

# The Chromatographic Research of the Structure –Group Content of the Surakhani and Balakhani Well Oils and Naturally Occurring Reactions in it

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## Abstract

*The physicochemical and structural properties of the Surakhani and Balakhani well oils of the Absheron Peninsula of Azerbaijan Republic have been investigated by using modern and high sensitive methods. It has been determined that the Surakhani oils (b.p. =124°C and b.p. =110°C) have less density and viscosity than the Balakhani oils (b.p. =143°C) and the former and the latter belong to semi heavy and heavy oils respectively. As a result of the chromatographic researches, cyclopentane, cyclohexane and their homologues those are formed on the basis of the cyclization process of unsaturated aliphatic acids have been determined in both oils. The scheme for the formation reaction of decalin as a result of the hydrogenation reaction of the naphthalene and its homologues as well as the scheme for the reaction of the formation of azulene in Balakhani oil are presented and the reversibility of both reactions is indicated. It has been revealed that the Surakhani oil differs with its unsaturated bicyclic hydrocarbons (octahdropentalen, cis-octahidropentalen, 2-methyloctahidropentalen) and saturated spirans (spiro (4, 5) decane, spiro (5, 6) dodecane, trans, cis-1,8-dimethyl spiro (4, 5) decane, 5,5-dimethyl spiro hexane-4-on), while Balakhani oil differs from the previous oil with a saturated cyclic hydrocarbon named adamantane and heteroatomic cyclic compounds – steranes like stigmastane, cholestane and phltane. Olefin hydrocarbons (1-decene, 5-octadecene and etc.) have been determined in Surakhani well oil. There are saturated acids in both oils.*

**Key Words:** Natural petroleum, Chromato-mass spectrometry, Photocatalytic conversion, Five membered cycloalkanes, carbonic acid, Bicyclic hydrocarbon, Heteroatomic compounds, Olefin

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## 1. INTRODUCTION

It is obvious that, petroleum consists of a large number of organic compounds, as well as aromatic, naphthene, olefin hydrocarbons and hundreds of individual compounds [1-4]. The study of the chemical structures of the hydrocarbons requires an individual approach since they keep the information about the structure of the initial biological molecules and content.

On the other hand, petroleum is both resource for heat energy and valuable feedstock for petrochemical industry.

Over time, a number of complicated processes are observed as a result of the conversion process of the organic compounds and reactions between them due to the internal heat of earth and because of it, the content and properties

of petroleum are changed. It should be mentioned that, the content of petroleum is changed due to the depth of the well, drilling location and etc. That is why, the study of the content of the raw petroleum is actual in order to direct them for petrochemical industry processes correctly

As it is mentioned in the previous proceedings [5,6], the modern, high sensitive spectroscopic and luminescent methods offers a wide opportunities for the detailed study of different field oils. By these methods, the structural and structure – group analysis of petroleum are studied and obtained results provide full information of investigated petroleum with physicochemical properties (density, viscosity, refraction index and etc.) of it. That is why, the evaluation of the chromatographic results is very essential for these kinds of modern researches.

## 2. EXPERIMENTAL DETAILS

In the presented proceeding, the content of the Surakhani and Balakhani well oils is determined by using modern chromatographic methods and the natural conversion processes which occur in these oils are explained.

The researches are fulfilled by “Agilent Technologies 6890N” chromatograph, “Agilent Technologies GC-7890A-5975C”

(with

HP-5MSD column) and “Thermo Electron GMS Trace DSQ” chromato – mass spectrometry device.

The physicochemical properties of the Surakhani and Balakhani well oils are presented in the Table 1.

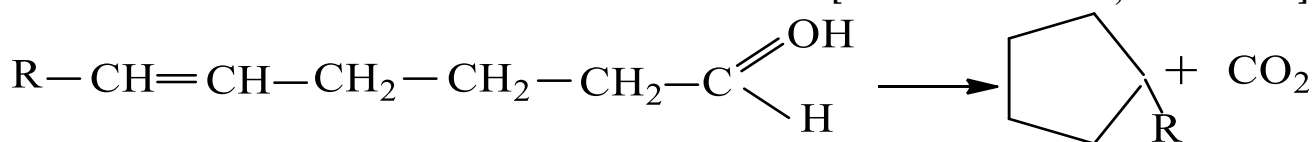
**Table 1. The physicochemical properties of the Surakhani and Balakhani well oil**

Physicochemical properties	Surakhani oil (b.p. 124°C)	Surakhani oil (b.p. 110°C)	Balakhani oil -greasy
Density, kg/m <sup>3</sup>	802,3	841.7	887,8
Freezing point, °C	-60	-40	-50
Viscosity, mm <sup>2</sup> /sec	1.22	6.33	17,5
Total Acid Number, mg KOH/100ml	28,02	2.55	3,5
Iodine number	-		15,49

As it is obvious from Table 1, the density and viscosity of the Surakhani oil are less than the Balakhani oil. According to the density classification, the Balakhani oil belongs to the heavy oils [7].

As it is clear from the literature [8], in natural petroleum the photo-catalytic conversion of acids – the cyclization of aliphatic

unsaturated acids causes the formation of cycloalkanes and arenes over time. First of all, it belongs to five membered cycloalkanes – cyclopentane and its homologues and etc:



This opinion is proved by the chromatographic researches. According to the results of the investigations, cyclopentane,

cyclohexane and their homologues have been identified in the mentioned well oils and some of them are given in Table 2.

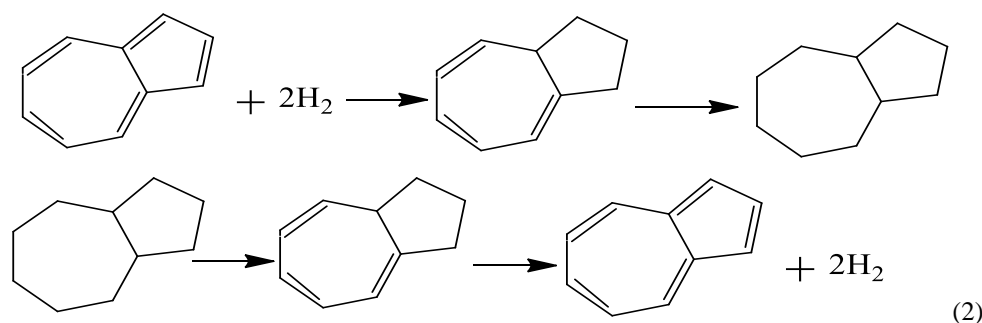
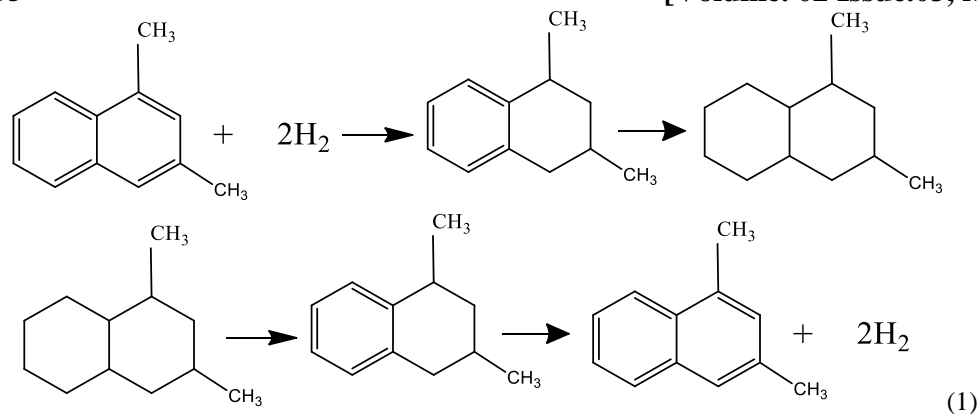
**Table 2. The qualitative content of the Surakhani and Balakhani well oils**

Name of the compound	mole. %
methylcyclopentane	0,649
1,1-dimethylcyclopentane	0,022
1,3- dimethylcyclopentane	0,044
1,2- dimethylcyclopentane	0,111
ethylcyclopentane	0,066
1,2,3- trimethylcyclopentane	0,370
3 -ethylmethylcyclopentane	0,214
1,2,3- trimethylcyclopentane	0,389
cyclohexane	0,155
1,1,4-trimethylcyclohexane	0,138
propylcyclohexane	0,103
butylcyclohexane	0,218

In spite of the fact that the five membered cycloalkanes and their derivatives are found in the Surakhani well oil, the unsaturated carbonic acids have not been identified by chromatographic method. This can be explained by the instability and the quick photo-catalytic conversion of the following unsaturated carbonic acid

Besides that, the cyclohexamethyl sulfonic acid, pentafluoro propionic acid, oxalic acid and etc. have been found in the Surakhani (light) oil.

During the chromatographic investigations of the Surakhani and Balakhani field oils, the derivatives and isomers of decalin (2-methyl-trans-decalin, anti-1-methyl-cis-decalin and etc.) have been found. As it is clear according to the literature [4], hydrogenation, dehydrogenation and disproportionation reactions may be observed in natural petroleum. The following reactions occur in the Surakhani (reaction 1) and Balakhani (reaction 1,2) well oils as naphthalene and its homologues (the reaction (2) may occur since azulene has been found in the Balakhani field oil) and decalin are found during the researches (reactions are reversible).



The other unsaturated hydrocarbons (for example, 1,3-octadiene (0.189 mole.%), 2,3-dihydroinden (0.255 mole.%) in the Surakhani oil and 2,2,4,4,7,7-hexamethyloctahydro-1H-inden (0.215 mole.%) in the Balakhani oil) are found in both oils. Unsaturated bicyclic hydrocarbons like octahydropentalene, cis-octahydropentalene, 2-methyl octahydropentalene have been recorded in the Surakhani oil (b.p. =  $124^{\circ}C$ ), unlike the Balakhani oil.

The saturated hydrocarbons like 4-methylindan (0.543 mole.%), 2-methylindan (0.181 mole.%) (b.p. =  $110^{\circ}C$ ), spiro (4,5) decane, spiro (5,6) dodecane, trans,cis-1,8-dimethylspiro (4,5) decane, trans,trans-1,8-dimethylspiro (4,5) decane, 5,5-dimethylspirohexan-4-on (b.p. =  $124^{\circ}C$ ) have been found in the Surakhani oil. However, in the Balakhani oil, saturated cyclic compound like adamantane has been recorded.

In addition, heteroatomic cyclic compounds – steranes like stigmastane, cholestane and phtlane, as well as 28-nor-17a(H)-hopane have been found in the latter. The concentration of the steranes is usually equal to the concentration of hopanes in petroleum (0.00015% according to oil), but sometimes it is high [10,11].

The hopanes and steranes in petroleum are the branched compounds those approve the organic origin of it. These compounds are the main hydrocarbons those keep the structure of natural biomolecules and spatial displacement of the separate atoms in petroleum. They are used for catagenic conversion and possible genetic correlation.

According to the literature [12], the less amount of olefin hydrocarbons is found in the well oils in which the amount of the unsaturated hydrocarbons are higher than 5% and these kinds of oils are considered as unique oils. Whereas, in spite of the fact that the amount of unsaturated hydrocarbons is higher than 25%, 1-decene, 5-octadecene, 9-

octadecene, 6-methyl-4-undecene (b.p. = 124°C) and 1-dodecene (b.p. = 110°C) olefins have been determined in the Surakhani well oils.

### 3.RESULTS AND DISCUSSIONS

So, as a result of the chromato-mass spectrometric researches of the Surakhani and Balakhani oils, the chemical content of these oils have been studied accurately, the saturated and unsaturated aromatic hydrocarbons have been determined and the mechanism of a number of catalytic conversions for them over time have been presented.

As a result of the researches of the mentioned oils, it has been determined that their organic compounds – branched heteroatomic compounds, indanes, spiranes and cyclocompounds undergo catalytic conversions and these conversions may be used in order to investigate the connection between the genetic modifications of petroleum.

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