

ANNOTATION

for dissertation work of Boranbayeva Asia Nurlybayevna
«Scientific Substantiation and Development of Technologies of Processing of Oil
Sludge for Reduction of Man-Made Load on the Environment», submitted for
Doctorate of Philosophy (PhD) Degree in Specialty 6D060800-«Ecology»

Relevance of the research topic. Relevance of the topic.

The oil industry is potentially environmentally hazardous. This is due to the toxicity of the extracted petroleum products and related substances, application in the technological processes and related hazard classes 3-4[1]. Oil sludge is a significant source of environmental pollution and is used in this research work to investigate non-operational oily waste from mining and storage.

During the exploitation of oil fields, the formation of oil sludge's, which are persistent oil emulsions, the properties of which vary over time and depend on a variety of factors: the gas content and water saturation of oil wells, mineralization of reservoir waters, method of extraction, component composition, physical-chemical and colloid-chemical properties of oil and their natural stabilizers, the presence of particles of mechanical impurities and their composition, temperature, etc. The stability of such systems increases greatly when they are stored in open barns and ponds. This happens due to «aging» emulsions, compaction and hardening in time of booking shells on water droplets, evaporation of light fractions, smelting of oil products, increase of mechanical impurities due to atmospheric dust, etc. [2].

The formation of oil sludge during the exploitation of oil fields is due to:

- Discharges from oil preparation;
- Discharges from cleaning of oil tanks;
- oil-containing fluids used in drilling operations;
- discharges during testing and overhaul of wells;
- accidental oil spills during oil extraction and transportation.

The accumulation and storage of oil sludge is carried out in open earth tanks - oil sludge barns of various designs. Due to increasing environmental requirements, the problem of oil sludge disposal and the elimination of oil slurry barns is becoming increasingly important year after year. Modern methods of utilization of oil sludge are not technological, energy-intensive and require significant capital investments, so the volumes of utilization lag behind the volumes of their formation and new volumes are added to the already accumulated volumes. In the oil-producing regions of Kazakhstan and the CIS countries, as well as in the refineries, the problem of creating highly efficient and environmentally friendly technologies for the utilization of oil sludge and the elimination of oil-sludge barns is very urgent and requires a quick solution. The wide range of physical and chemical properties of oil sludge determines the variety of technologies for its utilization. Despite the many methods and technologies

available for the disposal of oil sludge, none of them is sufficiently technological and versatile for different categories of oil sludge.

Based on the effects on emulsion, oil slurry recovery methods can be divided into two groups - with emulsion breakdown and without destruction. In the recycling of oil sludge with the destruction of the emulsion, the product is a raw material brought to a certain quality required for its further use.

When using oil slurries without breaking the emulsion, they are used as raw materials for production that does not require a change in the quality of oil sludge - these are mainly additives in finished products or raw materials, usually reducing the quality or increasing the cost of the final product.

Oil sludge, because of its significant content of petroleum products, can be classified as secondary material resources. Its use as a raw material is widespread, as it achieves certain environmental and economic benefits. One of the applications of oil sludge is road construction, where it is used as an additive to asphalt, improving the quality of asphalt concrete mixture by increasing strength, reducing water absorption of the road surface.

The analysis of existing methods, technologies and means of cleaning the soils saturated with Mangyshlak paraffinic oil, showed that they are practically non-existent, and existing - do not provide complete cleaning from paraffin. The main problem is high paraffin content (25-28%) at a density of 0.83-0.86 g/cm³. These characteristics cause oil to pour at 30 °C. In this regard, research is needed to pre-remove asphalt resin from oil, followed by extraction with paraffin solvents.

In this connection, research aimed at development of technology modification of oil road bitumen with oil waste, production of modified bitumen with specified properties depending on the field of application are relevant.

The main idea of the work is to study the physical and chemical properties of oil wastes in the conditions of deposits, namely oil sludge (OS) and oil-contaminated soils (OCS) selection of conditions of their processing with extraction of additional oil products with economic benefit and with environmental effect to reduce the load of oil production on OCS in the area of oil fields.

Work objective.

Scientific substantiation and development of technologies of oil sludge processing and destruction of oil-contaminated soils with the use of micro-organisms to reduce man-made load on the environment with further development of technology of their processing for modification of oil bitumen.

Research objectives:

- research of physical and chemical properties of oil waste oil fields Mangistau;
- selection of oil waste processing parameters with the use of chemical reagents, low-temperature oil separation with the preservation of the light fraction;
- study of the action of the consortium of micro-organisms and determination of optimal concentrations, immobilized carriers from limestone shell on the processes of destruction of oil waste and oil contaminated soil;
- investigation of the influence of oil sludge on the production of polymer-modified bitumen;

- Development of a road mixture formulation based on hard to recover petrochemical waste.

Research objects. Oil sludge fields Uzen and Zhetybai and oily soils of Mangistau region, bitumen LLP «SP«CASPIBITUM». The bio-drug and the limestone shell.

The subject of scientific research is physical-chemical, mechanical characteristics of oil sludge, bitumen and oil-contaminated soils, bioremediation of oil-contaminated ground, technological parameters, optimal conditions of treatment of oil sludge.

Source materials and research methods. The thesis is based on data made on the grant financing project, in which the doctoral student participated on the topic IRN AP08856022 «Modification of oil bitumen's with industrial and household polymer waste» 2020-2022.

The studies used laboratory-experimental, physical-chemical, spectral, microstructural analyses of chemical-mineralogical composition, physical-chemical properties, interpretation of research results with the use of computer programs.

For the study of the composition of bitumen and oil products modern physical-chemical methods were used: IR spectroscopy, CHSN-elemental analysis, X-ray diffraction and microscopic analysis, etc.

The scientific novelty of research

- for the first time scientifically developed method of destruction of oil-contaminated soils on the basis of bioregulator-oil destructor using as filler local waste of limestone shell;

- for the first time scientifically developed a new method of processing oil sludge by directly adding oil sludge to the modification of bitumen during the processing of oil waste.

Scientific provisions to be protected:

- data on physical and chemical properties and composition of oil waste;
- optimum filler for biopreparation for different composition of oil waste;
- optimal parameters for destruction of oil-contaminated soils by bioremediation using a consortium of microorganisms in the presence of a local limestone shell as an immobilizer;

- optimum technological parameters of application of oil, isolated by bioremediation from high-sparafin oil waste, for the production of bitumen;

- optimal variants of beneficial use of oil sludge waste in the production of polymer bitumen binders;

- a new method for producing road bitumen using oil waste to reduce the environmental burden.

The practical significance

Considering that the methods of processing waste oil production in the country are economically inefficient, experimental value of application of the results of the proposed research works in the production of bitumen and oil refining plants with extraction of oil by treatment of oily soils by biological treatment and improvement of operational properties of the produced soil oil and

oil waste on the roadway by directly adding them to the modification of bitumen is of great practical importance in the production of bitumen and oil refineries. The results of scientific research work are patented in 2 patents of the Republic of Kazakhstan for the invention №35103 Method of bioremediation of oily soils from 04.06.2021 and №36090. Method of utilization of oil sludge with the production of polymer-modified bitumen from 10.02.2023.

Personal contribution of the author. The thesis is the result of research by Boranbaeva A.N. in the period 2018-2022. The author independently set the goal, defined the tasks and plan of research on the processing of oil sludge (on the example of Mangistau region, Kazakhstan), the sampling of oil sludge samples in the object of research, conducted laboratory physical-chemical analyses, experimental and field research biological agent. Laboratory studies of the preparation of samples of modified bitumen and the selection and analysis of the obtained data were also performed.

The analysis and synthesis of research and experimental results of work is conducted.

Relationship with other research work. The dissertation was carried out in the framework of participation of doctoral candidate Boranbaeva A.N. in the project of grant financing, in which the doctoral student participated on the topic IRN AP08856022 «Modification of oil bitumens by industrial and household polymer waste» 2020-2022.

Approbation of the work. The main results of the dissertation work were discussed at the international scientific and practical conference, Tyumen: TIU, 2019. ; an international scientific and practical conference. Penza: 2021; Gylum Kyzmetkerlery kUnine Arnalgan GylGan-Tayribelik online - conference, Aktau, 17-29 april, 2020y. Caspian Sea in the 21st century: regional and global problems, cooperation and security», dedicated to the 70th anniversary of the professor, doctor of technical sciences Kenzhetaev G.Z. -Aktau, December 23, 2020.

The main points of the dissertation in 2020-2021. heard at the scientific and technical council of the engineering faculty, at the meetings of the department «Ecology and geology».

Publication of research results. According to the materials of the dissertation, 12 scientific papers have been published, of which: 2 articles have been published in journals recommended by the Committee for Quality Assurance in Education and Science of the MES of the RK; 3 publications in journals included in the database of the company Scopus. Other articles in the collections of international scientific and scientific-practical conferences.

Volume and structure of work. Thesis consists of introduction, 4 chapters, conclusion, applications, list of literature from 219 titles. The work is presented in 112 pages of computer text, illustrated by 13 drawings, 32 tables and 6 applications.