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RESEARCH OF RADIATION-CHEMICAL TRANSFORMATION OF SYNTHETIC OIL FROM OIL-BITUMINOUS ROCK

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Synthetic oil from oil-bituminous rocks of the Balakhany deposit has been used as a test subject. The regularities of synthetic oils radiation-chemical transformations have been studied. Laboratory studies have been carried out in an interval of absorbed dose 43-216 kGr and dose rate P=0.5 Gr/s (γ - radiation). Concentration and radiation-chemical yields of obtained gases in various absorbed doses established. Results of studies make it possible to estimate the possible use of oil products obtained from synthetic oil in terms of isolation of radioactive sources from environment.

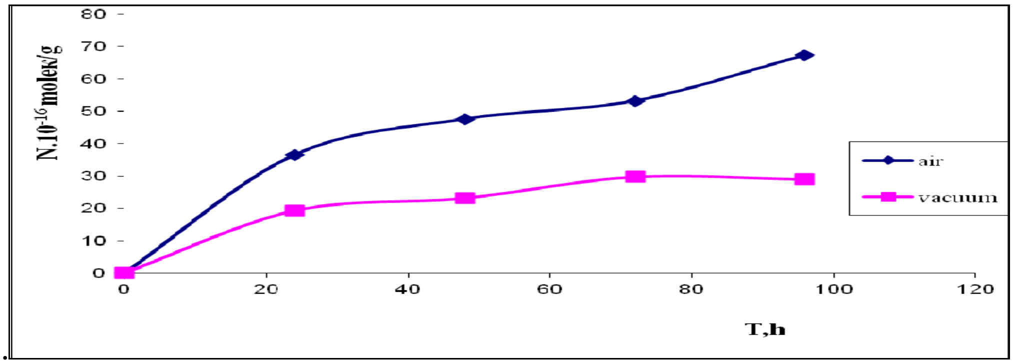
***Keywords**: bituminous rock, synthetic oil, radiation-chemical transformations, radiolysis.*

Bituminous rock (BR) - the natural material formed from oil in the top layers of earth crust due to the slow evaporation of easy fractions from it, natural de-asphalting of oil, as well as processes of interaction of its components with oxygen and sulfur. According to the UNO, world geological resources of bituminous rocks (BR) make up approx. 360 billion tons due to the recalculation of a hydro-carbonic component as an alternative source of hydro-carbonic raw materials. Total world oil extraction from BR makes up about 84 million barrels per day. BR resources in Azerbaijan make up 200 million tons.

The purpose of this work is to examine the radiation stability of synthetic oil from BR. Results of the study will allow to estimate possibility of the production of various oil products from synthetic oil by radiation-chemical methods, as well as the use of these materials in terms of isolation of radioactive sources from environment. We analyzed the synthetic oil obtained from BR on the Balakhany deposit, Azerbaijan. Through distilling on Retort Heating Jacket device at temperature 950 F (510^{0}C) from 375 g we have obtained 50 ml synthetic oil. Rock composition is as follows: oil – 22%, water – 6%, sand – 2%. Experiments have been carried out in γ – source ^{60}Co at dose rate of 0,5 Gy/s and in absorbed doses of 43-216 kGy. Gas products are analyzed by a gas chromatography method.

EXPERIMENTAL RESULTS

On Fig. 1 as an example is shown a kinetic curve of formation gases in the vacuum and in the presence of air during gamma-radiolysis of synthetic oil from bituminous rock.



a

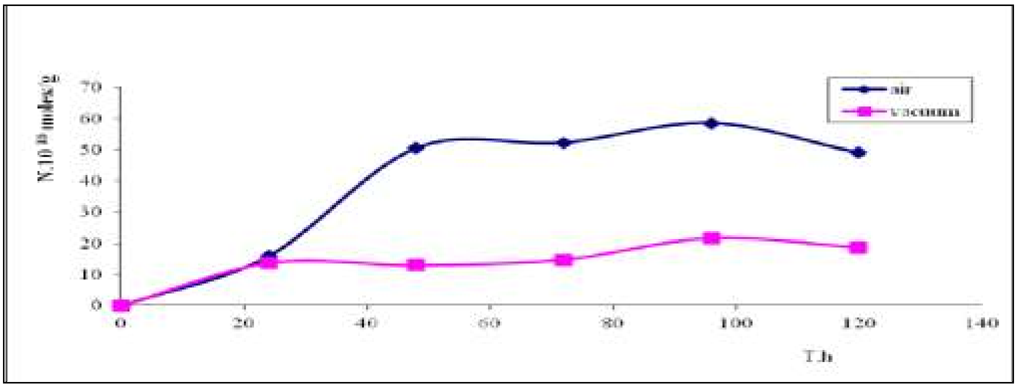


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Fig. 1 (a,b). Kinetic curve of methane (a) and ethane (b) accumulation during gamma-radiolysis of synthetic oil from natural bitumens. P=0.5 Gy/s.

As is known, in all gases the oxygen acts as accelerating factor in the process of radiation-chemical decomposition of synthetic oil which is related to the behavior of oxidizing-destructive reactions with the participation of radiolytic radicals. Average values of radiation-chemical yields of gases are shown in Table 1.

Table 1. Average values of radiation-chemical yields of gases (molec/100 eV) synthetic bituminous oil

Average values of radiation-chemical yields of gases (molec/100 eV) from BR	H_2	CO	CO_2	CH_4	C_2H_6	C_2H_4	C_3	C_4	C_5	C_6	C_7
Air	0.31	0.85	0.66	0.06	0.05	0.024	0.13	0.33	0.32	0.16	0.04
Vacuum	0.37	0.26	0.67	0.03	0.02	0.005	0.014	0.022	0.176	013	0.06

Fig. 2 provides chromatograms samples of synthetic oil. According to chromatograms, components in the input and irradiated samples of synthetic oil are identified

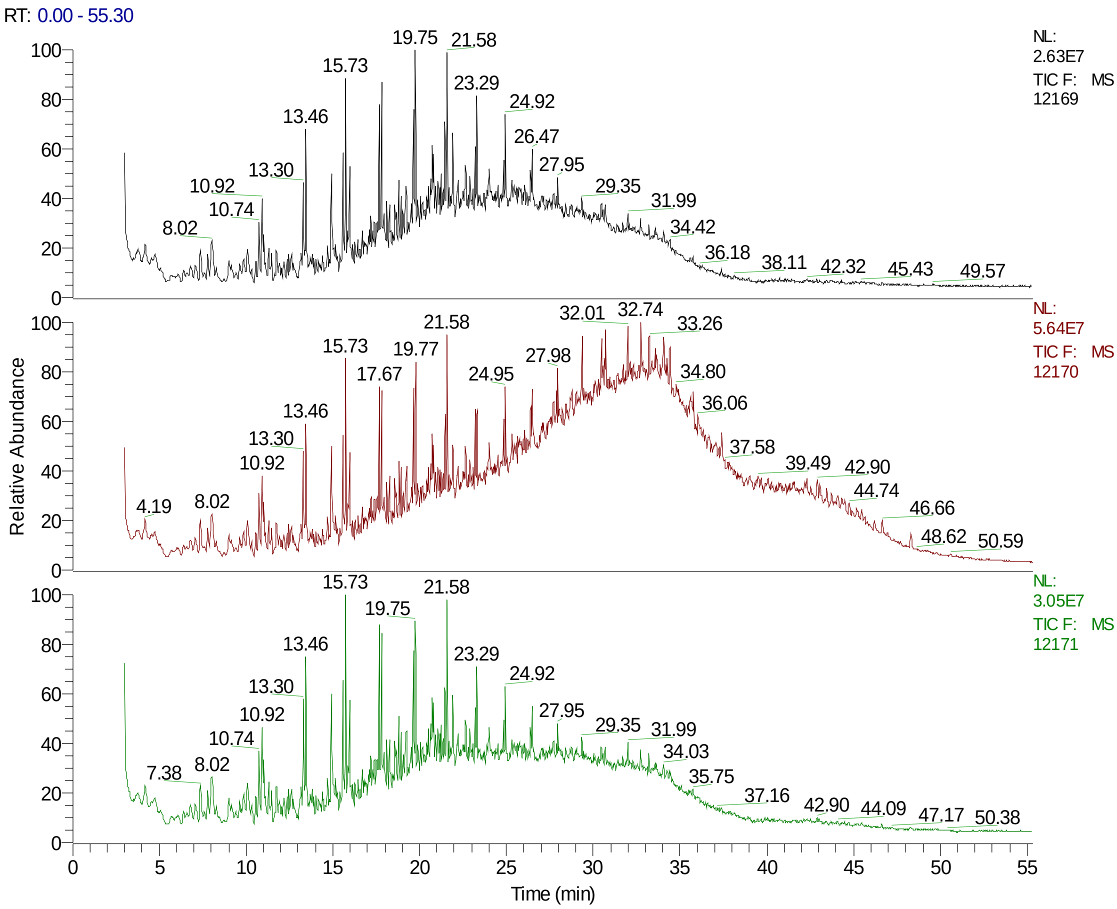

Fig. 2. Chromatograms0 in the input and irradiated synthetic oil in air and vacuum

Identified components of input synthetic oil are shown in Table 2.

Table 2 .Identified components of input synthetic oil

№	RT, *min*	Identified components of input synthetic oil	Formula
1	4,17	Toluene	C_7H_8
2	7,37	p-Xylene	C_8H_{10}
3	7,79	cis-2-Nonene	C_9H_{18}
4	8,02	Nonane	C_9H_{20}
5	9	Octane, 2,6-dimethyl-	$C_{10}H_{22}$
6	9,65	1-Octyn-3-ol, 4-ethyl-	$C_{10}H_{18}O$
7	10,09	Benzene, 1-ethyl-3-methyl-	C_9H_{12}
8	10,56	Benzene, (1-methylethyl)-	C_9H_{12}
9	10,74	1-Decene	$C_{10}H_{20}$
10	10,92	Decane	$C_{10}H_{22}$
11	11,31	1-Octanol, 2-methyl-	$C_9H_{20}O$
12	11,75	Benzene, 1-ethyl-4-methyl-	C_9H_{12}
13	13,3	1-Undecanol	$C_{11}H_{24}O$
14	13,46	Undecane	$C_{11}H_{24}$

15	14,67	Undecane, 6-methyl-	$C_{12}H_{26}$
16	14,93	Benzene, 1,2,4,5-tetramethyl-	$C_{10}H_{14}$
17	15,58	Cyclopropane, nonyl-	$C_{12}H_{24}$
18	15,73	Dodecane	$C_{12}H_{26}$
19	15,97	Undecane, 2,6-dimethyl-	$C_{13}H_{28}$
20	17,67	1-Tridecene	$C_{13}H_{26}$
21	17,8	Tridecane	$C_{13}H_{28}$
22	18,81	1-Pentadecanol	$C_{15}H_{32}O$
23	18,92	Cyclohexanol, 5-methyl-2-(1-methylethyl), [1R-(1à,2á,5à)]-	$C_{10}H_{20}O$
24	19,64	1-Tetradecene	$C_{14}H_{28}$
25	19,75	Tetradecane	$C_{14}H_{30}$
26	20,73	Naphthalene, 2,7-dimethyl-	$C_{12}H_{12}$
27	20,81	Tetradecane, 2,6,10-trimethyl-	$C_{17}H_{36}$
28	21,45	2,6-Dodecadien-1-ol, 3,7,11-trimethyl,(E,E)-	$C_{15}H_{28}O$
29	21,58	Pentadecane	$C_{15}H_{32}$
30	21,92	1H-Indene, 2,3,3a,4,7,7a-hexahydro-2,2,4,4,7,7-hexamethyl	$C_{15}H_{26}$
31	22,64	Naphthalene, 1,6,7-trimethyl-	$C_{13}H_{14}$
32	23,19	1-Hexadecanol	$C_{16}H_{34}O$
33	23,29	Hexadecane	$C_{16}H_{34}$
34	24,84	1-Heptadecanol	$C_{17}H_{36}O$
35	24,92	Heptadecane	$C_{17}H_{36}$
36	26,4	8-Heptadecene	$C_{17}H_{34}$
37	26,47	Octadecane	$C_{18}H_{38}$
38	27,95	Nonadecane	$C_{19}H_{40}$
39	29,37	Eicosane	$C_{20}H_{42}$
40	30,49	Octadecane, 3-methyl-	$C_{19}H_{40}$
41	30,72	Heneicosane	$C_{21}H_{44}$
42	32,74	Allopregnane	$C_{21}H_{36}$
43	33,26	Octadecane, 3-ethyl-5-(2-ethylbutyl)-	$C_{26}H_{54}$

To analyze the composition of bituminous oil we divided its distillation into 3 fractions: up to 110^{0}C; 125^{0}C and 145^{0}C. Samples of fractions have irradiated on a γ – source ^{60}Co at a dose rate of 0,5 Gy/s and an absorbed dose of 86.4 kGy. Radiation-chemical yields of gases are summarized in Table 3.

Table 3. Radiation-chemical yields of gases (molec/100 eV) in bituminous synthetic oil at absorbed dose of 86.4 kGy, P=0.5 Gy/s

Fractions from BR, ^{0}C	H_2	CO	CO_2	CH_4	C_2H_6	C_2H_4	C_3	C_4	C_5	C_6	C_7
1. T< 110	0.70	1.96	0.38	0.91	0.22	0.02	0.04	0.01	0.05	0.28	0.23
2. 110<T<125	0.42	3.72	0.89	0.60	0.41	0.03	0.07	0.04	0.28	0.38	0.14
3. 125<T<145	0.67	3.51	2.18	0.24	0.53	0.08	0.09	0.02	0.09	0.13	0.05

As is seen from Table 3, the total radiation-chemical yields of gases from fraction 1are as follows: - 4.8 molec/100 eV, from fraction 2 - 6.9 molec/100 eV and from fraction 3 - 7.5 molec/100 eV which is due to the concentration and differences in molecular structure of the compounds making up a part of these fractions. It is necessary to note that paraffin and polycyclic aromatic hydrocarbons have relatively high stability against radiation influence. At the same time, functional groups, especially oxygen-containing, as well as olephinic hydrocarbons, less radio-immunity. Stability of these organic compounds against radiation depends on the potential of excited conditions and ionization, i.e. all what defines behavior of energy transmission processes between components. In the presence of the poly-conjugate aromatic structures, the absorbed energy dissipates π-electrons, and as a result, bond breakage occur in functional groups. The irradiation of these samples in the air is brought to a small growth of destruction process, however, yields of products remain relatively low. To increase the radiation-chemical yield of gases and activate the chain mechanism of hydrocarbons' decomposition in these systems, it is necessary to apply high temperatures.

CONCLUSION

Relatively high radiation stability of synthetic oil from BR in the vacuum and the air is attributable to the presence of paraffin and polycyclic aromatic hydrocarbons in its structure. It has been established that the products obtained from BR are noted for high stability against the influence of radiation and temperature of 50^0C. Synthetic oil can be used as feed stock for the production of waterproof materials to be applied in terms of radiation influence. Organic part of BR can serve as a perspective source for obtaining of various kinds of fuels, oils, coke, and bitumen. To obtain the hydrogen, hydrocarbon gases and olefinic hydrocarbons from synthetic oil-combined influence of ionizing radiation and temperature are required at the agreed value of temperature and capacity of radiation.

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ИССЛЕДОВАНИЕ РАДИАЦИОННО-ХИМИЧЕСКОГО ПРЕВРАЩЕНИЯ СИНТЕТИЧЕСКОЙ НЕФТИ ИЗ НЕФТЕБИТУМИНОЗНОЙ ПОРОДЫ

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В качестве объекта исследования использовалась синтетическая нефть из битуминозных пород Балаханского месторождения. Изучены закономерности радиационно-химического превращения синтетической нефти. Лабораторные исследования проводились в интервалах поглощенной дозы 43-216 кГр и мощности дозы P=0.5 Гр/с (γ-излучения). Установлены концентрация, радиационно-химические выходы полученных газов при различных поглощенных дозах. Результаты

исследований позволяют оценить возможность использования нефтепродуктов, полученных из синтетической нефти, для изоляции радиоактивных источников из окружающей среды.
Ключевые слова: *нефтебитуминозная порода, синтетическая нефть, радиационно-химические превращения, радиолиз.*

NEFT-BİTUMLU SÜXURLARDAN ALINMIŞ SİNTETİK NEFTİN RADİASİYA-KİMYƏVİ ÇEVRİLMƏLƏRİNİN TƏDQİQİ

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Tədqiqat obyekti olaraq alternativ enerji mənbəyi olan Balaxanı neft-bitum süxurlarından alınmış sintetik neftdən istifadə olunmuşdur. Sintetik neftin radiasiya-kimyəvi çevrilmələrinin qanunauyğunluqları öyrənilmişdir. Laboratoriya tədqiqatları udulan dozanın 43-216 kQr intervalında və P=0,5 Qr/s doza gücündə (γ-şüalanma) aparılmışdır. Müxtəlif udulma dozalarında alınmış qazların qatılığı, radiasiya-kimyəvi çıxımı təyin edilmişdir. Tədqiqatların nəticələri sintetik neftdən alınmış neft məhsullarının radioaktiv mənbələrin ətraf mühitdən izolyasiya olunmasında istifadə olunma mümkünlüyünü qiymətləndirməyə imkan verir.
Açar sözlər: *neft-bitum süxuru, sintetik neft, radiasiya-kimyəvi çevrilmə, radioliz.*

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