ALTERNATIVE METHOD OF HEAT TREATMENT OF OILY WASTE

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SUMMARY: In this scientific article based on a study of the problem of utilization and processing of oily waste describes the problems of environmental safety and discusses possible ways of solving this problem. Based on alternative methods to influence the structure of hydrocarbons a way to clean the oily waste with the use of solar energy. Established and described in detail the experimental setup for cleaning oil-contaminated waste. The results of experimental studies on the clean-up of oil waste in the geliodevice which equipped concentrating elements. Also conducted physical and chemical researches of oil-contaminated waste before and after heat treatment with the use of solar energy.

1. INTRODUCTION

One of the most difficult and urgent problems of the oil industry is the processing and disposal of waste products in order to ensure environmental protection measures and ecological safety of territories. The barns Drives discharged oily foods: intermediate layers tanks, substandard oil, oily soil, etc. [1]. Oil wastes threaten the environment and leads to irreversible loss of the extracted hydrocarbons.

Significant loss of oil from oil sludge and their negative impact on the environment of the region creates the need to develop technologies for processing sludge. Sludge processing methods involves their thermal, chemical or biological treatment, which in turn is characterize by the release of large quantities of toxic gases, the use of expensive chemical reagents or bio strain. In this article, we propose a method for purifying oily polluted waste with using solar energy carried out on the developed, sponsored, helio device equipped with concentrating elements. The introduction of the energy of solar radiation in the processing of waste oil allows rational way to disposal of waste oil industry and their subsequent use. Therefore, a comprehensive approach to recycling processes oily waste is of paramount importance.

Seems the most appropriate comprehensive utilization, that is processing of oily waste with maximum consideration of the properties and use of all components, which resulted in the waste becomes raw material, reagents or fillers in the process of production or are involved in the processing of other waste. From our point of view, the system of waste oil is an organization of certain process steps, passing that oil undergo successive transformations in a "waste - secondary

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product - commodity product" with minimal losses and maximum safety for the environment [2, 3].

The most common trend in the world of recycling technologies and waste oil disposal is the maximum possible extraction of hydrocarbons. Solid processing residues mainly used in road construction, water - in the system to maintain reservoir pressure and oil from mixing with the oil commodity mining company surrenders the consumer or used as fuel. [4] In this connection, we tasked improve thermal method using solar energy, which requires low cost of treatment and is free from the flue gases.

2. INNOVATIVE OILY SLUDGE MANAGEMENT

2.1 Qualifying task of searching technologies for the separation of oil sludge

The oil industry by specificity of its activity is potentially dangerous to the environment. This is due to the toxicity of extracted hydrocarbons and substances used in technological processes of oil production.

Oil has a high melting point and because most of the time the year is in the solid state, so the technology is its utilization should include the melting process. The oil must be heated to a temperature (40 - 60) °C, resulting in a mobility sufficient for its transportation. Maximum heating temperature should not exceed (90 - 100) °C. Otherwise, it may boil-off of oil fractions and changing the oil quality. [5, 6]

When choosing heating system flow sheet paraffin oil, it is first necessary to clarify the composition and properties of oil, occurrence phase, and changes in the state of aggregation, as well as the composition of particular components containing oil or petroleum products.

Among the oily waste generated in enterprises is the most environmentally hazardous oil sludge, which is a highly stable three-component system: solid - oil - water, stabilized by the presence of gaseous phase - product biodegradability of organic substances. The components of oil sludge - oil, oil products and mineral salts are the most dangerous components of soil. Evaporation of hydrocarbons entails air pollution; drain the excess barns highly mineralized water (sulphates, chlorides) reduces soil fertility and adversely affects the upper fresh water aquifers. In each case, we need to find hardware and technological solutions that provide the most appropriate solution for purity and hydrocarbon phase, and water and mechanical impurities. [7]

In each case, the problem solved [8]:

- Development and selection of efficient technology blends with the preparation of hydrocarbon raw materials for the qualified processing;
- Allocation of water-salt dispersion of sludge, separation of solids, and coke-forming components;
- The development of water treatment technologies and methods of their use of technology or return to natural resources;
- Development of technologies for qualified usage of selected mechanical impurities.

For example, different types of individual oil sludge, oil sludge sample of the mix and the sample of waste oils developed methods for the separation of sludge on the phase separation of the hydrocarbon components to concentrate, removing water and mechanical impurities.

2.2 Analysis of the methods of processing waste oil

The organic part of the waste oil is a very complex mixture of hydrocarbons of various structural-group composition and their hetero-derivatives having a wide range of physical and chemical properties [9, 10]. For extract the carbohydrate portion of most researchers use thermal methods.

The method for extracting oil from the waste sludge to produce a product suitable for further processing in the refinery [11,12]. Raw petroleum process includes, water and ≥ 5% solids. From the sludge recovered by centrifugation hydrocarbon fraction, and water, after which the residue was heated first at a temperature of 107-227°C and then at 204-621°C to evaporate water and hydrocarbon phases. The solid, which is the current standard in the United States does not represent environmental hazards. The evaporated hydrocarbon phase and water is condensed. From the resulting condensate separated in the centrifuge hydrocarbon phase, which is sent for reprocessing.

The recovered water is subjected to a standard purification.

Also predlagetsya method [13] cleaning soil contaminated by hydrocarbons, in which the treated material is ground and mixed with the purge air and UV irradiation. Airflow and recycled dedusted.

The installation includes a mill, a vibrator, supply system and air purification, UV irradiator and a collection.

Despite the ways [14-16] still not evaluated the effect of temperature on the process of thermal processing. The disadvantages of the proposed thermal methods, despite the high degree of extraction of the organic part of the waste is the high cost installations, the complexity of the process flow diagrams and much smoke as a result of burning oil in the combustion zone.

The large variation in the composition and properties of potential oil sludge raw materials and a tendency either to the formation of stable emulsions or phase separation, require careful study and determine the need for a universal technology with unconventional technical solutions.

3. OIL SLUDGE RECYCLING SYSTEM WITH USING SOLAR ENERGY

3.1 Evaluation of the possibility of using solar energy in the oil industry

The urgency of processing of waste oil confirmed economically viable and environmentally efficient technologies, a return to the economic turnover lost high-value hydrocarbons and qualify them processed into oil products of high benefit. The main task is to search for effective technologies and environmentally friendly methods of cleaning sludge from mechanical impurities, water and salts and the preparation of the selected hydrocarbon concentrate for subsequent qualified processing. An attractive solution is the inclusion of alternative sources of energy in the processing of waste oil [17].

The main trends in the development of modern energy is the widespread use of alternative and renewable sources, as well as the development and introduction of energy-saving technologies in the high performers of traditional energy [18]. Of all the alternative and renewable energy sources has the largest potential for solar energy. The potential of solar energy as one of the main types of renewable energy sources, has today a predisposition to the development of large scale throughout the world, including in Kazakhstan.

The role of alternative energy in the modern world is steadily growing, more and more countries increase the share of renewable sources in electricity production. Along with the energy of wind and water, it is a well-known solar energy. The sun is a virtually inexhaustible resource, allowing a large number of clean energy and then converts that energy into the desired shape. The use of alternative energy sources in Kazakhstan is poorly developing in comparison with developed countries. This is despite the fact that Kazakhstan is located at latitudes between 42 and 55 degrees

to the north, the potential of solar radiation on the territory of the republic is quite significant and is 1300 - 1800 kWh/m^2 per year. Due to the continental climate, the number of hours of sunshine per year is 2200 - 3000. The significant potential of solar energy makes possible its economic use in Kazakhstan.

The advantages of using solar energy for the purification of waste oil industry are:

- Cleaner electricity production, the complete absence of greenhouse gas emissions;
- The modular set of power;
- High performance solar installation;
- The ability to operation of the plant directly in the oil fields and refineries in the territories;
- Simple design and noiseless devices.

For practical use of solar energy are favorable factors for the high intensity of direct solar radiation, the long duration of sunshine and high temperatures.

3.2 The process of heat treatment oil sludge

With selecting the technological scheme of the heating system paraffinic oil, it is first necessary to specify the composition and properties of oil, occurrence phase, and changes the state of aggregation, as well as the composition of those components containing oil or petroleum products.

The oil product is in a crystallized state and the small top layer in the summer period, under the influence of solar radiation into the liquid phase [19].

Processing of sludge on helio device exposed to various natural solar radiation flux densities with a significant participation in the process of petroleum oil as possible focusing the sun's rays, the mixture of sludge and water is absorbed and the storage element. The principal difference of this technology is the use of direct and diffuse radiation, even of low density by using a helio device equipped with solar panels, parabolic concentrator tracks the sun and the solar radiator. This ensures constant light direction perpendicular to the surface of the sun parabolic mirror concentrator from which the most concentrated rays fall directly on the oil waste.

In order to create conditions of displacing oil from waste oil sludge and oil-contaminated soil mixed with water, which is first in the unit volume of 30dm^3 filled with 20 liters of water and laid on top of 10kg of oil-contaminated soil or sludge. The focus of the case on a metal frame mounted parabolic concentrator equipped with a tracking system of the sun, which is the most direct and focusing diffuse solar radiation, collects all the incident solar energy on it. Stainless steel used as a hub of solar energy area of 2x2,5 m.

After saturation of the soil water through the mixer, channels are formed through which during heating by solar energy, become prominent petroleum fractions with water. The resulting oil productive with water through a pipe connected to the housing merges into a separation column where the oil fraction separated from the aqueous solution. Time phase separation in the column 10-15 minutes, that is, every 15 minutes will be ready to return water to clean the waste. Ie every 15 minutes will be ready to return water to clean the waste. The separation column is made of heat-absorbing material, so that the temperature of the liquid in the column kept within 60-80ºC, which allows efficient separation of oil products, mainly heavy oil. The water, having a temperature of 60-80ºC sent to the device thus ensuring rapid allocation of oil products from waste. The day carried out 6-8 games download oil waste into the device (60-80 kg/day) during active hours. After passivation of solar radiation on cleaning work is completed [20].

Optical system helio device has all the features of complex technical systems, normal operation is possible only when strictly balanced consideration of the plurality of heterogeneous constraints mutually opposite effects and conflicting requirements imposed on them in their functioning.

Practical implementation of the optimal combination of concentrator solar energy in the form of cylindrical shape equipped with the tracking system of the sun, which collects all the incident solar

energy it contributes to the maximum focus of direct and diffuse solar radiation, even of low density, and further used by solar panel provides the missing heat in cloudy and cold seasons, thereby improving the heating and shrinking process (Figure 1).

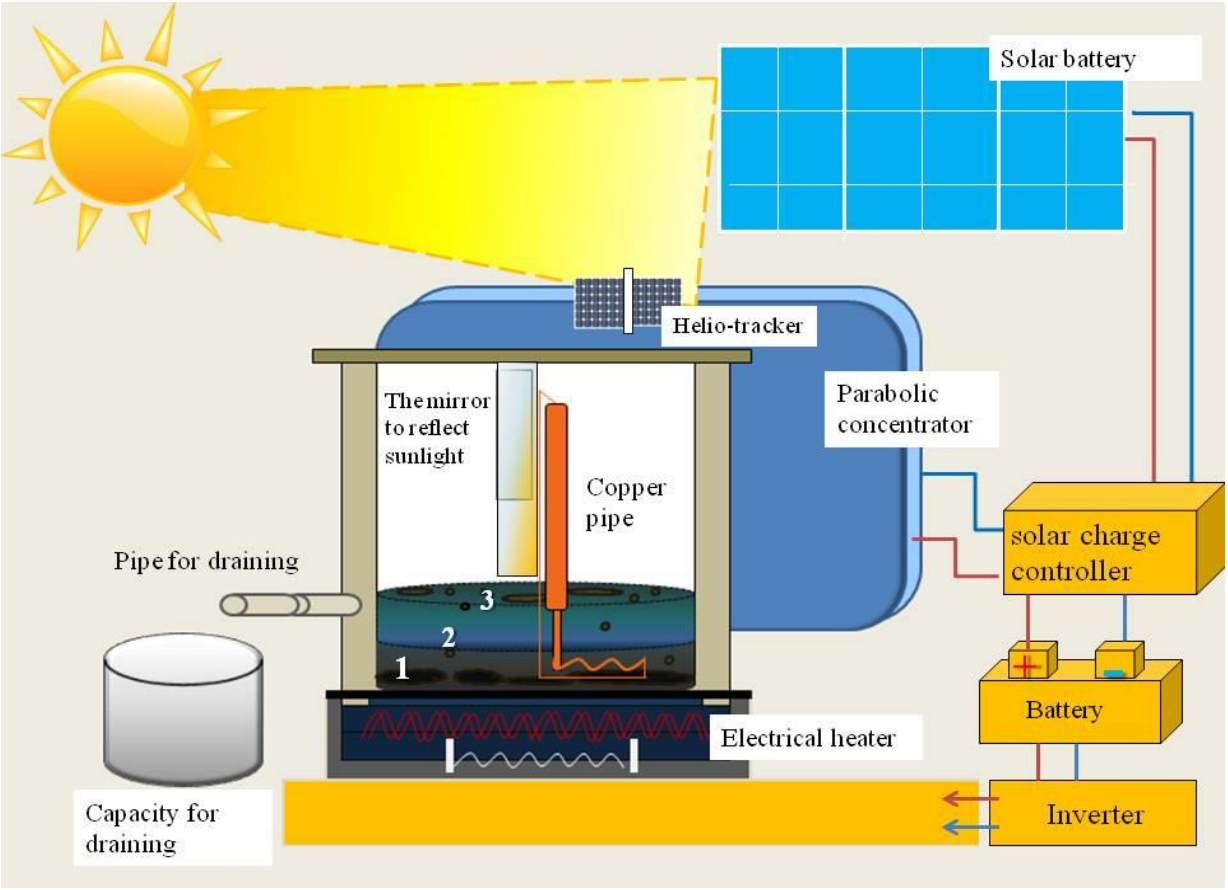

Figure 1. Helio device for cleaning oil-contaminated soil and sludge.

The process of cleaning oily waste was tested in a pilot plant with a capacity allocation valuable hydrocarbon concentrate in the volume of 6 liter per hour.

4. RESULTS AND DISCUSSION

The technology was tested on polluted soil and oil sludge oil producing enterprises of Atyrau region, Republic of Kazakhstan. Studied a sample of sludge with a density of 942 kg/m^3 characteristic prevails paraffin content. The content of the gasoline fraction less - 200°C boils to about 2% of the sample, the content of the diesel fraction to 350°C 23% on average, and the content of the gas oil fraction was 16%. From these data, it follows that the product oily waste is a valuable hydrocarbon feedstock that can be recycled or used for other purposes.

As an object of research in this paper was selected oil sludge. The experiments were performed with oil sludge density 942 kg/m^3. They studied the physical and chemical characteristics of the investigated sludge. To identify individual classes of compounds used for signals characteristic ions for the mass spectra, recorded at each point in the chromatogram [21]. The results of component analysis of the volatile portion of the sample submitted sludge is shown in Figure 2.

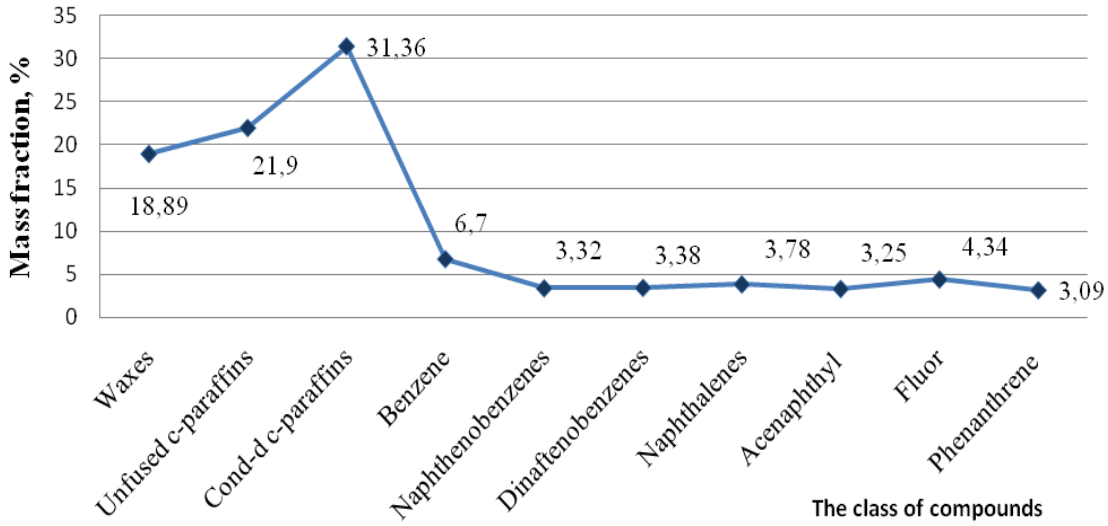

Figure 2. Results of component analysis of the volatile oil sludge.

During the experiment, the temperature of oil waste by heating the device was 75-82°C at ambient temperature 33-35°C, heating was carried out during daylight hours.

To determine the influence of thermal effects of solar energy on the properties of hydrocarbons was studied component composition of oil-contaminated soil and sludge and solid residue after pre-treatment with the use of solar energy in the developed device. The component compositions of oil-contaminated soil and solid residues after pre-treatment with the use of solar energy are shown in Table 1.

Table 1. The component composition of oil waste before and after pre-treatment with using solar energy.

Indicator	**The value index**		
	Before cleaning	**After the traditional heat treatment**	**After cleaning with the use of solar energy**
Density in 20 °C, kg/m^3	942	879	850,7
Content of mechanical impurities, %	8,0	78,5	83,21
Organic part, %	76,8	11,8	8,79
Water, %	15,2	9,7	8,0

The effects of the thermal effects of solar energy property of hydrocarbons were analyzed by the study of the properties of the thermal recovery of organic waste. The initial analysis of the component composition of oil waste showed that the content of solid residues do not exceed 77%, and after heat treatment with using solar energy amounted to 8.79%. After purification, the molecular weight of hydrocarbons is close in magnitude to the bitumen, and the ratio of carbon to hydrogen varies according to the given row, bitumen (6.29 - 10.7) > polluted soil or slime (8.56 - 8.79).

5. CONCLUSIONS

The use of solar energy strengthens the processes of phase transition and cleaning soil from oil products. To develop an effective method of cleaning oil-contaminated soils, soils and sludge using solar energy using parabolic concentrator aggregate and solar panels, to prevent heat loss when heating during daylight hours, as well as provides the required temperature in the environment and the pursuit of excellence in the preparation of a productive oil and petroleum products.
The alternative method of heat treatment of oily waste saves energy and traditional fuels, environmental clean environment, free of smoke emissions.

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