DESULFURIZATION OF DIESEL FUELS BY METAL-CONTAINING IONIC LIQUIDS

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УДАЛЕНИЕ СЕРНИСТЫХ СОЕДИНЕНИЙ ИЗ ДИЗЕЛЬНЫХ ТОПЛИВ С ИСПОЛЬЗОВАНИЕМ МЕТАЛЛОСОДЕРЖАЩИХ ИОННЫХ ЖИДКОСТЕЙ

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Аннотация. *Данная статья посвящена проблеме удаления сернистых соединений из дизельных топлив. Представлены характеристики полученных экстракционных систем на основе ионных жидкостей и солей металлов ($CuBr_2$, $CoBr_2$, $NiBr_2$). Показана возможность использования комплексов ионных жидкостей с солями металлов в качестве экстрагентов для удаления серы из дизельного топлива.*

Introduction. Currently there is a rapid growth of scientific research and technological developments in the "green chemistry" field. The replacement of traditional solvents is one of the important areas of this field. It is perspective to use ionic liquids (IL) because these compounds are not combustible, thermally stable, reusable, have low vapor pressure, and low toxicity [1-3].

ILs constitute compounds consisting of ions and being in the liquid state at room temperature. Generally, ILs contain a volumetric, unsymmetrical organic cation and a weakly coordinating inorganic or organic anion. ILs were described first in the 1910s, however, interest to them in scientific and industrial fields of activity has increased significantly only in the last 20 years [4-5]. This is because ecological characteristics of ILs considered as an alternative to traditional volatile organic solvents and their wide range of physicochemical properties. In recent years, ILs are widely used in the petrochemical industry for desulfurization of motor fuels.

The aim of this work is to synthesize ionic liquids based on imidazole with chlorides and metal trifluoroacetates and to study compounds obtained in desulfurization of diesel fuels by metal-containing ionic liquids.

Materials and methods. To study ILs as extragents of sulfur compounds, ionic liquids based on imidazole and 2-methylimidazole were synthesized from the diesel fuels. For the extraction system based on ILs (1,3-butylimidazole bromide, 1,3-butyl-2-methylimidazole bromide, and following metal salts $CuBr_2$, $CoBr_2$, $NiBr_2$), were chosen anhydrous metal bromides prepared according to the described methods [6] and then dissolved in ILs by a magnetic stir bar at room temperature.

Discussion. The extraction system "ionic liquids - metal salts» was obtained by dissolving anhydrous salts and trifluoroacetates bromides of metals in ILs. The ILs as the main components of the extraction system must satisfy following requirements: not to be mixed with the hydrocarbon phase, dissolve inorganic electron acceptors - variable valency metal chlorides. The dissolution of inorganic salts in ILs was conducted due to

solvation and coordination effects. The data on extraction of diesel fraction 200-350 ˚C by solutions of metal chlorides in ILs 1,3-butylimidazole bromide (1,3-butyl-2-methylimidazole bromide) are shown in table 1.

Table 1

The extraction of sulfur compounds from the diesel fraction 200-350 ˚C. Total sulfur (S_0) in the initial sample – 0,2%

Ionic liquid, name	Metal salt, name	Concentration of metal salt in IL,%	Total sulfur in the sample, S_0,%	Sulfur compounds recovery rate, %
1,3-butylimidazole bromide	copper bromide, $CuBr_2$	0,05	0,08	60
1,3-butylimidazole bromide	copper bromide, $CuBr_2$	0,1	0,09	55
1,3-butylimidazole bromide	copper bromide, $CuBr_2$	0,2	0,12	40
1,3-butylimidazole bromide	copper bromide, $CuBr_2$	0,3	0,14	30
1,3-butylimidazole bromide	cobalt chloride, $CoC1_2$	0,05	0,13	35
1,3-butylimidazole bromide	cobalt chloride, $CoC1_2$	0,1	0,14	30
1,3-butylimidazole bromide	nickel bromide, $NiBr_2$	0,05	0,15	25
1,3-butylimidazole bromide	nickel bromide, $NiBr_2$	0,1	0,17	15
1,3-butyl-2-methylimidazole bromide	copper bromide, $CuBr_2$	0,05	0,07	65
1,3-butyl-2-methylimidazole bromide	cobalt chloride, $CoC1_2$	0,05	0,13	35
1,3-butyl-2-methylimidazole bromide	nickel bromide, $NiBr_2$	0,05	0,17	15

Figure 1 illustrates the dependence of residual sulfur content in diesel fuel from the extragent 1,3-butylimidazole bromide with metal salts.

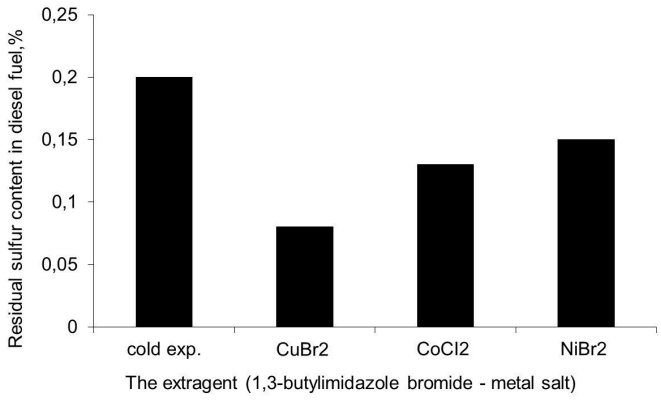

Fig. 1. The dependence of residual sulfur content from the extragent (1,3-butylimidazole bromide with metal salts)

Figure 2 illustrates the dependence of residual sulfur content in diesel fuel from the extragent 1,3-butyl-2-methylimidazole bromide with metal salts.

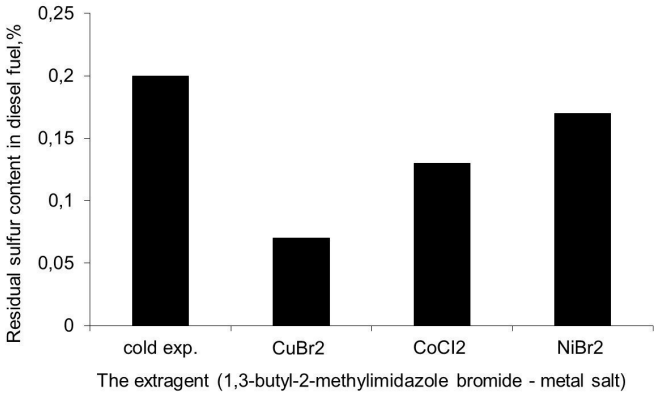

Fig. 2. The dependence of residual sulfur content from the extragent (1,3-butyl-2-methylimidazole bromide with metal salts)

From the diagrams it is visible that extragents (1,3-butylimidazole bromide, 1,3-butyl-2-methylimidazole and metal salts $CuBr_2$, $CoBr_2$, $NiBr_2$) are capable of removing sulfur compounds from the diesel fuels.

Conclusion. Thus, complexes of ILs with metal salts can be useful as extragents for removing sulfur compounds from diesel fuels.

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