SCF extraction process in oil refining and oil production

V.F. Khairutdinov[1,2], F.M. Gumerov[1], M.I. Farakhov[2], I. Z. Salikhov[1], I. M. Abdulagatov[3], L.Y. Sabirova[1]

[1]Kazan National Research Technological University, Kazan, Russia
[2]LLC Engineering Promotional Center "Inzhekhim", Russia
[3]Geothermal Research Institute of the Russian Academy of Sciences, Russia

The technologies for disposal of anhydrous oil sludges, extraction of hydrocarbons from oil-water emulsions and tar sand have been developed with the implementation of supercritical fluid extraction process.

The most preferred solvents (extractants) for petroleum and petrochemical industries are propane, butane and their mixtures. Propane and butane are "related" hydrocarbons to petroleum. The critical parameters of propane and butane correspond to the following values: propane: Tcr = 369.82 K (96.67 °C), Pcr = 4.247 MPa; butane Tcr = 425K (151.85 ° C), Pcr = 3.797 MPa.

The efficiency of the extraction process in the sense of providing highest yields of marketable hydrocarbons, the degree of sulfur extraction and dehydration of the final products is determined by the depth of the investigation of phase equilibrium characteristics for the systems "extractable component-extractant".

For that reason this current research contains phase equilibrium investigations of previously unexplored binary and ternary systems involved in disposal of anhydrous oil wastes, extraction of hydrocarbons from oil-water emulsions and tar sand using the SCFE process.

It has been found that phase diagrams of "naphthalene - propane/butane", "phenol - propane/butane", "hexadecane - propane/butane", "anthracene - propane/butane" and "acetophenone - propane/butane" systems belong to phase behavior of type 1 (according to the classification of D.F. Williams). The liquid-vapor phase equilibrium characteristics for these systems are in fact represented only by binodals, forming a kind of a continuous critical curve. Binary systems "sulfur - propane/butane" and "water - propane/butane" have a weak mutual solubility, phase diagram of these systems belongs to the fifth type of diagrams, which are characterized by breaks in the critical line of a solution. Phase diagrams of "anthracene - propane/butane" and "anthracene - propane" systems belong to phase behavior of the seventh type. Phase diagram of these systems is characterized by the presence of a crystalline phase as well as by a break in the critical line of a solution.

If a reliable data on phase equilibrium characteristics of the above-mentioned hydrocarbons with propane/butane allow to determine the depth of the refining and efficiency of the process, then data on "sulfur - propane/butane" systems may indicate the conditions for minimizing these undesirable substances in final oil product.

The data on kinetics for the processes of hydrocarbon extraction from anhydrous oil sludges, oil-water emulsions and tar sandstone have been obtained.

The feasibility and preference for using SCF extraction process (as opposed to liquid) have been established in relation to the processes of anhydrous oil sludge disposal, extraction of hydrocarbons from oil-water emulsions and tar sandstone in cases where the "soluble - extractant" is a system with a continuous critical curve.

The extraction process has been simulated with the aim of further scaling of the laboratory results to semi-industrial and industrial volumes.

A pilot plant has been created and the extraction process of hydrocarbons from oil sludge has been developed.

SCFE technology in relation to the problem of processing of oil sludge, tar sandstones and oil-water emulsions is appropriate, relevant, environmentally sound and promising from the point of view of economic feasibility and profitability.

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