil and gas production from the reservoir occurs due to natural mechanisms. In the next stage when the reservoir pressure is not enough for supporting the production from the formations, secondary recovery is applied to uphold the hydrocarbon production. Traditionally, these techniques are water flooding and gas injection. Water flooding is the main driving mechanism for maintaining reservoir pressure because of availability and low cost of injection fluid. However, oil recovery in this flooding process is not high enough (Radwan *et al*, 2021). In the tertiary recovery stage (EOR), it is possible to recover almost 30-60% of the field's original oil in place (OOIP) which is high compared to primary and secondary recovery methods where recovery factor approximately 20-40% (Hama, 2014).

Nowadays, almost large portion of oil produced in the world comes from matured oil fields that are in the second-half of their life cycles. This indicates that replacing these hydrocarbon resources with new explorations is difficult due to the costly and time consuming exploration. On the other hand, the increase in the global demand postulated that the oil is the dominating energy resource within the next two decades. Furthermore, the increase in conventional oil production rate taking into account that the recoverable reserves of primary and secondary recovery methods cannot produce more than 10%-40% of the initial oil in place resulting a large portion of remaining recoverable oil (Dickson et al., 2010; Kang et al., 2014; Takassi et al., 2017). Therefore, enhanced oil recovery (EOR) have emerged and proven their capability to establish a balance between supply and demand in the worldwide energy market (Madani et al.,2019). The goal of EOR is to mobilize the remaining oil after conventional recovery. No single process can be considered as the optimal for recovering remaining oil from every reservoir. Each process has its specific application. So screening must be done to determine which EOR method is the best and most efficient to be used on the selected well. Collecting data such as type of formation, permeability, viscosity, pressure, and fluid density must be taken into consideration for the criteria of the screening process. However, the screening criteria for selecting particular EOR process are complex because of the large number of petro-physical, chemical, geological, environmental and fluid properties (density & viscosity which are dependent on temperature) that must be considered for each individual case. For this reason different tools have been developed in order to make it easier for the selection of an EOR method.

Taber *et.al* (Taber *et.al,* 1997, pp. 189-198) developed EOR screening criteria. The criteria are based on the results of EOR field projects reported in oil and gas journal, and those reported at various SPE conferences. They mentioned that the depth, oil gravity and oil production from hundreds of projects are displayed in graph to show the wide distribution and relative importance of the methods. In the same year, Taber *et. al* (Taber *et.al,* 1997, pp. 199-206) mentioned that the CO_2 screening criteria were used for the estimation of the world's reservoirs oil capacity in order to deposit/dispose the CO_2.

Aladasani and Bai (Aladasani and Bai, 2010) published reviews for recent development in enhanced oil recovery (EOR) techniques which were published in SPE conference proceedings. The reviews updated the EOR criteria developed by Taber *et al.* and created an EOR database based on 652 reported EOR projects, which additionally specify the properties of the rock reservoir and fluids. They updated the published EOR screening criteria by Taber *et. al* and illustrated the relationship of the distribution of EOR projects to main reservoir properties. In addition, several researches in the literature provide clear procedures and strategies for screening criteria, dimensional analysis, and statistical approaches about studying various petroleum production and EOR operations (Dickson et al., 2010; Kang et al., 2014; Hashemi-Kiasari et al., 2014; Khojastehmehr et al., 2019; Zendehboudi et al., 2014; Taber et al., 1997; Mashayekhizadeh et al., 2014;

Gharbi, 2005; Adasani and Bai, 2011; Kamari and Mohammadi, 2014; Carolina. et al., 2020).

The first step in any EOR process is to study similar projects which were undertaken successfully in the past (Gharbi and Garrouch, 2001). In general, any screening process consists of three main parts; technical aspects, economic aspects and project location. The technical aspect is accomplished by comparing parameters of the desired reservoir with any reservoir that has undergone a successful EOR process. The reservoir parameters include rock and fluid properties or petro-physical properties. These parameters should be set enough weight on the EOR process. The economic aspect comes after technical screening where the EOR method is evaluated from an economical point of view by taking into account much of the recovery factor will be increased after execution of a desired EOR process and whether incremental production from EOR compensates the operational cost or not.

Different EOR methods have been used across the world including gas injection (either miscible or immiscible), thermal, chemical and microbial methods. All of these methods used to improve the reservoir fluid flow through the reservoir rock by increasing the temperature and reducing viscosity, reducing the interfacial tension (IFT) between injected fluid and reservoir fluid and eventually reducing capillary pressure, mass transfer or changing the reservoir oil properties (Fathinasab et al., 2015). It should be mentioned that the gas injection method can be performed as either miscible or immiscible including N_2, CO_2 and hydrocarbon gases or also WAG injection (Alshobaky and abdala, 2019). The displacement performance due to gas injection influences by many parameters such as viscosity and IFT reduction, oil swelling, injection and production rates, oil-gas density difference, viscosity ratios, oil-gas relative permeabilities, and wetting properties of reservoir rock (Rojas et al., 1991). In thermal methods, when the viscosity is reduced by increasing the temperature, heat is transferred to the reservoir by three ways; steam flooding, hot water injection and in-situ combustion (Zendehboudi et al., 2014). In chemical methods, certain chemicals such as polymer flooding, micellar flooding, surfactant, alkaline/caustic or gel are injected into the reservoir through the aqueous phase (Dickson et al., 2010). In the microbial method, micro-organisms are used to produce surfactants inside the reservoir and cause IFT reduction and wettability changes, which can be favorable for oil recovery (Yellig and Metcalfe, 1980).

In this paper, a new tool named "EOR Azzaytuna Analysis" based on updated screening criteria is developed for the screening purposes. This tool is programmed to have the capability to do selection of suitable EOR method based on the data provided.

2. Methodology

Several studies have been conducted regarding the analytical screening of EOR method. However, of the overall selection methods available, there is no single platform or application produces a comprehensive analysis. In the qualitative screening as an example, the EOR screening is based on expert knowledge and experience of EOR database, level of rock-fluid compatibility, and local displacement efficiencies for every EOR method. In the old days, the selection of the most technically applicable EOR method was achieved manually using SPE format. SPE has initiated technical EOR screening concepts using a specific format, which was based on field experience and project execution worldwide. In addition, this format was the beginning of all software regarding the EOR screening. The SPE format consists of five plots, the permeability plot, the viscosity plot, the depth plot, the plot of reservoir pressure vs. oil viscosity and the plot of reservoir depth vs. viscosity, and the oil gravity range for EOR methods. In these days, conventional screening is applied to rank and propose the more appropriate EOR methods. A list of EOR screening tools and their criteria are presented in Table 1. These tools consist of binary technical screening and analytical prediction. The binary screening is based on the comparison of the reservoir characteristics and its fluid properties with the screening criteria. The purpose of this screening is to determine the EOR method(s) that will be efficient and can be implemented in the given field. In the analytical screening, models are utilized to estimate and predict the production rate, cumulative oil production, and recovery factor of any EOR methods.

Table 1. EOR screening tools and their criteria (Moghaddam et al., 2022)

Software name	Reference	Company	Ability to evaluate the applicability of EOR method (number of methods)	Ability to forecast oil production (number of methods)	Used criteria
SWORD	Surguchev et al.	PETEC Software	11	11	Data base
EORgui	Trujillo et al.	Petroleum Solutions	9	6	Taber, Martin, Seright
SelectEOR (PRIze)	Alvarado et al.	Alberta Research Center	17	14	author’s Data base
Screening 2.0	Trujillo et al.	I.C.P. ECOPETROL	19	2	Lewin, Farouq, Taber, Seright
Expert System	Shindy et al.	Ciaro University	>10	-	Data base
Expert Analytical system	Ibatullin et al.	TatNIPIneft	>60	-	Data base

Expert System	Shokir et al.	King Saud University	+	-	Data base

2.1. Development of the tool

EOR Azzaytuna Analysis is designed and developed in order to make the selection of EOR methods easier and faster. The routine in this tool is based on the EOR screening criteria, which were updated by Aladasani and Bai [Aladasani and Bai, 2010]. By using this tool, the user can quickly screen an oil field in order to determine which EOR method(s) is/are more suitable to be applied. In this tool, eight EOR methods are screening using nine reservoir and oil properties. The investigated properties are API gravity, oil viscosity, hydrocarbon compositions, thickness, permeability, oil saturation, depth, temperature and type of the reservoir formation. A simple flow chart of the tool, EOR Azzaytuna Analysis, is described in Figure 1

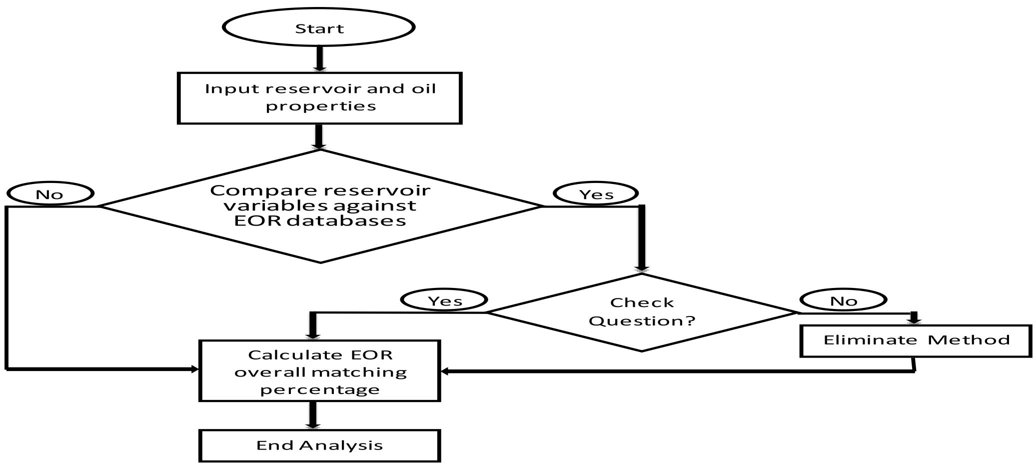


Figure 1. Flow chart of EOR Azzaytuna Analysis

The database guidance and conditions, named (System. Data. SQLite), are coded and entered for the eight enhanced oil recovery methods. The limited and conditions for every property is coded. The code for gravity as an example is shown in Figure 2.

The codes for the qualitative overall matching percentage for the selected EOR method is shown in Figure 3. The calculations using the following equation

$$P(x) = \frac{The\ passed\ number\ of\ \text{reservoir and oil properties}}{Overall\ tested\ number\ of\ \text{reservoir and oil properties}} * 100\%$$

Where P(x): Qualitative overall matching percentage for the selected EOR method

```
End Sub
0 references
Private Sub Button1_Click(sender As Object, e As EventArgs) Handles Button1.Click
    Try
    clear_All()
    DGV1.Rows(1).Cells(0).Style.BackColor = Color.Green
    If Val(txt_Gravity.Text) >= 35 And Val(txt_Gravity.Text) <= 54 Then
        DGV1.Rows(0).Cells(2).Style.BackColor = Color.Green
        A_Netrogen += 1
    Else
        DGV1.Rows(0).Cells(2).Style.BackColor = Color.Red
    End If
    If Val(txt_Gravity.Text) >= 23 And Val(txt_Gravity.Text) <= 57 Then
        DGV1.Rows(0).Cells(3).Style.BackColor = Color.Green
        A_HadroCarbon += 1
    Else
        DGV1.Rows(0).Cells(3).Style.BackColor = Color.Red
    End If
    If Val(txt_Gravity.Text) >= 22 And Val(txt_Gravity.Text) <= 45 Then
            DGV1.Rows(0).Cells(4).Style.BackColor = Color.Green
            A_Carbon_Dioxide += 1
    Else
        DGV1.Rows(0).Cells(4).Style.BackColor = Color.Red
        End If
        If Val(txt_Gravity.Text) >= 12 Then
            DGV1.Rows(0).Cells(5).Style.BackColor = Color.Green
            A_Immiscibie_Gases += 1
        Else
            DGV1.Rows(0).Cells(5).Style.BackColor = Color.Red
        End If
        If Val(txt_Gravity.Text) >= 20 And Val(txt_Gravity.Text) <= 44 Then
            DGV1.Rows(0).Cells(6).Style.BackColor = Color.Green
```

Figure 2: Coding for the database of gravity

```
            Else
                DGV1.Rows(6).Cells(9).Style.BackColor = Color.Red
            End If
            txt_Nitrogen.Text = Convert.ToInt64((A_Netrogen / 9) * 100)
            txt_Hydrocarbon.Text = Convert.ToInt64((A_HadroCarbon / 9) * 100)
            txt_Carbon_Dioxide.Text = Convert.ToInt64((A_Carbon_Dioxide / 9) * 100)
            txt_Immiscible.Text = Convert.ToInt64((A_Immiscibie_Gases / 9) * 100)
            txt_SP_ASP.Text = Convert.ToInt64((A_polymer_and_alkaline / 9) * 100)
            txt_polymer.Text = Convert.ToInt64((A_polymer_flooding / 9) * 100)
            txt_Combustion.Text = Convert.ToInt64((A_Combustion / 9) * 100)
            txt_Steam.Text = Convert.ToInt64((A_Steam / 9) * 100)
        Catch ex As Exception
            MessageBox.Show(ex.Message)
        End Try
    End Sub
    1 reference
    Private Sub clear_All()
        A_Netrogen = 0
        A_HadroCarbon = 0
        A_Carbon_Dioxide = 0
        A_polymer_and_alkaline = 0
        A_Immiscibie_Gases = 0
        A_polymer_flooding = 0
        A_Combustion = 0
        A_Steam = 0
        txt_Nitrogen.Text = ""
        txt_Hydrocarbon.Text = ""
        txt_Carbon_Dioxide.Text = ""
        txt_Immiscible.Text = ""
        txt_SP_ASP.Text = ""
        txt_polymer.Text = ""
        txt_Combustion.Text = ""
```

Figure 3: Coding to calculate the overall matching percentage for the selected EOR method

2.2. Steps to run the tool

2.2.1. Step 1: Collect the Data

Petro-physical data and local well information is a starting point for history matching. In general, the net reservoir data are important to assign the correct history matching for reserves. In addition to the collected data, eight of the reservoir and fluid properties must be provided. These properties are the Oil API Gravity, Oil Viscosity (cp), Oil Saturation (%PV), Formation Type, Net Thickness (ft), Average Permeability (md), Depth (ft) and Temperature (deg F). This include the name and location of the field that will be examined.

2.2.2. Step 2: Screen the EOR Methods

This step is based on binary criteria (Yes/No) by a lookup table. The table consisting of a row and a column, where the first row contains eight enhanced oil recovery methods and a first column that contains nine properties of a reservoir and fluids. During this step, the average properties of the reservoir are used to reduce the number of EOR methods. However, only binary criteria cannot be used to rank methods for a given reservoir.

The EOR screening is started by pressing (calculate) bottom. The result in each cell will be marked in different colors. If the value is within the limitation, it will given the green color and if it is out of limitation, it will given the red color. The neglected data is given the white color.

2.2.3. Step 3: Project Critical Parameters (Check question)

At this step, it is important to determine the critical reservoir uncertainties and the process technical variables. Some operational issues and local restrictions are not counted at this preliminary screening. For instance, a lack of injection gas may disqualify gas flooding, but it does not technically eliminate the process. Also, clay content, water chemistry and salinity can be critical parameters for most EOR methods. In the case of gas flooding, if the miscibility condition varies spatially in the reservoir, the recovery efficiency will not be equivalent in all sections of the reservoir.

3. Results and discussions

The tool has been running for the seek of testing using different data collections. For each field, the data are first checked for the quality, and for correlations into one another. At the same time, the missing data which is required to run the tool is completed.

3.1. Comparison studies

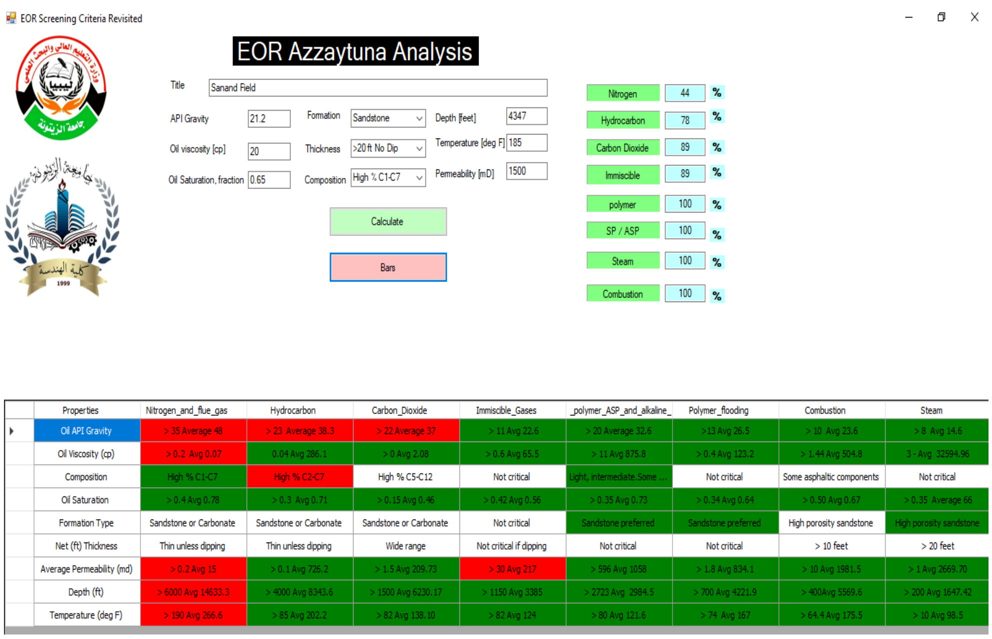
For this comparison, some published oil fields which have already applied EOR methods were chosen. The purpose of this step was to compare the results from the already applied EOR methods to the obtained results of using the new tool for the same field. In order to use the tool, it was necessary to have information regarding the reservoir and oil properties of each reservoir understudy.

3.1.1. The Sanand oil field (Vaswani et al, 2015)

This field is located in Cambay Basin in India. The reservoir and oil properties of the field are presented in Table 2. The production from the field began in 1969 but due to some problematic issues, it decided around 1979-1980 that a polymer flooding as EOR method would be suitable for this field. In 1995, a commercial application of polymer flooding was followed in the field. The data from the field was screened using the EOR Azzaytuna Analysis in order to compare the new results with the applicable method and check if there is a match with the new tool. The result of the screening using the tool is shown in Figure 4. The screening results showed matching with the already applied method to this field with a percentage of 100%. In addition, the tool suggested the possibility to apply of in-situ combustion, micellar/polymer/Alkaline surfactant polymer flooding or steam flooding as an EOR method. To judge the possibility of using the suggesting methods, a check question step has been added in this tool. The question considers some critical parameters such as the critical reservoir uncertainties and the process technical variables. Also, some operational issues and local restrictions such as clay content, water chemistry and salinity has to be counted. Unfortunately no much information is available regarding this reservoir at this stage.

Table 2: Reservoir and oil properties of the Sanand oil field

Reservoir and fluid properties	Value
API gravity	21.2
Oil viscosity (cP)	20
Temperature	185 ˚F
Permeability (md)	1500
Formation	Sandstone
Oil saturation (%)	65
Oil composition	C1-C7%
Reservoir thickness (ft)	23
Reservoir depth (ft)	4347



Properties	Nitrogen_and_flue_gas	Hydrocarbon	Carbon_Dioxide	Immiscible_Gases	_polymer_ASP_and_alkaline_	Polymer_flooding	Combustion	Steam
Oil API Gravity	> 35 Average 48	> 23 Average 38.3	> 22 Average 37	> 11 Avg 22.6	> 20 Average 32.6	>13 Avg 26.5	> 10 Avg 23.6	> 8 Avg 14.6
Oil Viscosity (cp)	> 0.2 Avg 0.07	0.04 Avg 286.1	> 0 Avg 2.08	> 0.6 Avg 65.5	> 11 Avg 875.8	> 0.4 Avg 123.2	> 1.44 Avg 504.8	3 - Avg 32594.96
Composition	High % C1-C7	High % C2-C7	High % C5-C12	Not critical	Light, intermediate.Some …	Not critical	Some asphaltic components	Not critical
Oil Saturation	> 0.4 Avg 0.78	> 0.3 Avg 0.71	> 0.15 Avg 0.46	> 0.42 Avg 0.56	> 0.35 Avg 0.73	> 0.34 Avg 0.64	> 0.50 Avg 0.67	> 0.35 Average 66
Formation Type	Sandstone or Carbonate	Sandstone or Carbonate	Sandstone or Carbonate	Not critical	Sandstone preferred	Sandstone preferred	High porosity sandstone	High porosity sandstone
Net (ft) Thickness	Thin unless dipping	Thin unless dipping	Wide range	Not critical if dipping	Not critical	Not critical	> 10 feet	> 20 feet
Average Permeability (md)	> 0.2 Avg 15	> 0.1 Avg 726.2	> 1.5 Avg 209.73	> 30 Avg 217	> 596 Avg 1058	> 1.8 Avg 834.1	> 10 Avg 1981.5	> 1 Avg 2669.70
Depth (ft)	> 6000 Avg 14633.3	> 4000 Avg 8343.6	> 1500 Avg 6230.17	> 1150 Avg 3385	> 2723 Avg 2984.5	> 700 Avg 4221.9	> 400Avg 5569.6	> 200 Avg 1647.42
Temperature (deg F)	> 190 Avg 266.6	> 85 Avg 202.2	> 82 Avg 138.10	> 82 Avg 124	> 80 Avg 121.6	> 74 Avg 167	> 64.4 Avg 175.5	> 10 Avg 98.5

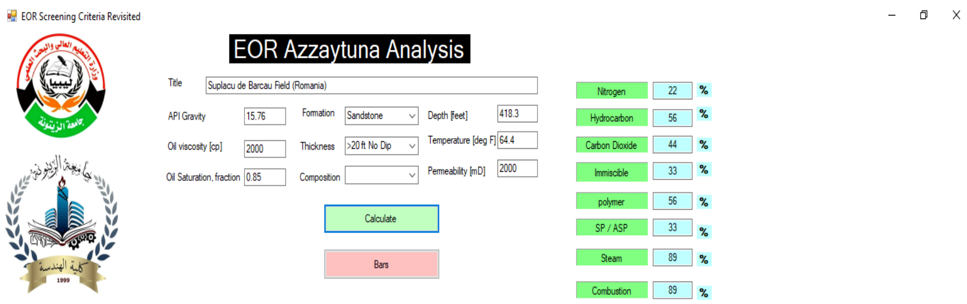
Figure 4: Screening by EOR Azzaytuna Analysis for the Sanand oil field

3.1.2. Suplacu de Barcau Field (Hincapie et al, 2011)

This field is located in the northwestern part of Romania. Its reservoir and oil properties are presented in the Table 3. The reservoir has oil with high density and viscosity. The studies propose the use of two methods, steam injection and in-situ composition, with commercial possibilities. The in-situ combustion was chosen to be applied. The field was screened using the EOR Azzaytuna Analysis in order to compare the new results with the applicable one. The result of the screening is shown in the Figure 5. The tool results showed that the already applied method to the field match with the results after screening by EOR Azzaytuna Analysis in a percentage of 89%. It can be confirmed that the application of both in-situ combustion and steam flooding as an EOR method is the most appropriate for this field. To judge the possibility of using the suggesting method, a check question step taking into account any critical parameters such as the critical reservoir uncertainties and the process technical variables has to be implemented. Also, some operational issues and local restrictions such as clay content, water chemistry and salinity has to be counted. Unfortunately no much information is available regarding this reservoir at this stage.

Table 3: Reservoir and oil properties of Suplacu de Barcau field

Reservoir and fluid properties	Value
API gravity	15.76
Oil viscosity (cP)	2000
Temperature	64.4 ˚F
Permeability (md)	2000
Formation	Sandstone
Oil saturation (%)	85
Oil composition	Asphalt
Reservoir thickness (ft)	45.91
Reservoir depth (ft)	418.3



Properties	Nitrogen_and_flue_gas	Hydrocarbon	Carbon_Dioxide	Immiscible_Gases	_polymer_ASP_and_alkaline_	Polymer_flooding	Combustion	Steam
Oil API Gravity	> 35 Average 48	> 23 Average 38.3	> 22 Average 37	> 11 Avg 22.6	> 20 Average 32.6	>13 Avg 26.5	> 10 Avg 23.6	> 8 Avg 14.6
Oil Viscosity (cp)	> 0.2 Avg 0.07	0.04 Avg 286.1	> 0 Avg 2.08	> 0.6 Avg 65.5	> 11 Avg 875.8	> 0.4 Avg 123.2	> 1.44 Avg 504.8	3 - Avg 32594.96
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Oil Saturation	> 0.4 Avg 0.78	> 0.3 Avg 0.71	> 0.15 Avg 0.46	> 0.42 Avg 0.56	> 0.35 Avg 0.73	> 0.34 Avg 0.64	> 0.50 Avg 0.67	> 0.35 Average 66
Formation Type	Sandstone or Carbonate	Sandstone or Carbonate	Sandstone or Carbonate	Not critical	Sandstone preferred	Sandstone preferred	High porosity sandstone	High porosity sandstone
Net (ft) Thickness	Thin unless dipping	Thin unless dipping	Wide range	Not critical if dipping	Not critical	Not critical	> 10 feet	> 20 feet
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Figure 5: Screening by EOR Azzaytuna Analysis for Suplacu de Barcau Field

4. Conclusion

A new tool for EOR screening has been developed using visual basic studio. The tool, named "EOR Azzaytuna Analysis", is mainly based on the technical part of the screening that determined which EOR method is the best to be implemented. However, economic feasibility is not included. The published data from successful EOR cases of some oil fields were acquired. A briefly description of using this tool for the chosen cases have been demonstrated. The study showed that results from the tool are in agreement with the already applied EOR methods. In addition, the tool was able to obtain the result without the necessity of sophisticated techniques and time consuming studies. However, some issues have been appeared during the use of this tool including the more suggested EOR methods that having the same matching percentages. A check question step taking into account any critical parameters such as the critical reservoir uncertainties and the process technical variables was proposed as a filter in this tool.

Recommendations

It is recommended to create a more sophisticated tool by integrating more options for calculating oil recovery. It is also recommended to use the latest published EOR screening criteria as well as the updated EOR current technology.

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