USED OIL CLEANING WITH FILTERS

Ergashev Yorkinjon Tulkin ugli[1]
[1]doktorant Tashkent chemical-technological institute, Tashkent
ergashevyorqinjon.2307@gmail.com , ORCID ID 0000-0002-5332-5752
Umarova Muattar Bakhtiyarovna[2]
[2]Senior teacher Tashkent chemical-technological institute
umarovamuattar2020@gmail.com
ORCID NO: 0000-0001-8881-3353
Maksumova Oyto'ra Siddikovna[3]
[3]professor of the Tashkent Institute of Chemical Technology
Pulatov Khayrulla Lutfullaevich[4]
[4]professor Tashkent chemical-technological institute
hayrulla00796@gmail.com

Akmalova Guzal Ysupovna[5]
[5]Associate Professor of the Tashkent Institute of Chemical Technology
https://doi.org/10.5281/zenodo.7460975

Annotation
Various filters are used to clean waste oils from foreign particles and extend the interval between oil changes. Most oil filters trap solid particles with transverse dimensions of 30-40 microns. Good filters are capable of retaining particles as small as 20 microns.
We tested various filters made from local raw materials (polyester (TLFT-5 brand), Belting BF, CleanEl filter based on organic and inorganic fibers (basalt + cellulose + Waste paper), for used oil treatment: used engine oil ADDINOL 10W-40 semi synth gap oil 7000 KM, used engine oil Liqui Moly 5W-40 Synthoil High Tech oil mileage 7500 km.
We have carried out research work on the purification of used oils. The quality indicators of the lubricant used were determined engine oil ADDINOL 10W-40 semi synth blank oil Mileage 7000 km (number of samples per test -1.5 l).
Keywords: filters, used oils, used engine oil ADDINOL 10W-40 semi synth gap oil 7000 KM, used engine oil Liqui Moly 5W-40 Synthoil High Tech

During the operation of any internal combustion engine (ICE), engine oils are constantly contaminated with solid particles. The main source of such particles is continuously formed soot particles. When soot enters the oil, it leads to the intensive formation of various deposits, and the soot content in engine oils of more than 3% suppresses the basic properties of oil additives and worsens the lubricating properties of oils in general, leading to increased wear of the internal combustion engine. Also, metal particles are continuously formed in the engine. This is the result of the destruction of engine parts: bearings, piston rings, bushings and valves. The presence of solid particles in motor oils is responsible for more than 50% of damage and failures. They act as an abrasive and can damage even very hard surfaces, especially during cold starts. Various filters are used to clean used oils from foreign particles and increase the interval between oil changes. Most oil filters trap solid particles with transverse dimensions of 30 - 40 microns. Good filters can keep particles as small as 20 microns. The content of solid contaminants larger than 5 microns is reduced from 5-10 thousand particles per ml. oils up to several hundred, then the engine resource increases

significantly. Continuous fine (up to 3 microns) oil purification occurs in addition to coarse (up to 40 microns) purification in a full-flow standard oil filter. The technologies used in the fine filter elements make it possible to purify the oil from solid particles, water and oil degradation products by 99%, which a standard oil filter is not able to do. All of our filter elements have passed the official ISO 4572 multi-pass test. This is the only recognized test in the world to determine the beta value of a filter element.

We have tested various filters made from local raw materials (polyester (TLFT-5 brand), Belting BF, CleanEl filter based on organic and inorganic fibers (Basalt + Cellulose + Macalatura) in order to purify used oils: used engine oil ADDINOL 10W-40 semi synth gap oil 7000 KM, used engine oil Liqui Moly 5W-40 Synthoil High Tech mileage oil 7500 km.

In the experimental and research workshop, research work was carried out on the purification of used oils. Determined the quality indicators of the lubricant used engine oil ADDINOL 10W-40 semi synth blank oil 7000 KM (number of samples per test -1.5 L).

Table 1.

Environmental conditions during testing

№	The name of indicators	Units of measurement	RD for test methods	Quality parameters according to manufacturer's specifications ADDINOL 10W-40 Semi Synth	Test result
1	Kinematic viscosity at 100 °C	mm^2/s	GOST 33	within 12.5-16.3	15,21
2	Kinematic viscosity at 40 °C	mm^2/s	GOST 33	-	114,94
3	Индекс вязкости	-	GOST 25371	at least 110	138
4	Total base number	mgKOH/ 1 g	GOST 11362	8,7	2,78
5	Water content	%	GOST 2477	missing	missing
6	Flash point in open cup	^oC	GOST 4333 Method B	230	219
7	Density at 15 °C	kg/m^3	GOST 3900	863	867
8	The content of mechanical impurities	mg/kg	GOST 6370	missing	0,125
9	Appearance	-	GOST 29188.1	-	Opaque black liquid with mechanical

We determined the quality indicators of the lubricant used engine oil Liqui Moly 5W-40 Synthoil High Tech mileage oil 7500 km (number of samples for testing -0.5 L.

Table 2.

Environmental conditions during testing

№	The name of indicators	Units of measurement	RD for test methods	Quality parameters according to the technical characteristics of the manufacturer	Test result
1.	Kinematic viscosity at 100 °C	mm^2/s	GOST 33	within 12,5-16,3	14,10
2.	Kinematic viscosity at 40 °C	mm^2/s	GOST 33	87,0	112,65
3.	Индекс вязкости	-	GOST 25371	-	126
4.	Total base number	mgKOH/1 g	GOST 11362	9,15	2,41
5.	Water content	%	GOST 2477	missing	missing
6.	Flash point in open cup	°C	GOST 4333 Method B	230	220
7.	Density at 15 °C	kg/m^3	GOST 3900	850	855
8.	The content of mechanical impurities	mg/kg	GOST 6370	missing	0,151
9.	Appearance	-	GOST 29188.1	-	Opaque black liquid with

We determined the quality indicators of used engine oil lubricant used engine oil ADDINOL 10W-40 Semi Synth 7000 km oil mileage after cleaning with a 100% cotton Belting filter and adding a copolymer (number of samples per test -1.5 L).

Table 3.

Environmental conditions during testing

№	The name of indicators	Units of measurement	RD for test methods	Quality parameters according to manufacturer's specifications ADDINOL 10W-	Test result
1.	Kinematic viscosity at 100 °C	mm^2/s	GOST 33	within 12.5-16.3	13,12
2.	Kinematic viscosity at 40 °C	mm^2/s	GOST 33	-	110,10
3.	Индекс вязкости	-	GOST 25371	at least 110	115
4.	Total base number	mgKOH/1 g	GOST 11362	8,7	2,78
5.	Water content	%	GOST 2477	missing	missing
6.	Flash point in open cup	°C	GOST 4333 Method B	230	223

7.	Density at 15 °C	kg/m³	GOST 3900	863	862
8.	The content of mechanical impurities	mg/kg	GOST 6370	missing	missing
9.	Appearance	-	GOST 29188.1	-	Transparent liquid of light yellow color, without

We determined the quality indicators of the lubricant used engine oil used engine oil Liqui Moly 5W-40 Synthoil High Tech oil sample 7500 km after cleaning with a filter TLFT-5 Polyester 100% and adding a copolymer (amount of sample for testing -0.5 L).

Table 4.

Environmental conditions during testing

№	The name of indicators	Units of measurement.	RD for test methods	Quality parameters according to the technical characteristics of the manufacturer Liqui Moly 5W-40	Test result
1.	Kinematic viscosity at 100 °C	mm²/s	GOST 33	within 12.5-16.3	12,90
2.	Kinematic viscosity at 40 °C	mm²/s	GOST 33	87,0	109,89
3.	Индекс вязкости	-	GOST 25371	-	112
4.	Total base number	mg KOH /1 g	GOST 11362	9,15	2,41
5.	Water content	%	GOST 2477	missing	missing
6.	Flash point in open cup	°C	GOST 4333 Method B	230	224
7.	Density at 15 °C	kg/m³	GOST 3900	850	852
8.	The content of mechanical	mg/kg	GOST 6370	missing	missing
9.	Appearance	-	GOST 29188.1	-	Transparent liquid of light yellow color, without

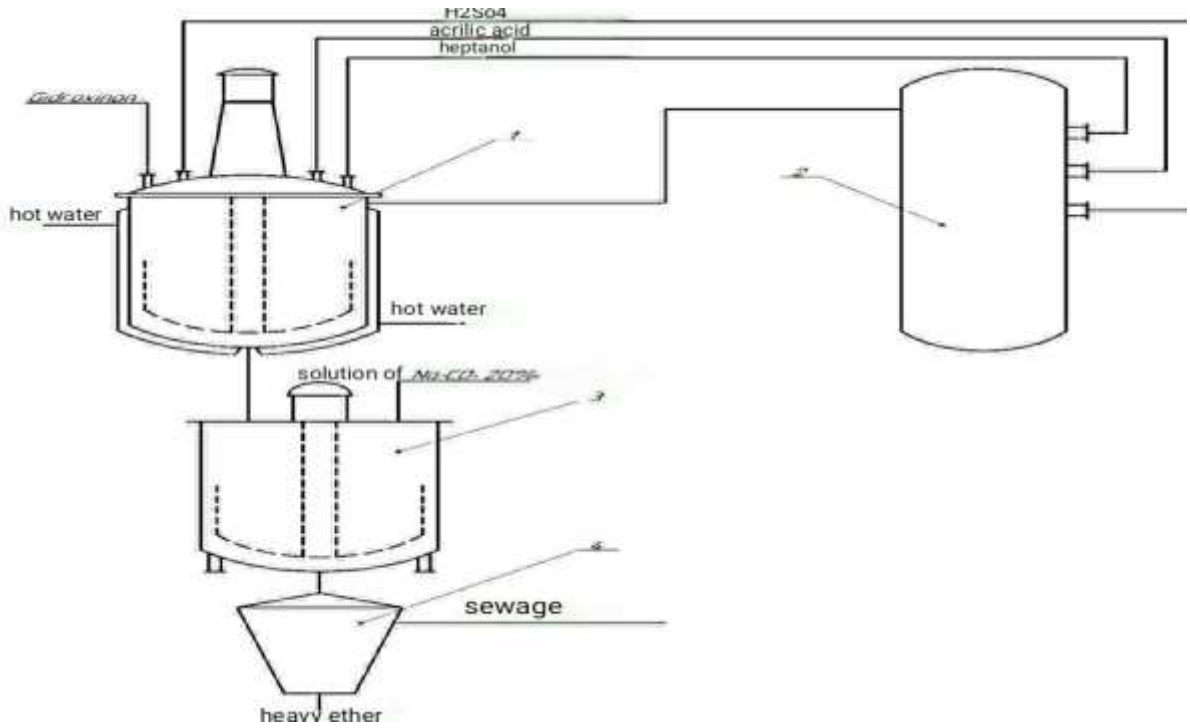


A number of copolymers based on AA (Acrylic acid) + HS (heptanol) and St (styrene) were synthesized under comparable conditions. The new copolymers synthesized by us in the presence of various initiators and with a commensurate ratio of components using the compensation method have low MW (molecular weight) values and a compositionally homogeneous structure. This suggested that they might have good thickening properties in mineral and synthetic oil bases. In this case, the homogeneity of their structure will manifest itself in resistance to destruction. To implement this assumption, the solubility of copolymers in petroleum and synthetic oil bases was first estimated. The solubility of the copolymers in oils was determined by studying the dissolution of copolymers at a concentration of 5 wt.% in the mineral oil base and the synthetic base DOS (dioctyl sebacate) during heating and stirring, followed by cooling to room temperature. In practical terms, we have obtained an HA ester (heptyl acrylate).

Studies of new copolymers in oil solutions as thickeners have shown a real prospect of using them as degradation-resistant MFs. At the same time, these data are additional confirmation of the compositional homogeneity of their structure: the sequential arrangement of monomeric units of different nature in the polymer increases the stability of the molecule. Attention should be paid to the fact that when obtaining acrylate additives to oils to reduce MW, chain transfer agents are introduced into the polymerizing mass. In this case, this is not necessary, which favorably distinguishes the proposed method for obtaining a copolymer as an additive.

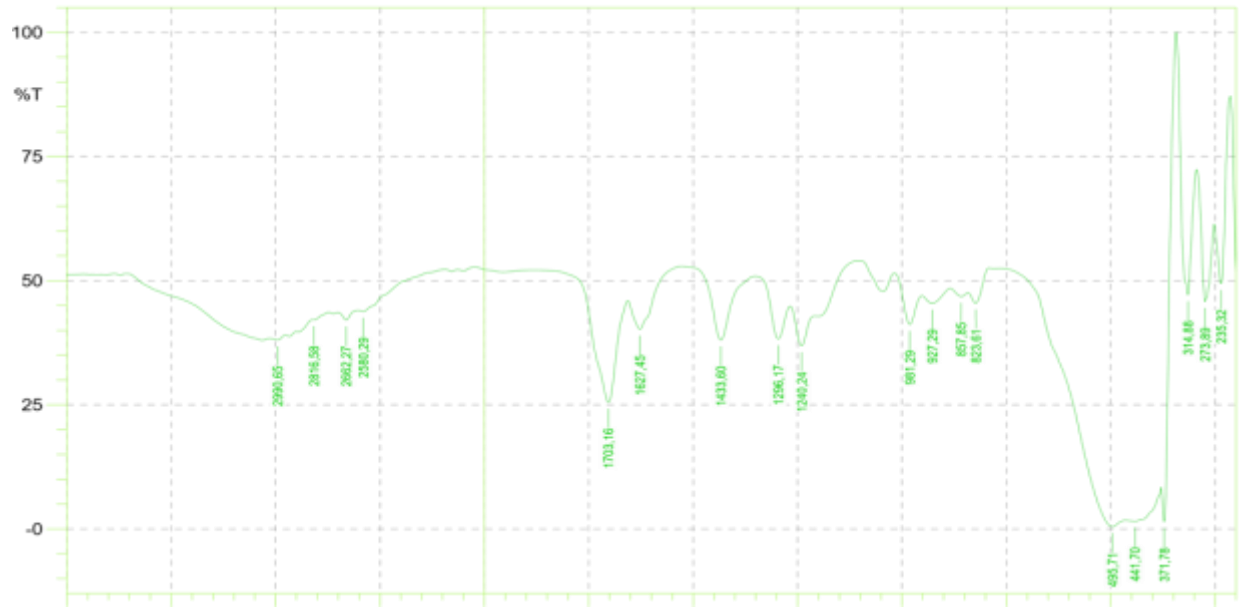
In used oil recovery, used oils can be purified based on the following physical-chemical, chemical and physical processes. The composition of used oils should not exceed 4% of water, emulsions, semi-liquid and liquid products. Such an assessment does not require complex technology for the recovery of used oils.

Purposeful research is being carried out all over the world to improve resource-saving technologies and equipment for cleaning and regenerating used oils. In this regard, it is important to develop an improved design scheme for the waste oil purifier, to implement the process of cleaning oils from oxidation products on a resource-efficient basis. In this scientific work proposed by us, an improved schematic diagram of a laboratory device for cleaning oils used with polyacrylates has been developed. As a result of testing, the proposed copolymers were found to be extremely effective in used oil refining and recommended as resource-saving modifiers for used oil refining based on synthesized copolymers.



Pic.1. Laboratory plant for the production of heptyl acrylate ester
1-reactor, 2-distillation column, 3-mixer, 4-separator.

Acrylic acid, alcohol and sulfuric acid are added to the reactor (1) and heated to a pressure of 1 atm at 90° C. to form an ester, the reaction is controlled with hydroquinone. Reagents that have not reacted (2) are sent to the distillation column, regenerated and returned to the cycle. At the end of the reaction, the mass is sent to a shaker equipped with a stirrer (3) and neutralized with a 20% aqueous solution of soda ash (sodium carbonate).



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	235,32	49,4	23,4	252,68	213,62	8,1	2,8
2	273,89	45,8	21,1	294,63	252,68	10,8	3,4

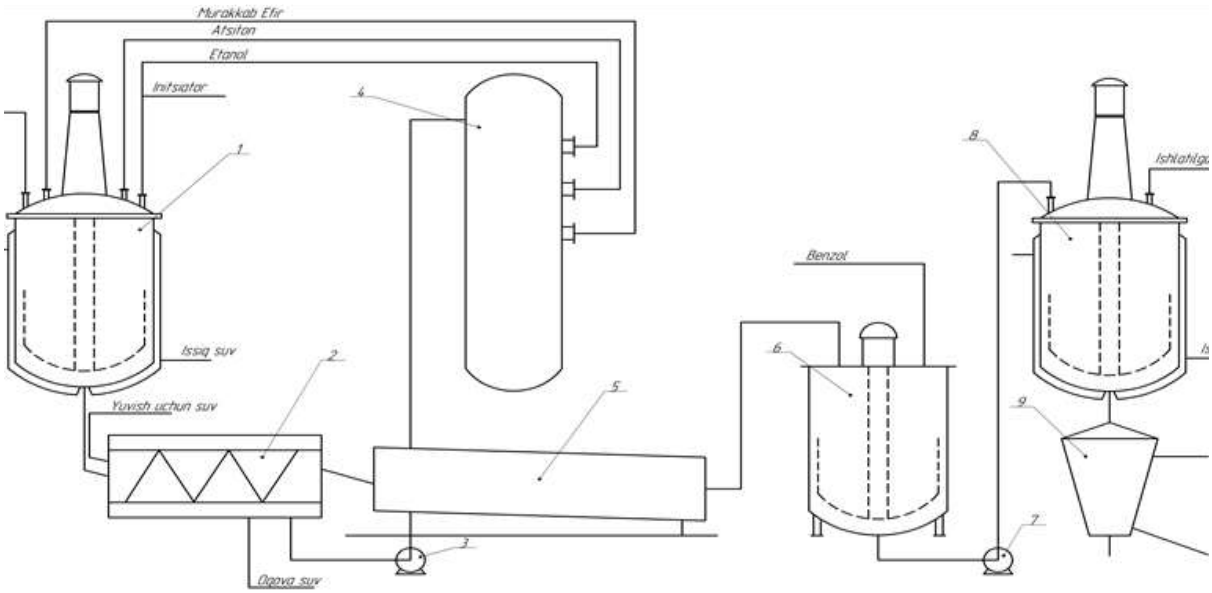
3	314,88	47,1	36,6	343,81	294,63	9,8	6,3
4	371,78	1,5	26,7	379,5	343,81	23,1	6,9
5	441,7	1,6	1,9	464,37	379,98	134,6	14,8
6	495,71	0,4	6,5	764,3	464,85	240,2	18,7
7	823,61	45,5	3,9	841,94	791,79	16	0,9
8	857,85	46,8	1,1	884,37	841,94	13,7	0,2
9	927,29	45,5	2,1	952,36	884,37	22,6	0,7
10	981,29	41,2	7,8	1018,42	952,36	22,5	2,2
11	1240,24	36,9	7,1	1267,72	1208,9	23	2
12	1296,17	38,3	8,6	1351,15	1267,72	29,3	2,5
13	1433,6	38,1	13,8	1527,15	1351,15	56,6	6,4
14	1627,45	40,2	7,3	1656,87	1527,15	42,6	2,8
15	1703,16	25,5	21,8	1872,9	1656,87	79,3	13,1
16	2580,29	43,8	0,7	2605,37	2187,78	130,5	-2,7
17	2662,27	42,1	1,7	2701,33	2605,37	35	0,6
18	2816,58	42,1	0,1	2823,81	2746,17	28,6	0
19	2990,65	38,1	0,6	3030,19	2952,56	32,3	0,3

In this case, an esterification reaction based on acrylic acid and heptyl alcohol occurs. In the esterification process, H2SO4 is used as a catalyst. The structure of the synthesized ether was studied by IR spectroscopy. The resulting GA-specific ester group appeared in 1296 regions.

In this study, a new viscosity modifier (MV) for used synthetic, semi-synthetic and mineral oils is proposed as promising modifiers - good thickening ability, high resistance to destruction, significantly better quality compared to imported analogues.

The new copolymers synthesized by us in the presence of various initiators and with a commensurate ratio of components using the compensation method have low MW (molecular weight) values and a compositionally homogeneous structure. This suggested that they might have good thickening properties in mineral and synthetic oil bases. In this case, the homogeneity of their structure will manifest itself in resistance to destruction. To implement this assumption, the solubility of copolymers in petroleum and synthetic oil bases was first estimated. The solubility of copolymers in oils was determined by studying the dissolution of copolymers at a concentration of 5 wt.% in a mineral oil base and a synthetic DOS (dioctylsebacinate) base during heating and stirring, followed by cooling to room temperature. In practical terms, we have obtained an HA ester (heptyl acrylate).

Studies of new copolymers in oil solutions as thickeners have shown a real prospect of using them as degradation-resistant MFs. At the same time, these data are additional confirmation of the compositional homogeneity of their structure: the sequential arrangement of monomeric units of different nature in the polymer increases the stability of the molecule. Attention should be paid to the fact that when obtaining acrylate additives to oils to reduce MW, chain transfer agents are introduced into the polymerizing mass. In this case, this is not necessary, which favorably distinguishes the proposed method for obtaining a copolymer as an additive.



Pic. 2. Schematic diagram of waste oil treatment
1,8 - reactor, 2 - drum filter, 3,7 - pumps, 4 - distillation column, 5 - drum dryer, 6 - mixer, 9 - separator.

In the reactor (1), the prepared HAE copolymer is fed to the drum press filter (2), the non-reacting copolymer is filtered from light volatile substances. The residue remaining on the filter is again washed in a small amount of filter drum equipment and sent back to the drum dryer for re-filtration and drying. After drying, the copolymer is sent to the mixing device (6) is dissolved in benzene and introduced into the reaction by the pump (7) in the reactor (8). The heated oil is subjected to a reaction at a pressure of 1 atm at a temperature of 70 °C and the purified oil is separated from the residue using a centrifuge-separator (9).

Conclusions

1. In the process of boiling acrylic monomers with styrene by their radical copolymerization, a new copolymer was obtained and tested as a resource-saving MV (viscosity modifier) for used oils. In this study, a new viscosity modifier (MV) for used synthetic, semi-synthetic and mineral oils is proposed as promising modifiers - good thickening ability, high resistance to destruction, significantly better quality compared to imported analogues.

2. We managed to purify waste synthetic, semi-synthetic and mineral oils used in various filters from local raw materials (polyester (TLFT-5 brand)), Belting BF, CleanEl filter based on organic and inorganic fibers (Basalt + Cellulose + Macalatura).

3. We have obtained a heptyl acrylate ester modified with azoisobutyric acid dinitrile (AAN), and received a patent certificate from DGU No. 14025 issued by the Intellectual Property Agency under the Ministry of Justice of the Republic of Uzbekistan for the ester technology.

References:

1.Умарова М.Б., Максумова О.С. Изучение и применение гомо- и сополимеров как загустители смазочных масел. “Илмий ва инновацион фаолиятни ривожлантириш бўйича давлат бошқаруви тизими такомиллаштирилиши–давр талаби” "Improvement of the state governance system for the development of scientific and innovative activities is a requirement" 27-НОЯБР 2020 ЙИЛ КОНФЕРЕНЦИЯ-СИМПОЗИУМ

2.Умарова М.Б. & Максумова О.С. Исследование влияний топливных фракций на очистку отработанных масел // Euro asia 8th. international congress on applied sciences // March 15-16, 2021 Tashkent, Uzbekistan. c. 970-975.
3.Умарова М.Б., проф. Максумова О.С.Изучение влияний топливных фракций на очистку отработанных масел. PROCEEDINGS of the INTERNATIONAL CONFERENCE «Innovations in the oil and gas industry, modern power engineering and actual problems» materials of the international conference. 26.05. 2020 page 603-605
4.Lurz, J.A. Grease production survey report for the calendar years 2004, 2003, 2002 and 2001 / J.A. Lurz // NLGI Spokesman. – 2005. – №10. Vol.68. – P. 21-41.
5.E.A Egamberdiev, Y.T Ergashev, G.R Rahmonberdiev. To study the effect of chitosan on the mechanical properties of paper. "Scientific-technical and practical journal of composite materials of Uzbekistan". 2021. 79.
6.Umbarov, I., Turaev, K., & Samadiy, M. (2020). Research chemical composition of samples of underground salt waters of Surkhandarya and Urtabulok of Bukhara-Karshi depression. Journal of Critikal Reviews, 7(19), 8559-8562.
7.Умбаров, И. А. (2016, November). Комплексная переработка природных подземных вод. In Горно-металлургический комплекс: достижения, проблемы и перспективы инновационного развития: Тез. докл. Республ. науч.-техн. конф.–Навои (p. 366).
8.Умбаров, И. А. (2002). Исследование и усовершенствование технологии получения йода из йодсодержащих подземных вод. Ташкент-2002.-24 с.
9.Умбаров, И. А., & Тураев, Х. Х. (2015). Исследование процесса осаждения йода из раствора абсорбента с потенциометрическим титрованием. Вестник ТашГТУ, (4), 151-156.
10.Умбаров, И. А., & Тураев, Х. Х. (2015). Исследование кинетики окисления йодид-ионов в гидротермальных водах различными окислителями. Узбекский химический журнал, (6), 12-16.
11.Umbarov, I. A., Mamatraimov, A., & Himmatov, S. (2014). Study of Iodine Distribution in Natural Sources. In Actual Problems in Analytical Chemistry, Abstract, Proceedings of 4th Republican Research-to-Practice Conference, Termez (pp. 345-346).
12.Умбаров, И. А., Кулматов, Р. А., Тураев, Н. Й., & Ишанходжаев, С. (2000). Содержание и форма нахождения йода в подземных соленых водах Сурхандарьинской области. Узб. хим. жур, (1), 70-72.
13.Ishanhojaev, S., Umbarov, I., Kulmatov, R. A., & Mingturaev, M. (2000). Study of iodine of ions of oxidation by potentiometric method. UZBEKSKII KHIMICHESKII ZHURNAL, (6), 14-15.
14.Umbarov, I. Study of iodine of ions of oxidation by potentiometric method. vol. 5 (2021). 2021-06.01.
15. Эшкараев, С. Ч., Тураев, Х. Х., & Умбаров, И. А. (2020). Радиометрическое определение активности бета-излучений стронция-90 в почвах Сурхандарьинской области Узбекистана. In Вестник научных конференций (No. 6-1, pp. 121-124). ООО Консалтинговая компания Юком.
16.Эшмуродов, Х. Э., Гелдиев, Ю. А., Тураев, Х. Х., Умбаров, И. А., Джалилов, А. Т., & Бабамуратов, Б. Э. (2020). Получение и исследование модифицированных глифталевых смол с кремнийорганическим соединением. Universum: технические науки, (12-5 (81)), 4-8.

17.Умбаров, И. А., Тураев, Х. Х., Набиев, Д. А., Тураханов, М. И., & Холтураев, К. Б. (2019). Процессы выделений йода из концентратов. Universum: технические науки, (10-2 (67)), 48-51.
18.Умбаров, И. А., Тураев, Х. Х., Аликулов, Р. В., Чориев, О. Э., & Эшмуродов, Х. Э. (2018). Кинетика окисления йодид-ионов в присутствии различных окислителей из подземных соленых вод. Universum: технические науки, (3 (48)), 41-44.
19.Умбаров, И. А., Тураев, Х. Х., Касимов, Ш. А., & Умбарова, М. И. (2017). Усовершенствование способа выделения элементного йода из абсорбентов. ILMIY AXBOROTNOMA, 5.
20.Умбаров, И. А., Тураев, Х. Х., Касимов, Ш. А., & Умбарова, М. И. УСОВЕРШЕНСТВОВАНИЕ СПОСОБА ВЫДЕЛЕНИЙ ЭЛЕМЕНТНОГО ЙОДА ИЗ КОНЦЕНТРАТОВ.
21.Курбанов, Ш. Й., Умбаров, И. А., & Бабамуратов, Б. Э. (2022). ОБЛАСТИ ПРИМЕНЕНИЯ ЙОДА И ЙОДНЫХ СОЕДИНЕНИЙ. In НАУКА И МОЛОДЁЖЬ: АКТУАЛЬНЫЕ ВОПРОСЫ СОВРЕМЕННЫХ НАУЧНЫХ ИССЛЕДОВАНИЙ (pp. 12-15).
22.Умбаров, И. А. (2021). Количественное Определение Содержания Йода В Гидротермальных Подземных Водах. CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES, 2(6), 339-342.
23.Гелдиев, Ю. А., Тураев, Х. Х., Умбаров, И. А., Эшмуродов, Х. Э., & Джалилов, А. Т. (2021). СИНТЕЗ И ИССЛЕДОВАНИЕ НОВОГО СОЕДИНЕНИЯ НА ОСНОВЕ ПОЛИКРЕМНИЕВОЙ КИСЛОТЫ, МОДИФИЦИРОВАННОЙ МОНОЭТАНОЛАМИНОМ. Universum: химия и биология, (10-2 (88)), 78-81.
24.Эшанкулов, Х. Н., Тураев, Х. Х., Умбаров, И. А., & Джалилов, А. Т. (2021). ОРГАНИЧЕСКИЙ ПОЛИМЕРНЫЙ СИНТЕЗ МЕТАЛЛОВ НА ОСНОВЕ АКРИЛОНИТРИЛА. Universum: технические науки, (7-3 (88)), 5-8.
25.Гелдиев, Ю. А., Тураев, Х. Х., Умбаров, И. А., & Джалилов, А. Т. (2021). СИНТЕЗ И ИК-СПЕКТРОСКОПИЧЕСКИЙ АНАЛИЗ ПРОИЗВОДНЫХ ПОЛИКРЕМНИЕВОЙ КИСЛОТЫ С МОЧЕВИНОЙ И ФОРМАЛЬДЕГИДОМ. Universum: химия и биология, (7-1), 95-98.
26.Umbarov, I. A., & Turaev, H. K. INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY INVESTIGATION MECHANISMS AND KINETICS OF OXIDATION IODIDE IONS IN HYDROTHERMAL WATERS VARIOUS OXIDANTS.
27.Umbarov, I. A., & Turaev, H. K. INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY STUDY OF IODINE DISTRIBUTION FORM IN AN ABSORBENT.
28.Умбаров, И. А., Тураев, Х. Х., Касимов, Ш. А., & Умбарова, М. И. (2017). Усовершенствование способа выделения элементного йода из абсорбентов. ILMIY AXBOROTNOMA, 5.
29.Potaenko, K. D., Umbarov, J., Kulmatov, R. A., Turayev, N. Y., & Ishankhodjayev, S. (1999). The removal of iodine from underground salt water by the air desorption method. UZBEKSKII KHIMICHESKII ZHURNAL, (5/6), 92-94.
30.Kulmatov, R. A., Turaev, N. Y., Kenjaev, D., Tillaev, K., & Umbarov, I. (1999). Investigation of distribution and migration forms of toxic elements by complex radioactivation methods.
31.Kulmatov, R. A., Kenjaev, D. S., Umbarov, I., Tillaev, K., & Normuradov, B. (2001). The investigation of physic-chemical forms of toxic metals by activation analysis.
32.Умбаров, И. А., & Тураев, Х. Х. (2017). Потенциометрические исследования окисления ионов йода с нитрита натрия. Universum: технические науки, (12 (45)), 48-50.

33.Умбаров, И. А., & Тураев, Х. Х. (2017). КОМПЛЕКСНАЯ ПЕРЕРАБОТКА ГИДРОТЕРМАЛЬНЫХ ВОД. In EUROPEAN RESEARCH: INNOVATION IN SCIENCE, EDUCATION AND TECHNOLOGY (pp. 8-11).
34.Умбаров, И. А., & Тураев, Х. Х. (2018). ОПРЕДЕЛЕНИЕ ЭЛЕМЕНТНОГО СОСТАВА ПОДЗЕМНЫХ СОЛЕНЫХ ГИДРОТЕРМАЛЬНЫХ ВОД. Science Time, (2 (50)), 76-79.
35.Умбаров, И. А., & Тураев, Х. Х. (2018). Подземные воды как промышленное ценное сырье. Universum: технические науки, (1 (46)), 7-9.
36.Умбаров, И. А., & Тураев, Х. Х. (2019). Изучение элементного состава гидротермальных подземных соленых вод скважины" Каттакум-2" месторождения Хаудаг. Universum: химия и биология, (9 (63)), 9-12.