

Application of Gas Chromatography to Identify Oil and Water

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Abstract. It is very important to identify the fluid character of reservoir and to judge the degree of water washing in oilfield development. However, well logging data can not meet the fluid recognition requirement. Gas chromatography can solve the problem of fluid identification in complex oilfield. It has certain guidance value to the utilization of oilfield and perforation program.

Introduction

Gas chromatography (GC) is a common geochemical analysis and evaluation technique, which is widely used in the oil industry because it can obtain the positive alkanes spectrum of C8-C37 by subdividing the single component of hydrocarbons in rock samples. In the oilfield water injection development process, with the increase of water, oil saturation and crude oil properties will change [1]. The peak of positive alkanes in the gas chromatographic spectrum shows their content in crude oil. The peak shape of the spectrum reflects the relative content of each positive alkanes, which is closely related to the composition of crude oil. The peak shape characteristic reflects the variation of crude oil composition [2]. The characteristics of gas chromatography spectra of different reservoirs were analyzed statistically to identify oil-water reservoir.

Gas Chromatography was used to Identify Oil and Water

Gas chromatographic analyzer can detect the composition and relative percentage of petroleum in rock. The result is expressed by gas chromatography spectrum. Through statistical analysis of the characteristics of gas chromatography spectrum, a gas chromatography identification method was established [3].

1) Gas chromatography spectrum features: main peak carbon is obvious, the range of carbon is usually about C12~C30, the distribution of positive alkanes is regular point comb structure, the content of undistinguished compounds is low, the spectral peaks are normal distribution.

2) Morphological features of oil and water chromatography spectrum: except for some characteristics of the oil layer, i.e. the main peak carbon range is obvious, the range of carbon is C13-29, the positive alkane distribution is more regular than the tip comb structure, the content of undifferentiated compounds is higher under the baseline. Baselines are mostly domed. When the content of undifferentiated compounds is not very obvious, the spectral peaks are typical non-normal distribution.

3) Morphological characteristics of water layer gas chromatography spectrum: the main peak carbon is not obvious, the range of carbon is C14-27, the distribution of positive alkanes is flat combed or saddled, the content of undistinguished compounds varies by the baseline is different.

Use Gas Chromatography to Determine Flood Layer

The oilfield not only changes in the pore space structure of the reservoir, but also the oil saturation of the reservoir, which is a difficult problem in oilfield development. The results show that the response characteristics of gas chromatography before and after flooding are different. The peak and peak shape change regularly under different washing degree. Thus, we can explain the flooded layer accurately [4].

According to gas chromatographic spectrum of different water-washing levels, the analysis of saturated hydrocarbon chromatographic curves in different water content shows that the variation of GC features with water content increases, i.e. the carbon response of main peak decreases gradually with the water content, the peak changes gradually [5]. The main carbon response of main peak carbon decreased obviously and the peak was arc-shaped, the top of the sag appeared during weak washing. The response value of low carbon number of (nC15-) decreased at middle wash, the peak height of spectral map decreased, and the peak shape was reduced at the arc top, and it was echelon. After strong water washing, the response value of low carbon number was not obvious, but the main carbon number (nC16-nC25) response changed obviously [6].

The results showed that the positive alkanes content in gas chromatography were high, spectral peaks were normal distribution, and .Due to the decrease of reservoir oil abundance and the effect of water on the composition of crude oil, the peak gas chromatography decreases with the increase of water content (Fig1). The flood layer was determined by means of chromatography and peak height [7].

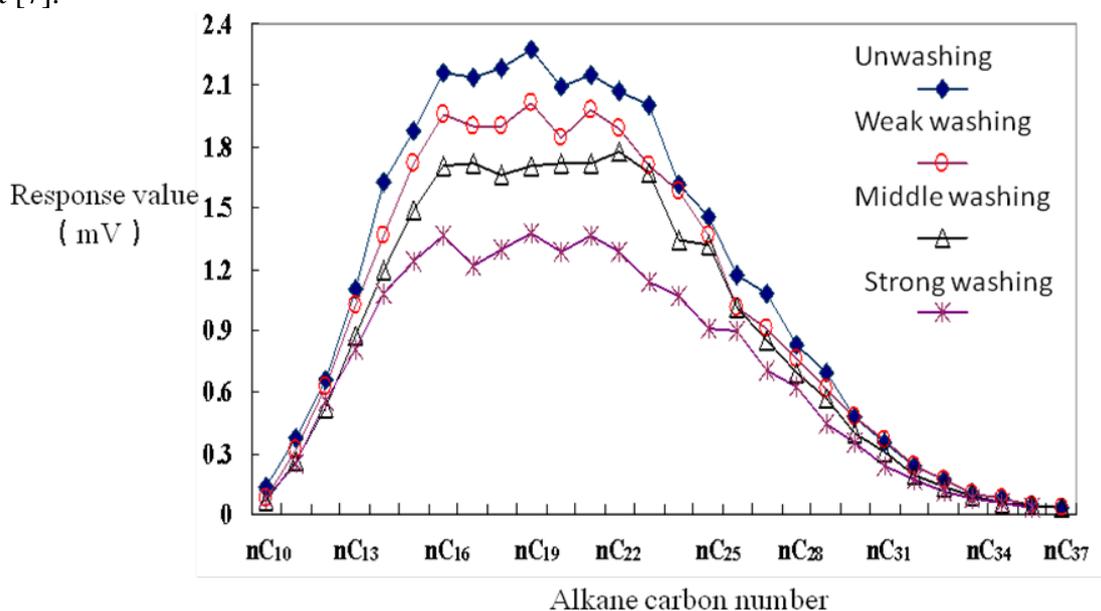


Fig1 Reservoir gas chromatographic analysis overlay diagram

Evaluation of Application Effect

In order to verify the well-wall core logging technology and the application effect in oilfield, the core log work was done on the well.

Well 5 for exaple

Well 5 is an evaluation and control well. The five reservoirs of the residual reservoir in this well were selected, and 10 were designed and 10 were designed to show oil content, and all samples were analyzed by gas chromatography. According to the physical observation and analysis result of well wall, the residual oil is medium oil, oil content, medium physical property. Oil test work was carried out in 3 layers, and the result was 3.218 tons.

The core of the M2 layer is 1, containing 1 oil, the lithology is brown oil-soaked sandstone. Physical observation: the oil-bearing sandstone has even distribution, under-full, the oil smell is lighter, the physical property is moderate. The gas chromatographic analysis shows the characteristics of the oil layer. The comprehensive analysis shows that the layer contains oil, the physical property is medium and the oil is poor (table1).

The core of the M3 layer is 3, 3 containing oil, the lithology is brown oil-soaked sandstone. Physical observation: the oil content of oil-bearing sandstone is uniform, under-full, the oil smell is lighter, the physical property is moderate, gas chromatography analysis are all the characteristics of difference. The comprehensive analysis shows that the layer is of good oil content, medium physical property. With a certain effective thickness, comprehensive interpretation is poor oil layer.

Table 1 well5 comprehensive interpretation data table

Plane	Well total depth (m)	thickness (m)	Φ %	SO %	Gas chromatography		Side well coring			Geological interpretation
					section	result	counts	sandstone	oiliness	
M2	1504.6~1507.0	1.6	11.7	47.8	1505.0	Thin layer	1	1	1	Thin layer
M3	1543.0~1547.4	4.4	12.8	53.2	1544.4 1546.2 1546.8	Thin layer Thin layer Thin layer	3	3	3	Thin layer
M5	1577.0~1579.0	2.0	12.1	42.5	1578.4 1578.8	Thin layer Thin layer	2	2	2	Thin layer

The core of the M5 layer is 2, 2 containing oil, and the lithology is brown-gray oil-soaked sandstone. Physical observation: the oil-bearing sandstone contains even distribution, under-full, the oil smell is lighter, the physical property is moderate, gas chromatography analysis are all the characteristics of the difference. The comprehensive analysis shows that the layer contains medium oil, medium physicality. The comprehensive interpretation is poor oil layer.

Three layers of oil test work. The oil test result is 3.218 tons, which is consistent with gas chromatography. Therefore, the characteristics of gas chromatography spectrum can be analyzed statistically and the reservoir can be identified (table2).

Table 2 well 5 layered oil test data table

Well name	Oil test date	Well section (m)	thickness (m)	effective thickness (m)	Daily oil production (t)	Daily water production (m ³)	Oil production per thickness	Oil test	conclusion
well 5	2009.10.4-2009.11.3	1504.6-1507.0	2.4	1.24	3.218		1.24	backdraft	Middle oil layer
		1543.0-1547.4	4.4	1.6					
		1577.0-1579.0	2.0						

Conclusion and Recognition

With the increase of moisture content, the saturated hydrocarbon chromatographic spectrum changed obviously. The general trend is that peaks change from normal to flattened peaks. Every single peak saturated hydrocarbon area, total saturated hydrocarbon area, main peak carbon and main carbon response value all decreased regularly.

By using the core analysis data, we can identify oilfield reservoir and determine the degree of flooding. Not only low cost, but also improve reservoir parameter interpretation accuracy, guide the new well perforation program.

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