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Ecological aspects of naphthenic acids extraction from heavy crude oil

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Abstract

The paper presents an ecological approach to the problem of acidic heavy oils which share in the total balance of the produced hydrocarbon raw materials is growing steadily. It is shown that naphthenic acids and their salts should be attributed to serious eco toxicants that pose the problem of removing them from the oil and petroleum products in a number of important technological and environmental challenges, which the oil industry faces. During the study naphthenic acids were extracted from four crude oils with relatively high oxidation, the method of «dry leaching» being used. The paper performs the scheme of acid extraction from fractions 200-300 °C and the calculations of the main data of naphthenic acids extraction: removal rate of naphthenic acids from oil, distillate output, reagent output. The results show that the higher the acid index of crude oil is, the higher is the acidic index of the acids obtained. To determine the structural – group composition of the extracted acids the method of IR spectroscopy was used and spectral ratios of the naphthenic acids were calculated: aromatic, aliphatic, branching coefficients, degree of oxidation. It is also shown that using the IR spectroscopy it is possible to control the extraction ratio of naphthenic acids, their oils and the fractions. However, methods of removing naphthenic acids from crude oil and petroleum products are associated with the formation of stable water-oil emulsions, large amount of alkaline waste. To decrease the formation of secondary oily waste the alternative method was tested to remove naphthenic acids from petroleum with imidazole, which can be attributed to a new class of compounds – "ionic liquids". The results of the study show that using imidazole for acids extraction from crude oil leads to higher acid value products numbers, thus there is no need in tertiary treatment of acids, also imidazole can be regenerated. This method of acids extraction from crudes is not less effective compared to traditional one, and more ecofriendly.

References

[1] S.P. Yakutseni. Abundance of hydrocarbon crude enriched with heavy impurity elements. Environmental impact assessment. *St.Pet.: Nedra Press.* **2005**. P.363. (russian)
[2] Speight, James G. Handbook of petroleum product analysis. James G. Speight, PhD, DSc. 2nd edition, **2014**.
[3] A.A. Sukhanov, Y.E. Petrova. Resourse base of Russia`s heavy oils associated components. Petroleum geology. *Theory and Practice*. **2008**. No.3. P.1-11. (russian)
[4] E.B. Zeinalov, N.Y. Ischenko. Naphthenic acids in environment: eco-risks factors. *Petroleum Technologies*. **2014**. No.11. P.87-90. (russian)
[5] C. Whitby. Microbial Naphthenic Acid Degradation. in: Laskin AI, Sariaslani S, Gadd GM, editors.Advances in Applied Microbiology.Vol 70. Burlington. *Academic Press*. **2010**. P.93-125.
[6] N.S. Nametkin, G.M. Egorova, V.H. Hamaev. Naphthenic acids and their chemical treatment products. *Moscow: Chemistry.***1982**. P.184. (russian)
[7] L.V. Ivanova, B.N. Koshelev, N.A. Sokova, E.A. Burov, O.V. Primerova. petroleum acids and their derivatives. Extraction and application (overview). *Gubkin Russian State University of Oil and Gas.* **2013**. No.1(270). P.68-80. (russian)
[8] V.D. Ryabov, R.Z. Safieva, G.N. Gorgadze, L.V. Ivanova, N.A. Sokova, O.B. Chernova, I.A. Bronzova, M.V. Giruts. Petroleum chemistry.study guide. *Moscow: Gubkin Russian state University of Oil and gas.* **2008**. P.100. (russian)
[9] R. Martínez-Palou and R. Luque. Applications of Ionic liquids in contaminants removal from Refinery Feedstocks: an industrial perspective. *Energy Environ. Sci.* **2014**. P.1-54.

[10] P. Wasserscheid, W. Keim. Ionic Liquids – New “Solutions” for Transition Metal Catalysis. *Angew. Chem. Int. Ed.* **2000**. Vol.39. No.21. P.3772-3789.
[11] Manuel Aguilar, Jose Luis Cortina. Solvent Extraction and Liquid Membranes: Fundamentals and Applications in New materials. *CRC Press, Taylor and Francis group, USA*. **2014**. 368p.