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Distinctive Features of IR Spectra of Crude Oils of the Absheron Peninsula

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Abstract

Infrared (IR) spectroscopy provides useful information about hydrocarbon fluid inclusions in crude oils. In particular, the presence or absence of hydrocarbon functional groups may be qualitatively determined. It is known, there are 12 Oil-gas Production Companies (OGPC) in Azerbaijan, including 8 owned by Azerbaijan and 4 Joint Ventures. In most oil spills situations, it is desirable to have more than one analytical technique for detecting of spilled oil to its suspected source. In this paper we present first results of Fourier Transform IR (FTIR) spectroscopy spectra of crude oils taken from 6 OGPC of Azerbaijan Republic.

Keywords: IR spectroscopy, IR transmission, crude oil, application of Fourier spectroscopy, oil pollution, optical spectroscopy, crude oil absorption.

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Abşeron yarımadasının xam neftinin İR spektrlərinin fərqli xüsusiyyətləri

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Xülasə

İnfraqırmızı (IR) spektroskopiya, karbohidrogen mayelərinin xam neftə daxil olması barədə faydalı məlumatlar əldə etməyə imkan verir. Xüsusilə, karbohidrogenlərin funksional qruplarının olması və ya olmaması keyfiyyətcə müəyyən edilə bilər. Məlumdur ki, Azərbaycanda 12 Neft-qaz İstehsal Edən şirkət var, o cümlədən 8-i Azərbaycana məxsusdur və 4 Birgə Müəssisə var. Neft dağılmaları ilə əlaqəli əksər hallarda, tökülən neftin təxmin edilən mənbəyini müəyyənləşdirmək üçün birdən çox analitik metodun olması məsləhətdir. Bu yazıda Azərbaycan Respublikasının 6 Neft-qaz İstehsal Edən şirkətindən alınan xam neftin Furye çevrilməsi ilə IR spektroskopiyasının ilk nəticələrini təqdim edirik.

Açar sözlər: İR spektroskopiyası, İR buraxması, xam neft, Fourier spektroskopiyasının tətbiqi, neft çirklənməsi, optik spektroskopiya, xam neft udma.

Отличительные особенности ИК-спектров сырой нефти Апшеронского полуострова

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Аннотация

Инфракрасная (ИК) спектроскопия позволяет получить полезную информацию о включениях углеводородных флюидов в сырую нефть. В частности, можно качественно определить наличие или отсутствие функциональных групп углеводородов. Известно, что в Азербайджане насчитывается 12 нефтегазодобывающих компаний - 8 из них принадлежат Азербайджану и 4 совместных предприятия. В большинстве ситуаций, связанных с разливами нефти, желательно иметь более одного аналитического метода для определения предполагаемого источника разлившейся нефти. В этой статье мы представляем первые результаты ИК-спектроскопии с преобразованием Фурье сырых нефтей, полученных от 6 нефтегазодобывающих компаний Азербайджанской Республики.

Ключевые слова: ИК-спектроскопия, ИК-пропускание, сырая нефть, применение Фурье-спектроскопии, нефтяное загрязнение, оптическая спектроскопия, поглощение сырой нефти.

Introduction

Crude oil is very diverse class of substances [1-7]. The complex nature of crude oil, may lead in complex chemical analysis method. In our previously published paper, we described KA-14 LIDAR developed at National Aviation Academy (NAA) of Azerbaijan to detect oil spills on water surface of Caspian Sea and earth of Absheron peninsula [5, 7-12]. According to existing literature 4 different techniques (infrared spectroscopy, photo-luminescence (PL), gas chromatography and low temperature luminescence) were used to identify oil spills on water surface and to establish spills source. PL spectra and identification of oil spills on Caspian Sea as measured by KA-14 LIDAR, developed at the NAA, were published by the authors of present article and the results have been described in [10-12].

The purpose of the work

In this paper we present the first results of IR transmission spectra of crude oils taken from 6 Oil-gas Production Companies (OGPC) of Azerbaijan Republic.

Analysis of scientific and technical literature on the topic

The IR transmission method is widely use for the purpose of studying and confirming the composition of useful fossil migrations for obtaining oil spectra from different oil fields. The study showed that fats had similar molecular-mass regions, which were specific to a baseline region.

An analysis of the literature shows that FTIR transmission spectra of crude oils are observed in a wide range of the spectrum, including near-, and far-IR ranges. The most pronounced stripes of IR bands are observed in the following wavelength ranges:

I – bands in the spectral range of 850 - 1550 cm^{-1} (high frequency IR range);

II – bands in the range of ~ 2800 - 3100 cm^{-1};

III – bands in the spectral range of 435- and 5800 cm^{-1} [13-15].

FTIR, as well as Raman spectroscopy, facilitate the process of direct measurement in solid, liquid and gaseous media. The pattern has a number of advantages, such as special training and the absence of neutral to absorption strips.

IR spectroscopy appears to be a viable alternative due to its effectiveness in freely placing crude oil on a surface soaked in soil or floating in water for characterization.

In accordance with the above described, it was decided to carry out measurements on a special Fourier spectrometer BRUKER IFS66, located at the Institute of Spectroscopy of Russian Academy of Sciences (city Troitsk, Moscow region).

Analysis of the available literature, was carried out. An analysis of the available literature has led to the conclusion that the IR spectra of crude oil is a fairly reliable method for creating IR spectra of crude oil debris on water and earth surfaces and a Data Bank based on these spectra. The results given by the measurements carried out on the basis of the caliber are consistent with the results published in modern literature. The scientific and technical requirements of the research work put forward have been experienced and clarified. Thus, it was decided to measure the IR spectra of crude oil samples from 12 OGPC of Azerbaijan. On the basis of the project, separate spectral analysis of the extracted oils in different zones of Absheron peninsula and the creation of IR spectra`s Data Bank of oils based on the data obtained are underway. The mentioned zones included 8 (eight) OGPC belong to AzNeft (Azerbaijan) and 4 (four) Joint Ventures under AzNeft: *OGPC*:

1. Absheron; 2. Narimanov; 3. Oil Rocks; 4. Amirov; 5. Siyazan; 6. Tagiyev; 7. May 28; 8. Bibiheybat; *Joint Ventures*: 1. Balakhani Oil; 2. Muradkhanli Oil; 3. Surakhani Oil; 4. Binagadi Oil.

Measurements of transmission spectra of oils were performed by using the Fourier Transform IR spectrometer (BRUKER IFS66) available at the Institute of Spectroscopy of Russian Academy of Sciences (town Troitsk, Moscow region).

Measurements have been done in the spectral range of 500-7000 cm^{-1} (20-1.43 μm). Spectral resolution was 5 cm^{-1}. A cuvette with silicon windows and a gap of 20 μm was used for measurements. All measurements were performed at room temperature. Some of these results are presented in Figures 1-6. Notations in Figures 2-7, same as in Figure 1.

Vertical axis- transmission coefficient (relative units); horizontal axis- wave number (cm^{-1}). The frequency values of the transmission spectrum minima (absorption maxima) shown in Figures 1-7 are summarized in Table.

Planned measurements in the IR transmission spectra of crude oil from the remaining six organizations will allow creation of a Data Bank of IR spectra of crude oils from Absheron Peninsula of Azerbaijan.

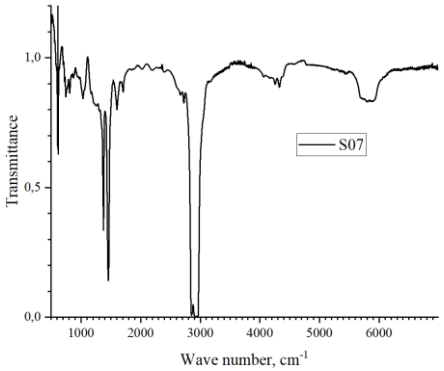

Figure 1 – The IR transmission spectrum of crude oil from the Neftjanije Kamni OGPC.

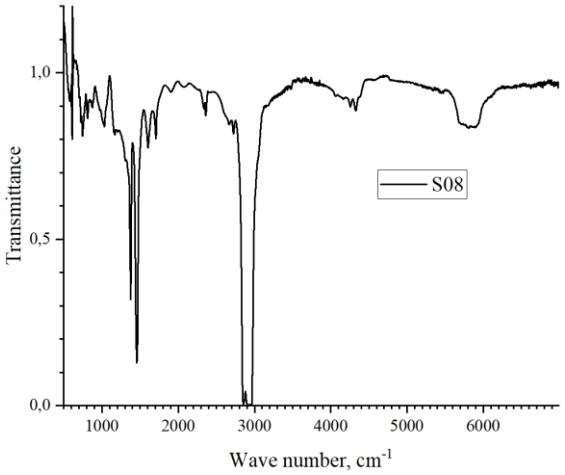

Figure 2 – The IR transmission spectrum of crude oil from Amirov OGPC.

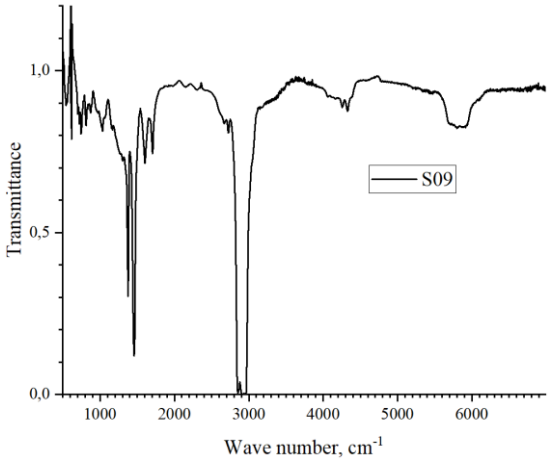

Figure 3 – The IR transmission spectrum of crude oil from Balaxani OGPC.

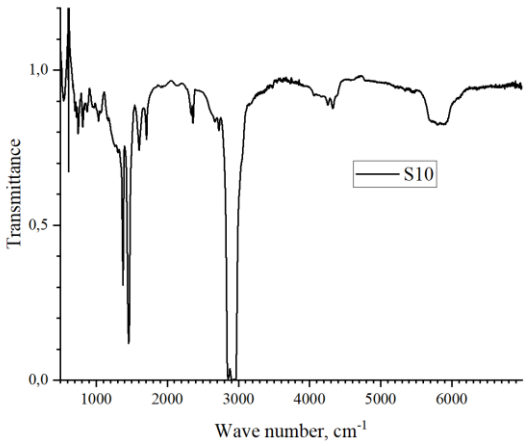

Figure 4 – The IR transmission spectrum of crude oil from Muradxanli OGPC.

Table – Designations (a, b, c, d, e, f, g, h) and spectral positions of the wave number values (cm^{-1}) corresponding to the minima of the IR transmission spectra of crude oils obtained as a result of the final processing of the spectra shown in Figures 1-6.

Name of the Oil Company of the Absheron Peninsula of Azerbaijan	Band (a) cm^{-1}	Band (b) cm^{-1}	Band (c) cm^{-1}	Band (d) cm^{-1}	Band (e) cm^{-1}	Band (f) cm^{-1}	Band (j) cm^{-1}	Band (h) cm^{-1}
Neftjanije Kamni	975	1380	1485	1580	2840	2950	4300	5800
Amirov	975	1370	1485	1580	2820	2950	4300	5800
Balaxani	970	1380	1495	1585	2825	2950	4300	5800
Muradxanli	970	1400	1450	1585	2820	2950	4300	5800
Suraxani	970	1400	1480	1585	2825	2950	4300	5800
Binagadi	970	1400	1490	1585	2825	2950	4300	5800

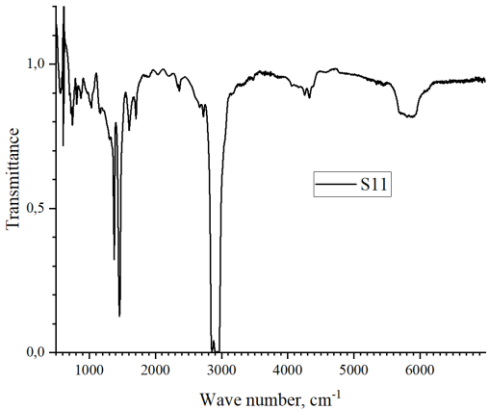

Figure 5 – The IR transmission spectrum of crude oil from Suraxani OGPC.

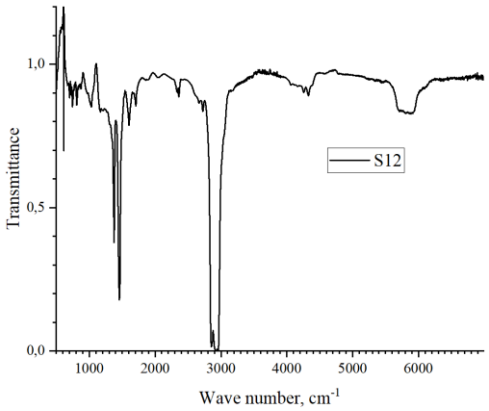

Figure 6 – The IR transmission spectrum of crude oil from Binagadi OGPC.

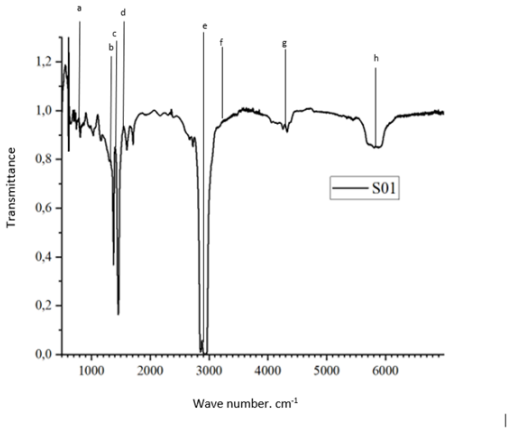

Figure 7 – The designations of the spectral position of the absorption bands (Figures 1-6) shown in Table.

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Conflict of Interests

The authors declare there is no conflict of interests related to the publication of this article.

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