

# The Fast Potential Evaluation Method of Enhanced Oil Recovery Based on Statistical Analysis

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*Date Submitted:* 2019-12-16

*Keywords:* rapid analogy, grey correlation, screening method, potential evaluation, tertiary oil recovery

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*Record Type:* Published Article

*Submitted To:* LAPSE (Living Archive for Process Systems Engineering)

*Citation (overall record, always the latest version):*

LAPSE:2019.1600

*Citation (this specific file, latest version):*

LAPSE:2019.1600-1

*Citation (this specific file, this version):*

LAPSE:2019.1600-1v1

*DOI of Published Version:* <https://doi.org/10.3390/pr7110795>

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Article

# The Fast Potential Evaluation Method of Enhanced Oil Recovery Based on Statistical Analysis

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Received: 31 August 2019; Accepted: 16 October 2019; Published: 2 November 2019



**Abstract:** Based on a large number of empirical statistics of tertiary oil recovery technology in China, including polymer flooding, chemical flooding, gas flooding, in situ combustion, steam flooding, ect., 22 key reservoir parameters were filterized. Five levels of quantitative screening criteria were developed for different tertiary oil recovery methods. The mean algorithm for the downward approximation and the grey correlation theory were used in this paper to quickly select the appropriate tertiary oil recovery method for the target blocks, which provides a preferred development method for subsequent potential evaluation. In the rapid analogy evaluation method of tertiary oil recovery potential, the total similarity ratio between the target block and the example block is determined. The target block is matched with the appropriate instance block according to the total similarity ratio value, using 80% as the boundary. The ratio of the geological reserves is used to predict the oil recovery interval, the actual annual injection data, and the economic profit, thus quickly predicting the economic potential of the tertiary oil recovery technology in the target block. Currently, our research team has integrated these two methods into the tertiary oil production potential evaluation software EORSYS3.0. The empirical analysis shows that this method is reasonable and the conclusion is reliable. In addition, the actual enhanced recovery value is within the effective range predicted by the method. The method and results of this paper will provide an important decision-making reference for the application and sustainable development of China Petroleum's main tertiary oil recovery technology in the next 5–10 years.

**Keywords:** tertiary oil recovery; potential evaluation; screening method; rapid analogy; grey correlation

## 1. Introduction

All countries in the world actively carry out technical research and the application of enhanced oil recovery according to the characteristics of their own oil national reservoirs [1,2]. In particular, under the background of the continuous collapse of the international oil price since October 2014, the practical significance of enhancing oil recovery is more obvious [3]. In 2014, the *Journal of Oil and Gas* examined enhancing oil recovery projects worldwide, in which tertiary oil recovery contributed 663,000 BBL/d of crude oil to the United States. Thermal oil production and gas-flooding production accounted for a significant proportion of the tertiary oil production contribution [4].

In 1990, a study on enhancing the oil recovery of the potential evaluation and development strategy of waterflood oilfields in China revealed that polymer flooding is a technology with great potential, and it is feasible both technically and economically for enhanced oil recovery in China, who

have used it to solve a series of key problems and make breakthroughs. Limited to the conditions at that time, the initial potential evaluation still has many deficiencies. Since 1996, there has been chemical compound flooding [5,6], CO<sub>2</sub> miscible flooding [7], gas injection immiscible flooding, thermal recovery, etc. This was supplemented by the Petroleum Exploration and Development Institute, who compiled the corresponding economic potential evaluation software. The range of the second potential evaluation is wider, the software used is more suitable for the actual situation of our country, and the evaluation result is more reliable, which has more guiding significance for future work [8].

The following problems exist in the application and promotion of the second national potential evaluation software: (a) The model mechanism is oversimplified, which results in the limitation of the application scope of the model and affects the reliability of the operation results. (b) The increase of polymer flooding potential and chemical compound flooding is lower than that of numerical simulation, and the enhancing oil recovery of most blocks is less than 2–5%. (c) Heavy oil thermal recovery and steam flooding effect time lag, affecting the technical and economic evaluation results. (d) There are some bugs in the model program, through a series of means, which still cannot be solved. (e) The materialization parameters are too simple to be considered without considering the relationship between them, and so on. Since 1998, the third potential evaluation has been carried out in China. This evaluation is of great significance for the standardization of the third oil recovery and the formulation of medium - and long-term development strategies [9–15].

In this paper, a rapid evaluation method of tertiary oil recovery potential based on a statistical analysis is established by investigating the actuality of the tertiary oil recovery application, potential evaluation methods, and system technology of software at home and abroad, summarizing the experience of the field application and technical development trend. The fine quantitative screening method for tertiary oil recovery, and the rapid analogy evaluation method for the tertiary oil recovery potential are two important components of this method. The two parts are mutually inherited and progressively developed. At the same time, the integrated software of the potential evaluation and economic evaluation with a high integration degree, perfect function, and independent intellectual property rights are developed according to this method, which provides good technical support for the work of the tertiary oil recovery potential evaluation.

## 2. Fine Quantitative Screening Method for Tertiary Oil Recovery Technology

Combined with the present situation and trend of tertiary oil recovery technology and the classification standards formulated by various oil fields and industries, 22 specific reservoir parameters were selected as the key classification indicators, based on the main reservoir and fluid characteristic parameters of typical field tests. According to different oil production methods, the specific influence parameters suitable for different oil recovery technologies were selected from 22 parameters. Based on the statistical analysis of actual effects, the screening criteria were comprehensively determined by the Delphi method. We refer to this method as a fine quantitative screening standard. According to the fine quantitative screening criteria, the classification of the five types of reservoirs by the three types of oil recovery methods—polymer flooding, large PV gel profile-control flooding, alkali-polymer binary combination flooding, polymer-surfactant flooding, alkaline-surfactant-polymer (ASP) flooding, miscible gas flooding, immiscible gas flooding, and in situ combustion and steam flooding—and classification according to the key indicators from left to right and top to bottom, ensured the uniqueness of the classification of the reservoir types.

### 2.1. Fine Quantitative Screening Model Establishment

The fine quantitative screening method of the tertiary oil recovery technology is based on 22 specific reservoir conditions, and comprehensively scores the feasibility of each enhanced oil recovery technology.

$$S = \left( \frac{A_1 + A_2 + \cdots + A_n}{n} - A_{\min} \right) \times 0.25 + A_{\min} \quad (1)$$

where  $S$  is the method to screen the comprehensive scoring results;  $A_1, A_2, \dots, A_n$  is the single parameter according to the screening criteria;  $n$  is the number of influencing parameters in different tertiary oil recovery modes; and  $A_{\min}$  is the minimum value of the scoring results of the different influencing parameters.

The comprehensive scoring results of the different tertiary oil recovery methods obtained in this model are (0, 1) numerical intervals. When the comprehensive score ( $S$ ) approaches 0, the lower the degree of adaptation between the predicted block and the calculated tertiary oil recovery mode, and the more the predicted block is not suitable for mining with the tertiary oil recovery method. When the comprehensive score ( $S$ ) approaches 1, the higher the degree of adaptation between the predicted block and the calculated tertiary oil recovery mode, and the more the block can be mined by the tertiary oil recovery method. In this paper, the comprehensive scoring screening limit was set to 0.5, and the tertiary oil recovery method with the predicted block comprehensive scoring below 0.5 was not considered. The tertiary oil recovery method above 0.5 could enter the pre-selection scheme, and be analyzed and screened by the late potential evaluation.

## 2.2. Fine Quantitative Screening Standard Setting

In the tertiary oil recovery process, when different quantitative methods are used to evaluate the different oil displacement methods, different influencing factors need to be considered for the different tertiary oil recovery methods. For example, polymer flooding does not need to consider the evaluation block gas source and single storage coefficient. Therefore, it is necessary to formulate corresponding fine quantitative screening standards for different tertiary oil recovery technologies, and to classify the screening criteria so as to facilitate the comprehensive scoring of the feasibility of tertiary oil recovery. After extensive research and expert argumentation, a total of 22 screening parameters were selected, as summarized in Table 1.

**Table 1.** Summary of the screening parameters.

Serial Number	Parameter Name	Unit	Ranges	Parameter Category
1	Reservoir type			Geological parameter
2	Rock feature			Geological parameter
3	Reservoir depth	m	0–10,000	Geological parameter
4	Reservoir pressure	MPa		Geological parameter
5	Reservoir temperature	°C	0–200	Geological parameter
6	Average single layer effective thickness	m	0–250	Geological parameter
7	Net to gross ratio	f	0–1	Geological parameter
8	Porosity	%	0–100	Geological parameter
9	Air permeability	$10^{-3} \mu\text{m}^2$	0–30,000	Geological parameter
10	Oil saturation	%	0–100	Geological parameter
11	Permeability coefficient of variation	f	0–1	Geological parameter
12	Bottom water influence			Geological parameter
13	Side water impact			Geological parameter
14	Crack/cave			Geological parameter
15	Upper and lower compartments and tube closure			Geological parameter
16	Gas source			Geological parameter
17	Single storage coefficient	$10^4 \text{ t}/(\text{km}^2 \cdot \text{m})$	0–150	Geological parameter
18	Formation crude oil viscosity	mPa·s	0–100,000	Fluid parameter
19	Crude oil density	$\text{g}/\text{cm}^3$	0.5–1	Fluid parameter
20	Acid value of crude oil	mgKOH/g	0–40	Fluid parameter
21	Formation water salinity	mg/L	500–300,000	Fluid parameter
22	Divalent ion content	mg/L	0–5000	Fluid parameter

Fine quantitative screening criteria can reduce investment risk, but it may also make the screening potential low and the screening criteria that are used are too broad. As the evaluation of the tertiary oil recovery potential mainly depends on the model prediction calculation, the fine quantitative screening criteria are only intended to eliminate some obviously unsuitable enhanced oil recovery methods, and to reduce an unnecessary workload. At the same time, because of the different specific screening criteria under different tertiary oil recovery modes, the important influence parameters considered are

also different. Therefore, for the sake of insurance, a broader selection of screening criteria should be chosen in order to avoid missing potential enhanced oil recovery methods.

### 2.3. Fine Quantitative Screening Method Flow

Firstly, according to the different tertiary oil recovery methods, the corresponding fine quantitative screening criteria are determined, and the key influence parameters are discriminated. The screening criteria for the different impact parameters of the evaluation block are different. The scores of the parameters are divided into 0, 0.25, 0.5, 0.75, and 1 for a total of five gears. Thereafter, the lowest score of the parameter is determined according to the single parameter scoring result, and the comprehensive scoring result under the different tertiary oil displacement mode of the evaluation block is calculated according to the value using the downward approximation average algorithm. Finally, according to the screening limit, the oil displacement method with a comprehensive score greater than 0.5 can be used as an alternative for tertiary oil recovery in this block. Excluding the severely non-conforming oil displacement method, a preliminary and rapid basic analysis of the block will be carried out in order to facilitate the detailed technical potential assessment in the later stage of the evaluation block.

## 3. Rapid Analogy Evaluation Method for Tertiary Oil Recovery Potential

The rapid analogy evaluation method of the tertiary oil recovery potential is based on the technical and economic effect database of the three mining oilfield test blocks in China, which provides a convenient method for quickly evaluating the corresponding tertiary oil recovery technology and economic potential evaluation of a certain block. This method mainly uses the fuzzy gray correlation method in big data statistical analysis. According to the basic parameters of 22 reservoirs recorded by the user in the analog block, the comprehensive analysis analogy represents the block and instance block parameters, and the similarity between the analog representative block and each corresponding instance block is obtained. The user can optimize and determine the instance block that best matches the analog representation block, according to the similarity. By using the ratio of geological reserves to predict the production and injection data of the target block in each year, the tertiary oil recovery technology and economic potential evaluation results of the target block are obtained.

### 3.1. Rapid Analogy Evaluation Model

The rapid analogy evaluation model of the tertiary oil recovery potential is mainly used to calculate the similarity between the evaluation block and the example block by the fuzzy grey correlation method, by judging the similarity or dissimilarity of the changes between the parameters, so that the screening evaluation block is suitable for the tertiary oil recovery method. The fuzzy grey correlation method provides a quantitative measure of the parameter change situation, which is very suitable for the dynamic process analysis. In the process of the parameter analogy, if the trend of the two block parameters changes, that is, the degree of synchronization changes is high, the instance block is highly correlated with the evaluation block [16]. The theoretical model is shown in the following formula.

Let the starting point zeros of the behavior sequence be as follows:

$$\begin{aligned} X_i^0 &= (x_i(1) - x_i(1), x_i(2) - x_i(1), \dots, x_i(n) - (1)) \\ &= (x_i^0(1), x_i^0(2), \dots, x_i^0(n)), (i = 0, 1, 2, \dots, n) \end{aligned} \quad (2)$$

Make:

$$\begin{cases} |S_0| = \left| \sum_{k=2}^{n-1} x_0^0(k) + \frac{1}{2}x_0^0(n) \right| \\ |S_i| = \left| \sum_{k=2}^{n-1} x_i^0(k) + \frac{1}{2}x_i^0(n) \right| \\ |S_i - S_0| = \left| \sum_{k=2}^{n-1} (x_i^0(k) - x_0^0(k)) + \frac{1}{2}(x_i^0(n) - x_0^0(n)) \right| \end{cases} \quad (3)$$

Then, the gray absolute relevance (similarity) as follows:

$$\varepsilon_{0i} = \frac{1 + |S_0| + |S_i|}{1 + |S_0| + |S_i| + |S_i - S_0|} \quad i = 1, 2, \dots, m \quad (4)$$

where  $x_i$  is the starting point zero image, and  $S_0$  is the behavior sequence.

The similarity result obtained by Equations (2)–(4) was a value in the interval of (0, 1). When the similarity is closer to 0, at this time, the difference between the two blocks is larger, which is not suitable for the corresponding instance block of the evaluation block. When the similarity is closer to 1, the smaller the difference between the two blocks, the more the block can be selected as the similar block of the evaluation block. When the similarity is equal to 1, the two block base values are identical, and can be processed as the same block. In this paper, the similarity limit is set to 0.8, and the instance block with a similarity lower than 0.8 is not considered. An instance block higher than 0.8 selects the instance block with the highest similarity as the analog block.

### 3.2. Rapid Analogy Potential Evaluation Process

Firstly, on the basis of summarizing the block data of the three completed oil production mine tests, a database of mine instances with different tertiary oil recovery technologies in China was formed. Then, the representative reservoir basic parameters of the evaluation block number 22 were determined (geological parameters: reservoir type, rock characteristics, reservoir depth, original reservoir pressure, original reservoir temperature, average single layer effective thickness, net to gross ratio, porosity, air permeability, oil saturation, permeability coefficient of variation, bottom water influence, edge water influence, crack/dissolution hole, upper and lower compartments and pipe seal closure, gas source, and single storage coefficient; fluid parameters: formation crude oil viscosity, crude oil density, crude oil acid value, formation water salinity, and divalent ion content). Thereafter, the basic parameter data of the analog block was analyzed by gray correlation with the instance database, and normalized to obtain the similarity between the analog block and the instance block, and the best matching instance block was determined. Finally, by using the proportional analogy of the geological reserves, the annual injection and production data can be obtained, and the tertiary oil recovery potential of the target block can be quickly evaluated.

#### 3.2.1. Recovery Prediction

After obtaining the similarity between the evaluation block and each instance block by the rapid potential evaluation analysis, the recovery range of the evaluation block can be determined according to the similarity relationship and the original recovery factor of the example block. The specific calculation is as follows:

$$S \times O_{recovery} \leq E_{recovery} \leq (2 - S) \times O_{recovery} \quad (5)$$

where  $S$  is the similarity,  $O_{recovery}$  is the original recovery, and  $E_{recovery}$  is the evaluation block recovery.

Equations (4) and (5) can obtain a range of recovery factors for the evaluation block, which has a great relationship with the similarity obtained by Equation (4). The smaller the similarity between the evaluation block and the example block, the larger the recovery prediction range and the less accurate the prediction result. The greater the similarity between the evaluation block and the instance block, the smaller the prediction range of the recovery factor, and the more accurate the prediction result. When the similarity is 1, the predicted recovery factor is equal to the original recovery factor of the example block.

#### 3.2.2. Potential Prediction

After determining the optimal instance block corresponding to the evaluation block, the production data of the instance block may be enlarged or reduced according to the ratio of the utilization geological

reserves between the evaluation block and the instance block, so as to adapt to the actual situation of the evaluation block.

The specific formula is as follows:

$$\frac{D_{evaluation}}{D_{example}} = \frac{R_{evaluation}}{R_{example}} \quad (6)$$

where  $D_{evaluation}$  is the evaluation block production data,  $D_{example}$  is the example block production data,  $R_{evaluation}$  is the evaluation block using geological reserves, and  $R_{example}$  is the example block using geological reserves.

The production data includes injection parameters such as the water injection amount, injection amount, and production parameters such as oil production, gas production, and water production. The evaluation block can determine the specific tertiary oil recovery mode and production plan of the block according to the data, so as to achieve the optimal effect.

#### 4. Software Development and Case Analysis

##### *Software Development*

In order to expand the ease of use and operability of the rapid evaluation method for the tertiary oil recovery potential, the research team developed the three-time oil potential evaluation software, named EORSYS3.0. This software is an upgraded version of the tertiary oil recovery potential evaluation software EORSYS2.0. It has the main features of a friendly interface, flexible use, perfect function, fast batch operation, and so on. After the upgrade, the software process was rationally optimized, the software algorithm was improved and innovated, and the tertiary oil potential evaluation and economic evaluation software with independent intellectual property rights was formed. It can provide technical support and software tools for the comprehensive development of China's third potential evaluation work.

The goal of software development is to integrate an integrated potential evaluation system platform with method support from the underlying database, from method screening to statistical analysis, including the following three aspects:

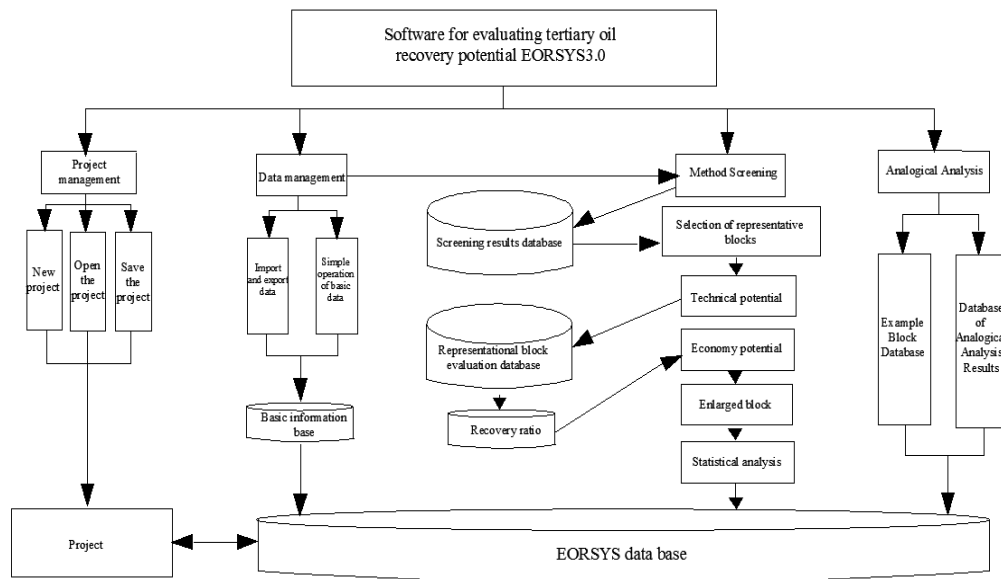
(1) Integration of the use of research materials. An integrated analysis function that integrates and utilizes different tertiary oil recovery method evaluation data.

(2) Meets the integration needs of different users. At the same time, it can meet the potential evaluation and economic evaluation integration of different tertiary oil recovery methods, such as the preliminary screening of oil displacement, polymer flooding, chemical flooding, gas flooding, and fired oil layer and steam flooding.

(3) Evaluate the integration of the research content. The integrated technical process is used to provide users with a technical means of method screening, potential evaluation, economic evaluation, and statistical analysis.

Aiming at the research and development goal, the "three-time oil potential evaluation software EORSYS3.0" has realized eight functions of data management, method screening, representative block, technical potential, economic potential, enlarged block, statistical analysis, and analogy analysis. Figure 1 depicts the flow chart of the software.

In order to verify the rationality of the method and the accuracy of the prediction results, the tertiary oil recovery potential evaluation software EORSYS3.0 was used to verify the fine quantitative screening method, and the rapid analog evaluation method of the tertiary oil recovery technology. First, three known blocks were used as the target block, and the potential block was evaluated and analyzed. The specific parameters are summarized in Table 2.



**Figure 1.** Flow chart of the software operation. The software interface adopts the combination of the switching function window and the pop-up association window in the main window, that is, the upper main menu, the lower left navigation bar, and the lower right function window. 4.2. Case Analysis.

**Table 2.** Analytical data of the examples.

Evaluation Parameter (Quantitative Scoring)	Instance Block A	Instance Block B	Instance Block C	Target Block
Oil displacement method	Polymer flooding	Fire oil layer	Chemical compound drive	To be matched
Reservoir type	Assembly and rules to expand the block of the application well network	Assembly and rules to expand the block of the application well network	Assembly and rules to expand the block of the application well network	Assembly and rules to expand the block of the application well network
Rock feature	Sandstone	Sandstone	Sandstone	Sandstone
Reservoir depth (m)	1510	1840	3320	1675
Reservoir pressure (MPa)	Greater than or equal to the minimum miscibility pressure	Greater than or equal to the minimum miscibility pressure	Greater than or equal to the minimum miscibility pressure	Greater than or equal to the minimum miscibility pressure
Reservoir temperature (°C)	65	70	85	72
Average single layer effective thickness (m)	15	20	18	22
Net to gross ratio (f)	0.55	0.6	0.63	0.73
Porosity (%)	23	35	29	37
Air permeability (10 <sup>-3</sup> μm <sup>2</sup> )	800	1200	1000	936
Oil saturation (%)	60	50	55	56
Permeability coefficient of variation (f)	0.65	0.52	0.58	0.48
Bottom water influence	no	no	no	no
Side water impact	no	small	no	no
Crack/cave	no	small	small	no
Upper and lower compartments and tube closure	Basic closure	Completely closed	Completely closed	Completely closed
Gas source	no	no	no	air
Single storage coefficient (10 <sup>4</sup> t/(km <sup>2</sup> ·m))	18	20	15	5.8
Formation crude oil viscosity (mPa·s)	52	1800	33	600
Crude oil density (g/cm <sup>3</sup> )	0.87	0.89	0.90	0.873
Acid value of crude oil (mgKOH/g)	15	30	10	0.42
Formation water salinity (mg/L)	2000	5000	3500	9673
Divalent ion content (mg/L)	15	20	18	58.56
Enhanced oil recovery (%)	22.46	38.23	29.52	Treatment test



In the fine quantitative screening method of tertiary oil recovery technology, the calculation results of 22 basic parameters of the target block are summarized in Table 3.

**Table 3.** Comprehensive scoring results of the method of screening. ASP: alkaline–surfactant–polymer.

Oil Displacement Methods	Comprehensive Score Results
Polymer flooding	0.19
Large PV gel profile-control flooding	0.20
ASP flooding	0.19
Alkali–polymer combination flooding	0.18
Polymer–surfactant flooding	0.19
Miscible gas flooding	0.18
Immiscible gas flooding	0.00
In-situ combustion	0.80
Steam flooding	0.21

According to the analysis, the target block was less than 0.5 in polymer flooding, large PV gel shifting, ternary composite flooding, alkali poly binary flooding, poly-broad binary flooding, miscible gas flooding, non-miscible gas flooding, and steam flooding. Therefore, the block was not suitable for the above eight types of oil displacement as a means of tertiary oil recovery. The comprehensive scoring result of the fired oil layer in the target block reached 0.8, which was higher than 0.5. Therefore, the fired oil layer method can be considered as the tertiary oil recovery development method in this block, but its specific development potential still needs to be quantitatively analyzed for potential evaluation.

In the rapid analogy evaluation method of the tertiary oil recovery, the known blocks, A, B, and C, were selected as the example blocks, and the integrated research and development of the three-stage oil potential evaluation software EORSYS3.0 was used to solve the problem. The similarities between the evaluation block and the instance blocks of A, B, and C were 0.348, 0.868, and 0.416, respectively, and the evaluation block had a higher similarity with instance block B. In the actual production process, instance block B can be selected as the reference target, and the oil displacement mode of the in situ combustion is used as the main development means, to ensure that the evaluation block can achieve the optimal mining effect. As the recovery factor of the example block B in the tertiary oil recovery process can reach 38.23%, the final recovery factor of the block predicted by the software was calculated to be between 33.18% and 43.27%. The actual enhanced oil recovery rate of the target block was 39.62%. Compared with the predicted enhanced oil recovery interval, the results were within the effective range of the analogy results, thus proving the accuracy of the evaluation results.

Through the comparative analysis of the above two methods, it can be seen that the tertiary oil recovery fine quantitative screening method can realize the quantitative analysis of the tertiary oil recovery method for the evaluation block, and the analysis results are wide in scope, the evaluation speed is fast, and the detailed evaluation workload can be greatly reduced. However, this method can only initially screen the suitable oil displacement mode of the evaluation block, and cannot predict the actual production and ultimate recovery rate of the block. Therefore, the evaluation results are not detailed enough. Later, it will be necessary to analyze the potential of the suitable tertiary oil recovery technology by the analogy evaluation method. The calculation method of the rapid analogy evaluation method of tertiary oil recovery is slightly slower than the fine quantitative screening method. However, by comparing and analyzing with a large number of example blocks, with reference to the preferred test plan representing the example block, the effective range of the evaluation block production, injection data, and recovery factor can be predicted in detail. This provides a basis for judging the test results and implementation feasibility of the oilfield rapid evaluation of suitable technologies.

Finally, using the method established in this paper, the tertiary oil recovery potential of 12 oil fields in Daqing, Changqing, Xinjiang, Liaohe, North China, Jilin, Dagang, Tuha, Tarim, Yumen, Qinghai, and Jidong was systematically evaluated. According to the development effect, the mining stage and technical maturity of the different blocks in each oil area, according to the gradual implementation

principle of sub-level, grade, benefit, and succession, appropriate tertiary oil recovery techniques were preferred, and the long-term and realistic tertiary oil recovery potential of each oil zone was evaluated. The evaluation results show that the total potential of the tertiary oil recovery in all of the oil fields is nearly 2 billion tons. Among them, the potential of chemical flooding accounts for more than half, and the average enhanced oil recovery is about 16.0%; the potential of gas flooding accounts for more than one third, and the average enhanced oil recovery is 12.0%; the thermal recovery potential accounts for about 10.0%, and the average enhanced oil recovery rate is 23.3%. The research results can provide technical support and a decision-making reference for the high-quality development of China's tertiary oil recovery technology, and the sustainable and stable supply of crude oil production.

## 5. Conclusions

A fine quantitative screening method for tertiary oil recovery technology was established. The method draws on the classification criteria formulated by various oilfields and industries and uses 22 reservoir and fluid characteristic parameters as reference indicators to establish a five-level and fine tertiary oil recovery technology screening standard using the approximation average algorithm—the original. The qualitative screening improvement is a quantitative scoring method, which can predict the suitable tertiary oil recovery mode of the research block intuitively, quickly, and accurately.

Based on the big data analysis, a rapid analogy evaluation method for the tertiary oil recovery potential was established. This method combines the status quo and development trend of tertiary oil recovery technology at home and abroad, and develops a typical mine instance database of China's tertiary oil recovery technology. Using the grey relational theory, the similarity between the representative block and each oilfield instance block in the database is obtained by analogy, and the instance block that best matches the representative block is specified according to the analog score, thereby predicting the representative area by using the ratio of geological reserves. Potential evaluation indicators are, for example, the ultimate recovery range of the block, actual annual production data, and production data.

Based on the analysis method of the fine quantitative screening method of the tertiary oil recovery technology, and the rapid evaluation method of the tertiary oil recovery potential, the research and development of a new generation of tertiary production potential evaluation decision support software EORSYS3.0 with independent intellectual property rights was achieved. The example test results show that the software process is reasonable, easy to operate, and reliable in conclusion. It can quickly predict and evaluate the tertiary oil recovery technology in the research block.

**Author Contributions:** Conceptualization, Z.W., Q.W. and Z.L.; Formal analysis, D.M.; Investigation, W.Z. and Z.L.; Methodology, D.M., W.Z., X.F. and Z.L.; Project administration, Z.W.; Software, X.F.; Supervision, Q.W. and D.M.; Validation, X.F.; Visualization, Z.W., Q.W., W.Z., X.F. and Z.L.; Writing-original draft, Z.W.; Writing-review & editing, W.Z.

**Funding:** This research was supported by the Potential Evaluation and Technical Development Direction of TOR in Petrochina (2014B-1308), Major Development Test Tracking and Research (ZDSY2014021), and Major Development Trial Tracking and Evaluation Preliminary Research (ZDSY20190003).

**Acknowledgments:** This research was supported by the Potential Evaluation and Technical Development Direction of TOR in Petrochina (2014B-1308), Major Development Test Tracking and Research (ZDSY2014021), and Major Development Trial Tracking and Evaluation Preliminary Research (ZDSY20190003). Thanks to the support and direction of the China National Petroleum Corporation, and to the good research environment and academic atmosphere provided by the China Petroleum Exploration and Development Research Institute. I am grateful to all of the members of the project team for their innovation, solidarity, and determination. Once again, I would like to express my heartfelt gratitude to the above-mentioned organizations, leaders, and experts for their various support and assistance.

**Conflicts of Interest:** The authors declare no conflicts of interest.

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