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Research Article

PRODUCTION OF SUPERPLASTICIZERS BASED ON PYROLYSIS PRODUCTS OF HEAVY RESINS

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ABSTRACT

A process for obtaining naphthalene, indene and phthalic anhydride based on distillation of liquid and solid fractions of heavy pyrolysis products has been implemented. The quantitative and qualitative composition of resin samples and the products of processing their fractions have been determined. Superplasticizers-additives for cement have also been created, their strength, average density of cement particles, the effect of the amount of superplasticizers and the duration of their action on the properties of the material have been studied.

KEYWORDS

Pyrolysis heavy distillate, naphthalene, indene, phthalic anhydride, superplasticizer.

INTRODUCTION

The purpose of pyrolysis processes, which are extremely common in modern petrochemistry, is to

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obtain lower olefins, primarily ethylene, which is a valuable raw material for the synthesis of the most important petrochemical products [1-3].

The pyrolysis process produces ethylene, propylene, butylene, butadiene, as well as a significant amount of benzene, aromatic hydrocarbons such as toluene, xylene, indene, naphthalene and anthracene. Ethylene obtained by pyrolysis is used to produce ethylene oxide, ethyl alcohol, polymers, styrene, plastics and other products. The main areas of application of liquid pyrolysis products include the production of benzene and other aromatic hydrocarbons, oils from polymer resins, diesel fuel, coal and high-quality coke [4-5]. To improve the quality of the cement composition, it is important to use highly effective plasticizing additives. In the construction industry, superplasticizers are used to regulate the processes of structure formation and rheological properties of concentrated suspensions. These are chemical additives that allow changing the mobility of raw materials and the properties of finished products. One of the urgent tasks today is the search for new effective additives that will allow changing the interfacial properties and rheological characteristics of dispersions [8-12].

METHODS

For the first time, catalysts of the VBS-33, VBS-44, VBS-55, VBS-66 types were created for the separation of naphthalene and indene fractions from secondary products of gas chemistry at different temperatures and for the production of plasticizers. The methods of UV spectroscopy, Raman spectroscopy, gas chromatography, mass spectrometry and differential thermal analysis (DTA) were used in the work. Heavy pyrolysis oils from gas processing plants, naphthalene, indene and their homologues, plasticizers for concrete and cement, phthalic anhydride, naphthalene were studied.

RESULTS

The main direction of economic development of the Republic is the development of natural resources, their use, large-scale modernization of industrial production, technical and technological renewal, the introduction of modern scientific achievements and progressive innovative technologies in production, the creation of competitive import-substituting products with stable demand in the world market. Pyrolysis distillates and pyrolysis oils, such as naphthalene and aromatic hydrocarbons, are currently the main secondary raw materials for the production of valuable chemical products needed for industry. Processing of heavy fractions of liquid pyrolysis products and the introduction of these products into practice in the future are considered relevant, which allows producing expensive and necessary products based on modern technologies. Due to the lack of acceptable technologies for processing pyrolysis waste for the production of indene, naphthalene and its homologues, phthalic anhydride is not produced in the country. Therefore, research aimed at developing technologies for processing waste from gas chemical complexes is an urgent task and requires its own solution.

Pyrolysis distillates and pyrolysis oil, as well as heavy fractions of liquid pyrolysis products, are secondary raw materials with great potential for the production of naphthalene, aromatic hydrocarbons, indene, phthalic anhydride and other valuable chemical products.

Currently, modern technologies allow us to produce expensive and necessary products. Due to the lack of acceptable technologies for processing pyrolysis waste for the production of indene, naphthalene and its homologues, phthalic anhydride is not produced in our country. Therefore, research aimed at developing

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an integrated technology for processing waste from gas chemical complexes operating in the republic is an urgent task and requires a solution.

The process of thermal pyrolysis of hydrocarbon raw materials is the main method for obtaining low-molecular unsaturated hydrocarbons-olefins (alkenes) - ethylene and propylene. The main areas of application of liquid pyrolysis products include the production of benzene and other aromatic hydrocarbons, naphthalene, petroleum polymers, gasoline, raw materials for the production of high-quality coke, etc.

Currently, due to the decline in oil production in the petrochemical industry, the problem of expanding the raw material base for the production of aromatic hydrocarbons and their various derivatives is becoming more urgent. Heavy pyrolysis products such as indene and naphthalene, as well as their homologues, are of great interest as potential raw materials for the production of petrochemical products.

Secondary gas chemical products were separated into naphthalene and indene fractions at different temperatures. Based on the obtained products, catalysts of various compositions were created (VBC-33, VBC-44, VBC-55, VBC-66) [6].

In Uzbekistan, ethane, propane-butane fractions and gas condensates are priority raw materials for thermal pyrolysis of hydrocarbons. During the study, heavy fractions of liquid and solid pyrolysis products, secondary gas chemical products and the chemical composition of pyrolysis distillate were studied. Analysis of the results showed that the secondary products isolated from heavy pyrolysis are a liquid with a pungent odor, in the form of a dark brown fat-like liquid, and the composition of the resulting raw materials for pyrolysis is unstable. In order to use liquid pyrolysis products as secondary raw materials and develop a technology for their processing, work was carried out to study the chemical composition of the pyrocondensate produced at the Ustyurt Gas Chemical Complex.

Table 1. Chemical composition of pyrolysis distillate

Number of carbon atoms	Alkanes	Dienes	Olefins	Cycloalkanes	Arenes	Total
5	0,8	0,89	4,91	0,19	0	6,79
6	0,22	0,41	3,87	0,41	32,94	37,85
7	0,25	0,14	0,84	0,45	11,23	12,91
8	0,12	0,08	0,18	0,48	9,75	10,61
9	0,04	0,1	0,04	0,15	7,56	7,89
10	0,03	0,11	9,07	0,4	5,23	14,84
11	0,18	0,69	2,95	0	0,47	4,29
12	0	0,15	1,84	0	0	1,99
Total	1,64	2,57	23,7	2,08	67,18	97,17

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Fractions of naphthalene and its homologues were isolated from heavy pyrolysis resins by dealkylation and rectification. Naphthalene is produced using local raw materials, which has a positive effect on the efficiency of the entire process of processing heavy pyrolysis resins. At the same time, the main problem of the efficient use of heavy pyrolysis products is associated with asphaltenes and mechanical impurities in their composition. The isolated products from heavy pyrolysis oils are odorless and depend on the composition of the feedstock. Pyrocondensates from heavy pyrolysis products containing indene and naphthalene allow the synthesis of phthalic anhydride on their basis [7].

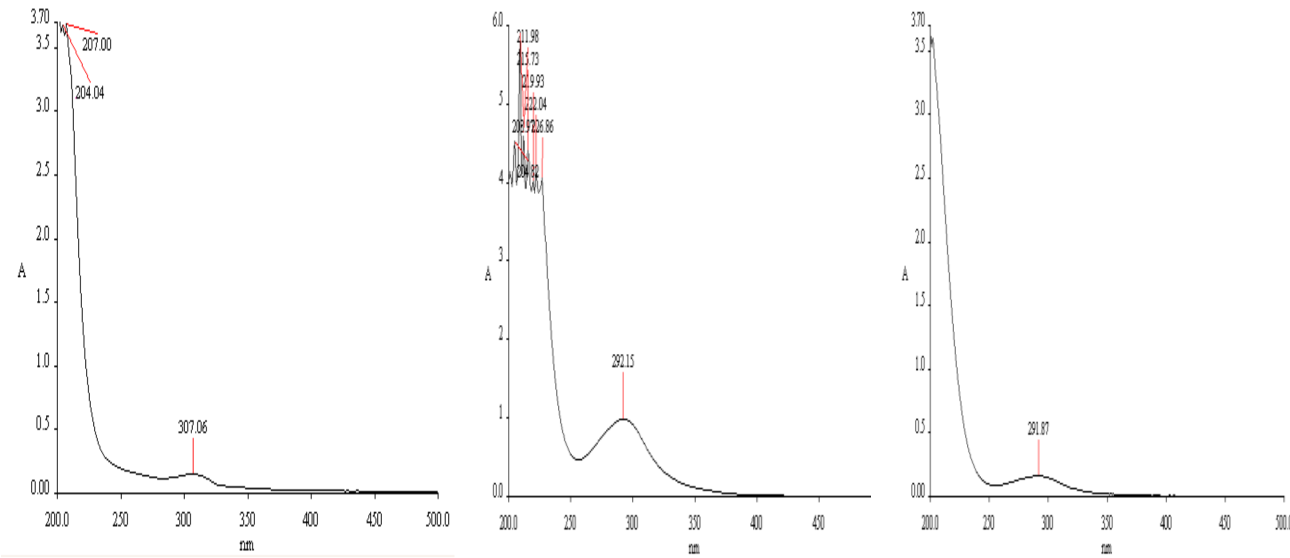
Table 2. Qualitative and quantitative composition of heavy pyrolysis resin samples

№	Substance	Number, %	Degree of compliance	Retention time, minutes
1	Indene	9,33	93	12,30
2	1-methylindene	8,96	96	14,72
3	Naphthalene	41,51	90	15,47
4	1-methylnaphthalene	8,61	97	17,59
5	2-methylnaphthalene	16,25	96	17,34
6	1-ethylnaphthalene	1,77	90	18,78
7	1,6-dimethylnaphthalene	1,71	95	19,18

The qualitative and quantitative composition of heavy pyrolysis resin samples was studied. The studies were carried out using an Agilent 5977-A gas chromatograph with a 30 m × 0.25 mm column, and the composition of the prepared sample was analyzed by chromatograph mass spectrometry. The results are presented in Table 2.

In the construction industry, superplasticizers are used to control the process and formation of the structure, as well as the rheological properties of organic chemical additives - concentrated suspensions, which allows for targeted changes in the fluidity of mixtures of raw materials and the properties of finished products.

Based on this, a superplasticizer based on naphthalene obtained from secondary raw materials of production was synthesized in the course of the work. The resulting hydrolyzed polyacrylonitrile, synthesized superplasticizer and diluted superplasticizer were analyzed by UV spectroscopy (see Figure 1).



A) Hydrolyzed polyacrylonitrile;

B) Synthesized superplasticizer;

C) Molten superplasticizer.

Dry building materials were selected for testing superplasticizers: PS400 D-20 Portland cement, gypsum, and cement with a high aluminum content. The effect of superplasticizers on the properties of these products was studied (see Table 3).

Table 3. Test results for cement with synthesized superplasticizer

№	Mass of cement, g	Amount of additives by weight of cement, %	Water-cement ratio	Average density g/cm³	Density
1	100	-	0.31	2.065	25
2	100	0.05	0.30	2.05	25
3	100	0.2	0.29	2.142	27
4	100	0.5	0.28	2.12	28
5	100	0.8	0.27	2.15	30
6	100	1	0.27	2.192	31

Superplasticizers were added in quantities of up to 1% by weight of the binder. Adding superplasticizers in quantities greater than 1% in most cases resulted in a decrease in cement strength.

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Table 4. Test results of cement pastes with synthesized superplasticizer and high aluminum content

№	Mass of cement, g	Amount of additives by weight of cement, %	Water-cement ratio	Average density g/cm³	Density
1	100	-	0.43	6	37
2	100	0.02	0.43	6	38
3	100	0.2	0.43	7	42
4	100	0.5	0.43	8	45
5	100	0.8	0.43	11	50
6	100	1	0.43	13	54
7	100	1	0.39	6	66

The analysis of the obtained results shows that when adding a superplasticizer to the mass at a constant water-cement ratio, the strength of the product increases, and the average density of cement particles increases with an increase in the amount of superplasticizer. This indicates the strength of the cement mixture and the improvement of its performance characteristics.

As can be seen from Table 4, when adding a superplasticizer, the fluidity of cement with a high aluminum content is 13 cm. Comparison of these results with conventional cement compositions showed an increase in plasticity. According to literary data, this is due to the high content of tricalcium aluminate. A study of the production of superplasticizers based on pyrocondensate-pyrolysis products was carried out, and cement mixtures with superplasticizers were examined. Their results are given in Table 5.

Table 5. Test results of the synthesized superplasticizer and gypsum pastes

№	Mass of cement, g	Amount of additives by weight of cement, %	Water-cement ratio	Average density g/cm³	Density
1	100	-	0.5	8	11.6
2	100	0.03	0.5	8	16.1
3	100	0.2	0.5	9	15
4	100	0.5	0.5	10	13.3

5	100	0.8	0.5	11	12
6	100	1	0.5	13	11

The analysis of the results showed that the distinctive feature of the superplasticizer is that when it is used, normal setting of the cement mixture occurs with the formation of a fine-crystalline structure. Also, according to the X-ray analysis of the binder samples, superplasticizers do not affect the composition of hydrated phases on the cement surface.

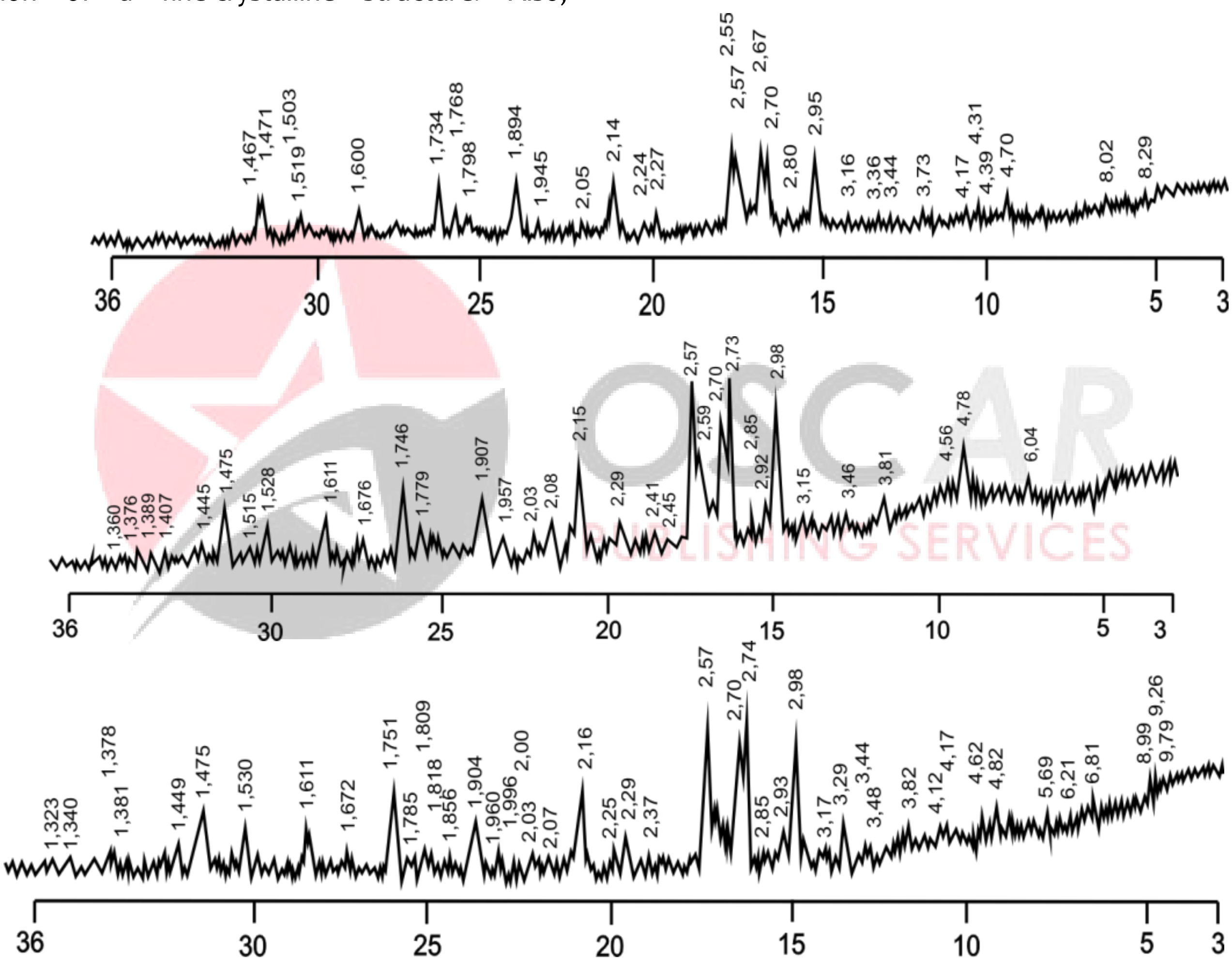

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Figure 1. XRF spectrometer for superplasticizers

At the same time, the superplasticizer also has a medium plasticizing effect. With an increase in the amount of superplasticizer, the density increases from 11.6 MPa to 16.1 MPa. With an increase in the amount of additives in relation to the mass of gypsum from 0.2% to 1%, the density of the mixture decreases from 15 to 11 MPa.

CONCLUSIONS

The main content of the pyrolysis distillate is 67.18% arene with a number of carbon atoms from 6 to 12 and 23.7% olefins, which allows the separation of naphthalene and indene from the distillate. Naphthalene, indene and their homologues were isolated from the composition of heavy pyrolysis oils of gas processing plants, and plasticizers for concrete and cement were also obtained. At the same time, the influence of catalysts of various compositions on superplasticizers in the process of extracting indene and naphthalene from heavy pyrolysis products was investigated and analyzed. The chemical composition of heavy pyrolysis distillate, the qualitative and quantitative composition of heavy pyrolysis oil samples and the results of testing cement with the synthesized superplasticizer were studied. The structure of the obtained substances and their physicochemical properties were confirmed using various methods.

REFERENCES

1. Павлович Л.Б., Андреиков Е.И. Улучшение производства фталевого ангидрида из нафталина промышленного класса. *Коксы Химия*, 2013, № 9, с. 59–62.
2. Романова Н.А., Леонтьева В.С., Хрекина А.С. Производство коммерческого нафталина путем переработки каменноугольной смолы. *Кокс и Химия*, 2018, т. 61, № 11, с. 453–456. © AllertonPress, Inc., 2018. Оригинальный русский текст опубликован в *Коксы Химия*, 2018, № 11, с. 36–40.
3. Саху Б.М., Бера В.В., Кумар Р., Баник Б.К., Бора П. Полиароматические углеводороды (PAHs): структуры, синтез и их биологический профиль. *CurrentOrganicSynthesis*, т. 17, вып. 8, 2020, с. 625–640.
4. Ша Ш., Ванг М., Цай Ц., Ши Ц., Сяо Ю. Влияние структуры полиуксуснойсуперпластификатора на его производительность в цементных материалах — Обзор. *Construction and Building Materials*, т. 233, 2020. https://doi.org/10.1016/j.conbuildmat.2019.117257.
5. Зиядуллаева К.Х., Нурманов С.Э., Мухиддинов Б.Ф., Кодиров О.Ш., Вапоев Х.М. Катализатор окисления ВК-10-2 для производства фталевого ангидрида из нафталина. *Национальная ассоциация ученых (НАУ)*, № 61, 2020, с. 46–49.
6. Зиядуллаева К.Х., Нурманов С.Э., Курбанова А.Дж., Ахмедова Н. Технологические основы приготовления и изучение свойств катализаторов при получении фталевого ангидрида на основе нафталина. *Universum: технические науки*, научный журнал, № 8(89), Часть 2, Изд. «МЦНО», 2021, с. 37–43.
7. Кодиров О.Ш., Зиядуллаева К.Х. Элементный анализ синтезированных катализаторов на основе оксида ванадия и бентонита. *Бухара*, 2020, с. 457–459.
8. Батраков В.Г. Модифицированные бетоны. Теория и практика. М.: Технопроект, 1998. 768 с.
9. Гамалий Е.А. Комплексные модификаторы на основе эфиров поликарбоксилата и активных минеральных добавок для тяжелого конструкционного бетона: дис. канд. тех. наук, Челябинск, 2009. 217 с.
10. Ибрагимов Р.А. Тяжелые бетоны с комплексной добавкой на основе эфиров поликарбоксилатов: дис. канд. тех. наук, Казань, 2011. 184 с.
11. Рамачандран В.С. Добавки в бетон. Справочное пособие. М.: Стройиздат, 1988. 244 с.
12. Рамачандран В.С. Применение дифференциального термического анализа в химии цементов. М.: Стройиздат, 1977. 408 с