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Separation Of Mononuclear Arenes in The Deg+Dmso System

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Abstract: One of the main points affecting the economics of the extraction process is the efficiency of the extractor, which determines the ratio of solvent to raw material. Reducing this ratio is one of the promising ways to improve the technical and economic indicators of the process

One of the main points affecting the economics of the extraction process is the efficiency of the extractor, which determines the ratio of solvent to raw material. Reducing this ratio is one of the promising ways to improve the technical and economic indicators of the process. The literature [2, 4] describes the requirements for selective solvents in detail. The industrial extractor must have high selectivity and dissolving power, easy regeneration, sufficiently high density difference with the raw materials to be separated, low viscosity, etc. When choosing an extractant, it is necessary to take into account the resources of the solvent and the possibility of using the selected solvent in addition to extraction processes and for other industrial purposes.

To date, universal type extractors that combine high separation selectivity with a sufficiently large solution power and fully meet the requirements of modern technology have not yet been found. Therefore, the search and study of the extraction properties of effective polar solvents for the production of benzene in Uzbekistan is an extremely important and urgent task of the national economy. Benzene production in different countries is based on different processes. The main sources of benzene production in Uzbekistan are pyrolysis distillate produced by Uz-Kor Gas Chemical LLC and reforming catalyst produced by Bukhara Oil Refinery LLC.

Benzene is the most important raw material of the petrochemical industry, on the basis of which large tons of organic synthesis products are produced. According to Rosstat, the volume of benzene production (including pyrolysis products, oil) was 1,200,000 tons. According to the experts of the Industrial Information Agency, the world demand for benzene will increase by 5.2% per year on average and will amount to 41 million tons per year. The fastest growth is observed in Asia (excluding Japan) - at an average of 7.5% per year, as well as in other regions of the world - 13.6% (mainly in the Middle East and South America). The main increase in the production of benzene occurs due to the commissioning of new capacities, as well as an increase in the production of pyrolysis benzene [1]. The consumption of benzene, which is a raw material for obtaining cyclohexane, linear alkylbenzenes, etc., is constantly increasing. Most of the obtained benzene is used to synthesize other products:

- about 50% of benzene turns into ethylbenzene (alkylation of benzene with ethylene);
- about 25% of benzene is converted to cumene (alkylation of benzene with propylene);
- approximately 10 - 15% of benzene is hydrogenated to cyclohexane;
- about 10% of benzene is used for the production of nitrobenzene;
- 2 - 3% of benzene turns into linear alkylbenzenes;

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• Approximately 1% of benzene is used for the synthesis of chlorobenzene [3].
Currently, more than 200 solvents have been proposed for the extraction of aromatic hydrocarbons, and about ten of them are used in industry. However, each of them, in addition to positive technological features, has a number of disadvantages.
Therefore, research is being conducted on a large scale in the field of synthesis of new efficient solvents and improvement of technology based on existing extractants [5-11]. Its widespread use is explained by high selectivity, relative cheapness, availability, high thermal stability and low toxicity. Diethylene glycol provides high extraction and purity of aromatic hydrocarbons. The Yudex process was intensively improved by improving the technology and replacing diethylene glycol with higher polyglycols - tri- and tetraethylene glycol, which have higher potency and almost the same selectivity compared to diethylene glycol.
In 1959, Shell developed an extraction process using sulfolane [l5,16]. Sulfolane has higher selectivity and greater solvent power than glycols. This allows the process to be performed at a lower solvent feed rate [20]. Sulfolane is one of the most effective modern selective solvents, indicating rapid industrial adoption of the sulfolane process overseas. So, if the first unit was launched in 1962, then in 1970 this process was already used in 40 units. Disadvantages of the process include the difficulty of removing the solvent from the separation products and the need to use reduced pressure to recover the solvent. Sulfolane has a relatively high melting point (27.8 °C) [l5], which can be lowered by adding water, but this causes a significant decrease in the solubility of sulfolane. Compared to the Yudex process, the drastic change in process conditions and the relatively high cost of sulfolane are major ca requires capital investments. Among the disadvantages of dimethyl sulfoxide is its relatively low thermal stability (heat-resistant up to 140 ° C), which makes it difficult to recover it by rectification. To obtain pure aromatic hydrocarbons, a second solvent (butane or pentane) is poured into the extraction column to displace 3-5% of non-aromatic hydrocarbons from the extract phase [l2-14]. Aromatic hydrocarbons are removed from the solvent extract phase by back-extraction with butane or pentane. The use of a second solvent complicates the technological scheme [33]. In addition, dimethyl sulfoxide is hygroscopic, and the presence of water in the solvent reduces its solubility. Thus, none of the above selective solvents are ideal for obtaining low molecular weight aromatic hydrocarbons. Such disadvantages of solvents from a technological and economic point of view force researchers to search for new, more effective solvents, including mixed solvents obtained on the basis of substances available in the chemical industry [30].
In order to increase the selectivity of the extraction process and increase the concentration of extractable components in the extract, the addition of water is most often used [12,21-29]. However, the use of water leads to an increase in solvent consumption, a decrease in its solubility and an increase in energy costs. In some cases, the introduction of water into the extractant is accompanied by hydrolysis of the solvent, which leads to corrosion of the equipment and a decrease in the stability of the solvent.
According to modern researchers, the use of non-aqueous mixed solvents is one of the promising ways to improve the extraction process of low molecular weight aromatic hydrocarbons. This literature review allows us to draw the following conclusions. Currently, in industrial practice, the process of liquid extraction with the help of selective solvents to obtain low molecular weight aromatic hydrocarbons from crude oil is widespread. The improvement of the process is due to the selection of new, more effective selective solvents than currently used. Analysis of the literature

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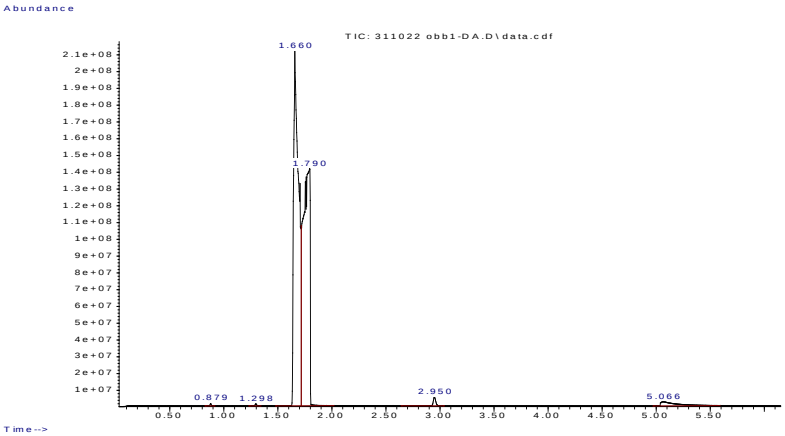
shows that dimethyl sulfoxide and diethylene glycol are of practical interest among the new selective solvents currently being proposed. The preparation of the benzene DMSO + DEG system can be carried out at low temperatures, atmospheric pressure and a low ratio of solvent to raw material. DMSO+DEG meets the requirements of selective solvents and has a cheap and convenient raw material base. The addition of DEG to DMSO results in a significant increase in the heterogeneous region of the diagram, the maximum concentration of benzene in the extract, and the upper limit of the aromatic hydrocarbon concentration in the feed. Addition of DEG to DMSO results in a decrease in solvation strength and an increase in solvent selectivity. Given the nature of the solubility curve, DEG content in a mixed solvent above 50% is impractical.

According to the above optimal technology condition, benzene from the pyrolysis distillate produced by JV "Uz-Kor Gas Chemical" LLC was extracted in a DMSO+DEG mixed solvent in a 1:1 ratio by weight, and the resulting benzene was formed. purified, analyzed on a GCMS instrument. The results of the analysis are presented in Table 9 and Figure 1.



The results of the obtained analyzes show that benzene was extracted from the pyrolysis distillate produced by "Uz-Kor Gas Chemical" LLC in a mixed solvent of DMSO + DEG in a benzene ratio of 1:1 by weight at 1,660 and 1,790 minutes. purity is 97.52%. The IR spectroscopic analysis of the resulting benzene is presented in Figure 2.

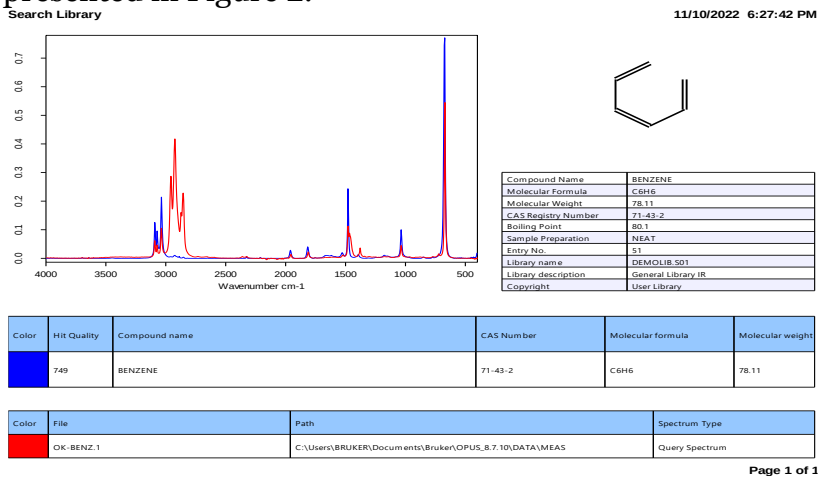


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Figure 2. IR spectrogram of benzene from pyrolysis distillate.

Thus, according to the obtained results, it is possible to increase the efficiency of extracting benzene from the pyrolysis distillate produced by JV "Uz-Kor Gas Chemical" LLC in a DMSO+DEG mixed solvent in a 1:1 mass ratio. Optimum parameters of benzene extraction process with mixed solvent DMSO + DEG were determined, which are necessary for designing devices for extracting aromatic hydrocarbons. Based on the obtained data and their mathematical processing in laboratory conditions, optimal conditions were created for obtaining benzene from sample mixtures of hydrocarbons and pyrolysis distillate with DMSO + DEG mixed solvent. The obtained information can be used in the design of devices for the extraction of benzene and in the reconstruction of similar devices.

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