The Method and Static Analysis of Making Well Logging Interpretation Standard of Oil-water Formation by Network

Pei Shi*

Geological brigade in No.7 Oil Production Plant of Daqing Oilfield Company Ltd., Heilongjiang, China, 163458

*E-mail: Loona1982@126.com

Abstract. In this paper, the research of oil and water logging is carried out again and a recognition standard suitable for people to distinguish the oil and water layers in the oil area is established. In addition, this paper reviews 47 old wells in Xia Er Men.

Keywords: Oilfield, Oil-water Layer, Static Analysis

1. Introduction

There are 47 wells in Xia Er Men are located in Henan Province. The altitude of the ground in this area is close to 160 meters. As researchers, we can use the rules of special oil field division to divide the oil field into five oil layer groups. These five oil reservoir groups include 45 small layers. There are 9 small reservoirs in 45 small layers.

On the basis of using the knowledge of oilfield exploration, we should also apply the knowledge of well logging and oil testing. Based on the computer network technology, we will use the static analysis method to determine the rules of oil and water layer identification.

2. Study on oil bearing, lithology and physical properties of oil field

2.1. Measurement of oil content characteristics

Generally speaking, the oil reservoir of an oilfield should be divided into oil trace level, oil spot level and oil immersion level. In the common oil field, the oil content of some oil layers is very high. The probability is also high. We can conclude that the oil quantity in the area with high oil content is larger than that in the oil trace level[1]. According to the calculation of the formula, we can find that the minimum limit of oil-bearing property of Xia Er Men oilfield is oil trace level.

2.2. Characteristic measurement of lithology
The lithology of oil field generally includes siltstone, grey sandstone and siltstone. Generally speaking, the oil content of fine sandstone is very high. Its oil content is also very good. The oil content of grey sandstone is relatively small. Its oil content is relatively low. In the actual measurement process, we can ignore the oil content of gray sandstone. We record it as oil-free. According to the analysis of previous logging data, we can judge that the lowest limit of lithology in Xia Er Men oilfield is siltstone.

2.3. Measurement of physical characteristics

The measurement of physical properties needs to be completed according to the measurement of lithology. According to the main distribution range of hole spacing is 3.0% - 14.0%, we can calculate its average value is about 8%. Similarly, the calculation of the average value of the permeability interval is the same as that of the average value of the hole spacing. Finally, we can get the conclusion that the physical properties of the oil field belong to less porosity and low permeability.[2].

3. Difficulties in identifying oil and water layers

According to the display information of logging curve, we can find that the sandstone reservoir in the oil field is of low natural potential. In the water layer mixed with oil layer, the composition of liquid is mainly sodium bicarbonate. The formation water resistivity is closely related to the deep layer. However, with the increase of reservoir depth, the formation water resistivity will be smaller and smaller.

The horizontal variation of water property in oil area is very large. In addition, due to the influence of residual oil, the resistivity of water layer will be higher than the actual value[3]. This phenomenon will cause the resistivity value of the oil layer to be similar to that of the water layer. This situation makes it difficult to distinguish the oil and water layers.

4. Determination of interpretation method of oil-water logging

4.1. Common methods of plate discrimination

Because the difference of resistivity between water layer and oil layer is very small, the traditional digital discrimination method can’t complete the judgment of oil layer and water layer. Therefore, we can use the ratio of resistivity of test reservoir and resistivity of water layer and the time difference of acoustic wave to analyze the specific difference between oil layer and water layer. This method can effectively eliminate the problem that the resistivity of oil layer and water layer are similar. The specific judgment results are as follows:

The judgment formula of oil layer is:

\[ \Delta t > \frac{215 \mu s}{m}, \quad RT/RO \geq 2.35 \]  \hspace{1cm} (1)

The judgment formula of dry layer is:

\[ \Delta t > \frac{215 \mu s}{m}, \quad 1.75 \leq RT/RO < 2.35 \]  \hspace{1cm} (2)

The judgment formula of water layer is:
\[ \Delta t > \frac{215 \mu s}{m}, \frac{RT}{RO} < 1.75 \]  

The identification of oil layer and dry layer can be completed by analyzing the difference between potential and electrode, the ratio of potential and acoustic time difference. The specific judgment criteria are as follows:

The judgment method of oil layer is:

\[ \Delta t \geq \frac{215 \mu s}{m}, \frac{(RNML - RLML)}{RNML} \geq 0.13 \]  

The judgment method of dry layer is:

\[ \Delta t < \frac{215 \mu s}{m}, \frac{(RNML - RLML)}{RNML} < 0.13 \]

4.2. Identification of porosity and water saturation patterns of oil and water layers

According to the schematic diagram of the recognition method of special patterns of oil and water layers, we can find that the data points are relatively scattered and their distribution range is very wide. Its shape is basically hyperbolic. This feature can show that this part of the reservoir contains water. We can understand it as a mixture of oil and water layers. If the distribution of data points is not regular, we can understand it as a pure water layer[4].

5. Comprehensive interpretation of oil-water logging and application results of static analysis

According to the latest research results of well logging and the difference between oil and water layers, we can draw the following conclusions:

| Table 1. Comparison of new and old interpretation of fractured well layers in oil field |
|-------------------------------|------------------|-----------------|
| Well number       | Well section          | Analysis results |
|-----------------|------------------|-----------------|
| Down D5-343     | 2469.6-2479.8     | Water layer     |
| Down D5-341     | 2498.8-2504.4     | Oil layer       |
| Down J5-87      | 2493.4-2508.6     | Oil layer       |
| Down D9-352     | 2553.0-2558.0     | Oil layer       |

| Table 2. Interpretation results of static analysis of deep system in oil field |
|-------------------------------|-----------|-----------------|---------------|
| Well number       | Effective thickness | Results | Logging display |
|-----------------|-----------------|--------|---------------|
| Down D5-342     | 5.2 m           | Dry layer | Oil spot fine sand |
| Down D9-352     | 7.0 m           | Dry layer | Oil spot fine sand |
| Down D9-342     | 1.4 m           | Dry layer | None            |
Down D9-343 | 3.2 m | Water layer | None
Down D9-351 | 2.4 m | Water layer | Oil spot fine sand
Down D9-354 | 3.6 m | Dry layer | Fluorescein sandstone

It has been proved that the identification technology described in this paper can distinguish the oil layer, water layer and dry layer in the oil field well. This will bring good economic benefits to people.

6. Conclusion

This paper optimizes the previous interpretation method by establishing the logging interpretation standard of the oilfield. This paper provides the latest recognition standards and methods of oil layer, water layer and dry layer[5–6]. We can know the identification method of oil and water layer through a lot of experiments. After that, we can extend it to the measurement of other oil fields[7].

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