

ABSTRACT

of the thesis by Otarbayev Nurlybek Shyrynbekuly on the topic: "Development of technology for obtaining reagents for oil demulsification based on by-products of cotton tar processing", presented for the degree of Doctor of Philosophy (PhD) in speciality 6D072100 - "Chemical technology of organic substances"

General characteristics of the dissertation research. The dissertation deals with the problem of obtaining new reagents based on by-products of processing cotton tar for dehydration and desalting of paraffinic oil, intensification of the process of preparation of well products.

The relevance of the research topic. The operation of oil wells in Kazakhstan's fields, aimed primarily at achieving maximum oil production, today leads to a distinct increase in the share of hard-to-recover hydrocarbon reserves. In a number of fields, together with oil, up to 90% of water is extracted, which forms with it stable water-oil emulsions stabilized by natural surfactants (surfactants) and resins. Today, serious problems that exist in the oil industry are the destruction of stable water-oil emulsions during the preparation of well products. The consequence of this is the processes of corrosion of both oilfield equipment and equipment of enterprises for the processing of hydrocarbon raw materials. These phenomena significantly complicate oil production from wells, negatively affect the operation of oil-producing equipment and pipeline communications. This issue is especially relevant for the fields of the South Torgai sedimentary basin, which produce highly paraffinic oil, for example, for the Kumkol, Akshabulak fields, etc. Due to the high stability of such emulsions, their destruction can be achieved only with the help of reagents - demulsifiers. Despite the presence of a wide range of existing demulsifiers, their use in practice does not always give the desired results. It should be noted that most of the demulsifiers used in the field are imported, and mainly purchased at a high cost. All this ultimately has a strong effect on the cost of oil during its preparation at enterprises, both in the field and during its processing. In recent years, the range of composite demulsifiers using imported components has expanded significantly. However, the high price of imported components increases the final cost of compositions based on them. Since the cost of demulsifiers is quite high, the problem of reducing their consumption by increasing the efficiency of the reagents is very urgent.

The use of secondary resources and waste is relevant to reduce the cost of production. The main constituents of secondary resources obtained in the process of processing vegetable oils are soap stocks and tars of fatty acid distillation. In this work, the above problems are solved in a complex way through the use of a by-product of the processing of fat and oil production - cotton tar and the isolation of the initial compounds from it for the subsequent production of composite demulsifiers on their basis by using surfactants of various structures and functional purposes.

An analysis of the existing methods of combating the formation of inverse emulsions of the "water-in-oil" type shows that chemical methods are the most used and promising. One of the effective directions in the creation of new demulsifiers is the compounding of surfactants of various structures, which allows, in the presence

of a certain set of initial components, to obtain compositions with different properties. This way allows expanding the most important characteristics of reagents and expanding their functional action.

The purpose and objectives of the study:

The purpose of the research is to develop a technology for producing oil demulsification reagents based on by-products of cotton tar processing and to obtain effective demulsifying compositions for dehydrating and desalting paraffinic oil, which makes it possible to intensify the process of preparing well products.

To achieve this goal, the following tasks were solved:

-analysis of the state of the problem of destruction of oil-water emulsions during the preparation of oil for transportation and processing;

-development of methods for fractionation of tar for the distillation of fatty acids, determination of the composition of individual fractions and the possibility of their use for the synthesis of chemical reagents of demulsifying action;

-obtaining chemical reagents of demulsifying action based on fatty acids of cotton tar by oxyethylation with olefin oxides, as well as esterification with aliphatic alcohols;

-substantiation of ways to improve the efficiency of demulsifiers, obtaining and researching reagents - demulsifiers of comprehensive action, exhibiting a synergistic effect in the dehydration of crude oil.

-calculation of economic efficiency and pilot-industrial testing of the obtained demulsifying reagents under production conditions.

Research objects. The main objects of research were: cotton tar; ethylene oxide; sodium hydroxide; water-oil emulsions obtained in laboratory conditions, as well products from the Kumkol, Akshabulak, Ashhysai fields; fatty acids from tar; demulsifiers obtained based on distillation tar fatty acids - reagents "OEZhKG" and "EZhKG", as well as foreign commodity demulsifiers Dissolvan 4411 and Proxanol 305; methyl, ethyl and isopropyl alcohols.

The subject of the study. Obtaining reagents for dehydration and desalting of paraffinic oil and study of their effectiveness in the conditions of preparation of well production.

Research methods. The experimental research base of this dissertation work includes physical, physicochemical, and chemical research methods designed to assess the properties of raw materials, obtained products and intermediate products. A complex of physical and chemical research methods was used: saponification; extraction; gas-liquid chromatography; infrared spectroscopy; viscosimetry; synthesis in a high-pressure reactor; determination of the cloud point of solutions; the Dean-Stark method; and centrifugation to determine the total water content of the oil.

The scientific novelty of dissertation work:

- methods for fractionation of tar for the distillation of fatty acids have been developed, the composition of individual fractions has been determined, the possibility of their use for the synthesis of chemical reagents of demulsifying action to destroy an oil-water emulsion has been shown;

- the mechanism of influence of the main factors on the process of saponification of tar was investigated, an equation was selected that describes the

process of diffusion of fatty acids from the organic into the aqueous phase, the limiting stage of neutralization was determined and the technology of the process of gasoline extraction of fatty acids was optimized;

- the processes of oxyethylation and esterification of fatty acids obtained from cotton tar were carried out, the principal method of conducting the process was scientifically substantiated, technological schemes of the processes of obtaining oxyethylated and esterified fatty acids were developed;

- Chemical reagents of demulsifying action were obtained, the compositions of reagents - demulsifiers for dehydration of crude oil were studied, the composition of demulsifiers and their mixtures were optimized, the principles of creating new compositions of demulsifiers of complex action were substantiated to give them a synergistic effect.

The practical significance of the work:

- the methods of saponification and liberation of fatty acids in free form from cotton tar for the distillation of fatty acids were developed, which made it possible to expand the raw material base of industrial organic and petrochemical synthesis, the optimal parameters of saponification and separation of fatty acids from cotton tar were determined, which made it possible to obtain the final product;

- chemical reagents - demulsifiers were obtained by the method of oxyethylation and esterification, which exhibit demulsifying properties at a rate of reagent consumption per ton of well production - 35-40 g/t, and reduce the total water content in oil to 0.2-0.3%, salts to 8 -10 mg /l;

- reagents of demulsifying action based on oxyethylated fatty acids of tar (OEFCG) and esters of fatty acids of tar (ELCG) were obtained and investigated, technological schemes of the processes of their production were developed;

- pilot tests of the obtained demulsifying reagents were carried out under production conditions, which ensured a sufficient degree of dehydration and desalting of crude oil;

- the calculation of the economic efficiency of using the obtained demulsifier for oil dehydration has been performed.

The main provisions for the defence:

- isolation of original fatty acids from distillation tar, the study of the kinetics and mechanism of the influence of the main factors on the tar saponification process;

- extraction of fatty acids in mixing and settling extractor;

- obtaining reagents for dehydration of crude oil by oxyethylation and esterification of fatty acids of tar;

- obtaining a composite composition for deep dehydration and desalting of oil based on oxyethylated fatty acids;

- compositional composition of complex action for the destruction of oil-water emulsions based on fatty acid esters;

- calculation of economic efficiency and results of tests carried out on the obtained reagents for oil demulsification.

Connection of work with research programs. The dissertation work was carried out following the themes of the state budgetary works of the departments "Oil refining and petrochemistry "and" Oil and gas business" at M. Auezov South

Kazakhstan University, B-16-02-03 "Study of the composition and properties of oils from promising fields of the Republic of Kazakhstan, development of an optimal technology for their processing" (2015-2020) and RIW B-11-03-05 "Development and improvement of methods for intensification of oil and gas production, design and calculation of oil and gas field equipment", as well as program-targeted financing on topic No. 0181 "Development of technologies for obtaining new effective materials for the oil and gas industry from wastes of the fat and oil industry".

Approbation of work. The research results and the main provisions of the dissertation were presented at international and domestic scientific conferences: III international conference "Industrial technologies and engineering". ICITE-2016, October 28-29, M.Auezov South Kazakhstan state university. Shymkent, Kazakhstan, 2016; Proceedings of the International Scientific and Practical Conference "Auezov Readings -15: The Third Modernization of Kazakhstan - New Concepts and Modern Solutions" dedicated to the 120th anniversary of M.O. Auezov, Shymkent, 2017; IV International conference "Industrial technologies and engineering" ICITE-2017, October 26-27, M. Auezov South Kazakhstan State University, Shymkent, Kazakhstan, 2017; XXXVII International Scientific and Practical Conference «Actual scientific research 2018», Moscow, April 27, 2018; V International scientific-practical conference «Industrial technologies and engineering», dedicated to the 75th anniversary of M. Auezov, South Kazakhstan state university, and 90th anniversary of academician Sultan Tashirbayevich Suleimenov holding within 4.0 industrial revolution ICITE-2018, Volume I, November 28, Shymkent, 2018; Materiały XV Międzynarodowej naukowo-praknycznej konferencji, "Strategiczne pytania światowej nauki – 2019", 07-15 lutego 2019 roku, po sekcjach: Biologiczne nauki. Ekologia. Medycyna. Fizyczna kultura i sport. Chemia I chemiczne technologie. Volume 9, Przemysl, Naukaistudia, 2019; Material for the XV International Scientific-Practical Conference, July 15-22, 2019 Dinamikata at the time of the Science - 2019, Volume 5 Sofia, "Byal GRAD-BG ODD" 2019; International scientific and practical conference "KAZAKHSTAN OIL: PAST, PRESENT AND FUTURE", dedicated to the 120th anniversary of Kazakhstani oil, Atyrau, 2019.

Publication of research results. The main provisions, results, conclusions and conclusions of the dissertation are set out in 18 printed works, of which 2 are articles in International scientific journals included in the Scopus database; 3 articles in journals recommended by COXON MES RK; 12 in materials of international conferences, 1 patent.

The structure and scope of the thesis. The thesis is presented on 140 pages, contains 35 figures, 20 tables and includes an introduction, literature review, materials and research methods, results, their discussion and conclusions. The list of references includes 277 items.