**UDC 621.7**

# ELECTROHYDROPULSE TECHNOLOGY OF PROCESSING OIL SLIMES AND OIL-CONTAINING TECHNOGENIC RAW MATERIALS.

Kussaiynov K., Satybaldin A.Zh., Sadenova K.K., Sagimbekova M.N.

Karaganda State University named after E.A.Buketov, Universitetskaya Str.28, Karaganda, 100026, Kazakhstan
k-sadenova@mail.ru

*At the present stage of development of the technology of oil production during the exploitation of oil deposits are formed by large volumes of waste. In recent years the oil-producing enterprises are implemented in production of different technological solutions at their disposal. However, a standardized method of processing of oil sludge and oil-containing technogenic raw materials for the purpose of disposal and recycling does not exist. In this regard, the authors propose a project to develop hydro technology for processing of oil sludge and oil-containing technogenic raw materials, which solves the problem of non-waste technology of sludge disposal in the field conditions and the elimination of oil sludge pits. The obtained optimal parameters of electrohydraulic shock-wave treatment of the waste will be used to create hydro-processing technology for the separation of oil-containing technogenic raw materials for refined oil and mineral impurities.*

*Keywords:* Electrohydropulse technology, Electrohydraulic effect, Waste, Oil slime, Oil-containing technogenic raw materials.

## Introduction

The oil industry is environmentally hostile owing to the specific character of its activity. This is due to the toxicity of produced hydrocarbons and byproduct substances, related to hazard classes 3 and 4 and used in production processes.

The operation of oil fields is inevitably followed by buildup of oil sludge and oil-containing technogenic raw materials, which are persistent water-oil emulsions. Their properties are time-variant and depend on many factors: gas content and water cut of oil wells, salinity of formation water, method of extraction, component composition, physico-chemical and colloid-chemical properties of oil and stabilizers of natural origin, mechanical impurities and their composition, temperature, etc. The stability of such systems is greatly increased during their long-term storage in open pits and ponds. This is caused by "aging" of emulsions, contraction and hardening of inhibiting covers on water drops in the course of time, evaporation of light fractions, resinification of oil products, increase in mechanical impurities due to atmospheric dust, etc. [1].

During the operation of oil fields, buildup of oil sludge and oil-containing technogenic raw materials takes place due to:

– discharges in the process of oil treatment;
– discharges during cleaning of oil tanks;
– oil-containing drilling fluids used in drilling operatio
– discharges under test and during capital workovers;
– oil spill emergency during production and transportation of oil.

The accumulation and storage of oil sludge and that of oil-containing technogenic raw materials are carried out in open earth reservoirs i.e. oil sludge pits of various designs. Owing to increasing restrictive environmental requirements, the problem of oil sludge handling and abandonment of oil sludge pits is becoming increasingly important from year to year.

There are various ways of processing of oil-containing technogenic raw materials:

- the thermal - combustion in open barns, furnaces of various types, receiving bituminous oddments;

- the physical - burial in express burial grounds, division in the centrifugal field, vacuum filtering and filtering under pressure;

- the chemical - infusion by means of solvents, consolidation with application of mineral (cement, liquid glass, clay) and organic (epoxy and polystyrene pitches, polyurethanes, etc.) additives;

- physical chemical - application specially adjusted reagents changing physical and chemical properties, with post-treatment on express inventory;

- biological-microbiological decomposition in the soil immediately in storage places, biothermal decomposition [2].

The modern methods of utilization of oil slimes are insufficiently technological, power-intensive and require considerable capital investments therefore volumes of utilization lag behind volumes of their formation and the new are added to already saved up volumes.

## Experiment technique

We offer to use electrohydraulic effect for oil separation from oil slimes and oil containing technogenic raw materials for waste-free technology of utilization of oil waste in field conditions. The electrohydraulic effect simultaneously combines in itself powerful mechanical compression, ultrasonic and X-ray exposure, and cavitation.

Novelty of the offered project is use of electrohydropulse technology in processing of oil slimes and oil-containing technogenic raw materials for waste-free technology of utilization of oilwastage in trade conditions. Shock and wave interaction of electrohydroimpulsing discharges on the processed raw materials is the cornerstone of this method. When passing a shockwave on structure of raw materials destructions of large molecules on two components, mineral impurity and on hydrocarbon is observed. The common scheme of influence of shock wave impact on structure of oil wastage is shown in Fig.1.

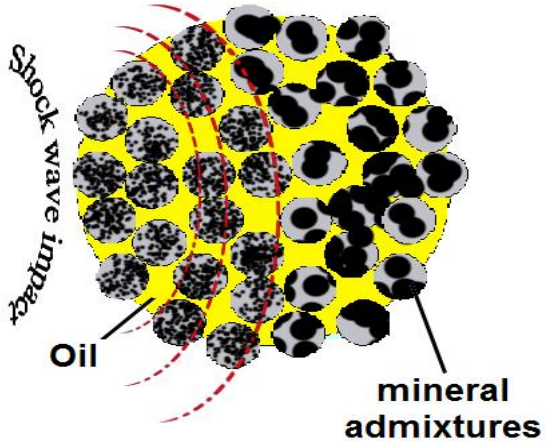



Fig 1. Scheme influence of shock and wave influence on structure of oil wastage

The offered method on development electrohydropulse technology of processing of oil slimes and oil containing technogenic raw materials solves the problem of waste-free technology of utilization of oil slimes in trade conditions and elimination of sludge depots and also environmental problem representing utilization of oil slimes as natural and technogenic origin.

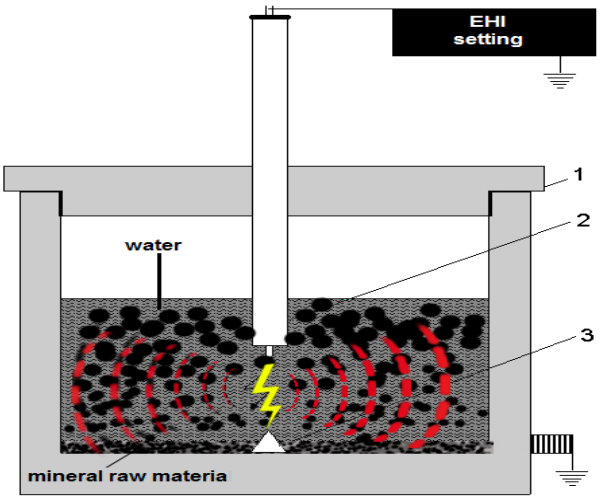
Use of electrohydraulic effect in the chemical industry and chemical mechanical engineering is one of the most perspective, but while and the least mastered directions in development of electrohydraulics.

It is theoretically proved and confirmed with experiments that the electrohydraulic effect as a method of mechanical, physical and chemical impact on materials can be applied to many purposes

in the chemical industry efficiently: at polymerization – complication of molecular structure of substances, receiving block polymers, graft polymers and etc; depolymerizations – simplification of the molecular structure of substances; synthesis of chemical combinations – receiving already known or new compounds; increase of activity of catalysts; acceleration of chemical reactions; formation of the multivalent ions arising under the influence of heavy-duty fields, pressure, temperatures and other factors accompanying process of electrohydraulic processing; loss of oddments – acceleration of crystallization or its delay; acceleration of disolution of substances; break of sorbing and other loose chemical bonds with passing into solution, bound to the processed material of chemical elements or connections [3, 4].

## Experimental equipment

For carrying out the systematized laboratory researches on influence of electrohydropulse impact on physical and chemical structure of oil slimes and oil-containing technogenic raw materials the experimental stand by definition of technological conditions and parameters of process of processing of the oil polluted soil with use the electrohydroimpulse of shockwaves intended for processing of oil slimes and oil-containing technogenic raw materials by short impulsive discharges shown in Fig.2 was developed and built.




1 cover, 2 – positive electrode, 3 – negative electrode

Fig 2. Working site for processing oil slimes and oil-containing technogenic raw materials with electrohydroimpulsing discharges

The vessel has hermetically closed cover 1, made of durable isolating material. On the cover 1 the electrode of positive polarity 2 is pressed with a stopper, it is connected by means of high-voltage cables to the operated discharger of electrohydraulic installation. The role of an electrode of the negative polarity plays the metal core 3 welded on the internal bottom of the vessel, its case by means of grounding tires has an electrical connection with a pole of the negative polarity of the generator. Electrode separation (working discharge gap) can be changed by application of removable covers with an electrode. The height of the core 2 is chosen so that the working spark gap settled down in the geometrical center of processed object of research.

Hydro installation is made in the form of structural units consisting of control unit, high voltage unit and the capacitor unit. High-voltage part of the hydro installation is fenced with screened grille with door. Diagram of hydro installations and units are given in Fig.3.

For realization of research of electrohydropulse technology of processing of technogenic oil-containing raw materials it is necessary to collect and test the installation which could be offered to

use in the industry. In Fig.4 the offered flow diagram of three-electrode electrohydropulse installation is shown.

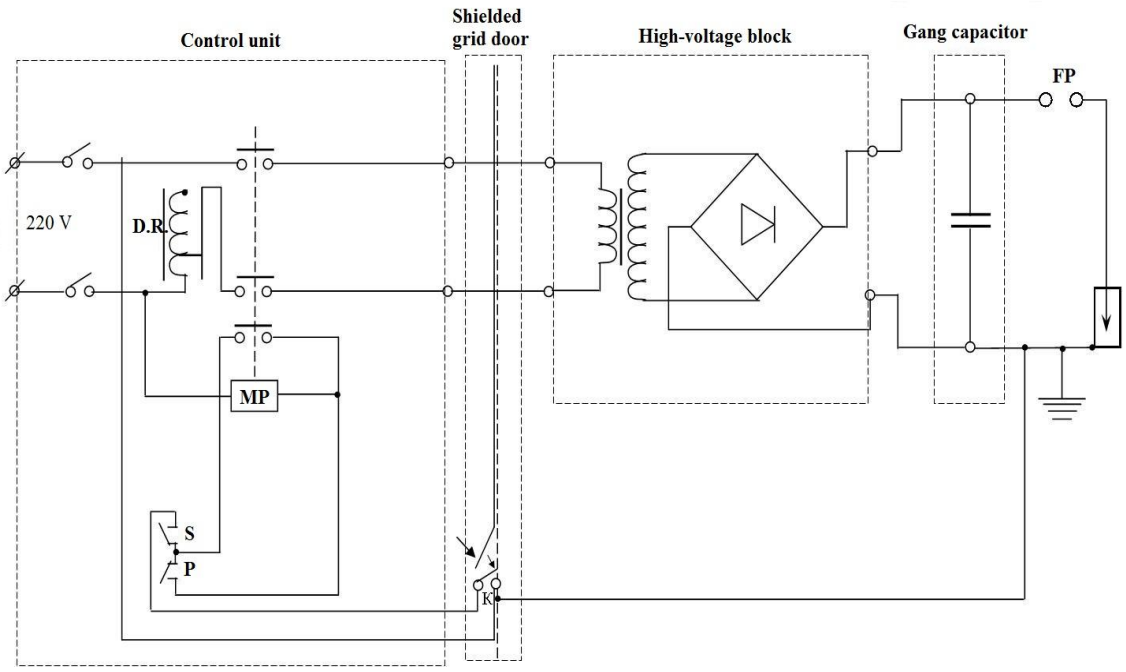
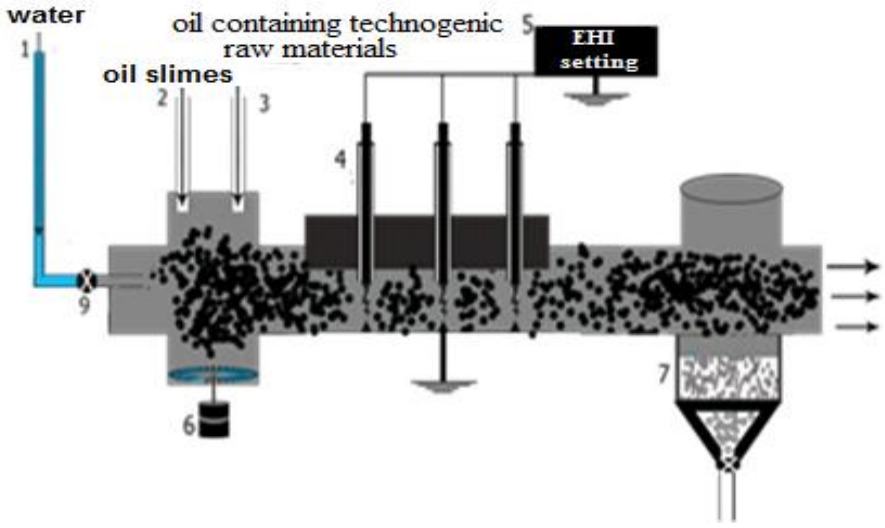



Fig 3. The electrical circuit electrohydraulic systems for the treatment of oil sludge and oil-containing technogenic raw materials




1 - canal for water delivery, 2 - canal for supply of oil slime, 3 - canal for giving of oil containing technogenic raw materials, 4 - electrode system of processing, 5 - electrohydropulse installation, 6 - cell for colliquation with curling device, 7 - a tank for sedimentation of heavy part of oil slimes and oil containing technogenic raw materials

Fig 4. Flow diagram of processing of oil slimes and oil containing technogenic raw materials

The installation will be collected of the basic elements necessary for ensuring process of electrohydroimpulsing discharge in the fluid environment. The principle of work of

electrohydropulse technology of processing of oil slimes and oil containing technogenic raw materials consists in the following:

1. *Processing of oil slimes.* Oil slime moves through the canal 2 in electrode system of processing 4 in which there is mixture separating, due to the serial shock wave impacts of the discharges created by system of three electrodes on two components: heavy (mineral part of oil slime) and light (hydrocarbonic part). The heavy component comes to the tank of the sedimentation of heavy parts 7, and light continues the movement on the canal for further use as shown in figure 2.

*2. Processing of oil containing technogenic raw materials.* In this case the oilcontaining technogenic raw materials move in the cell for colliquation 6 on the canal 3. Unlike the first case colliquation of this mix requires water delivery on the canal 1. After colliquation the raw materials pass into system 4. Further there are similar processes as well as in the case of the former to the working canal for electrohydropulse processing by means of system of electrodes.

## Conclusion

The received results when processing by electrohydroimpulsing discharges of oil slimes with the high maintenance of mechanical impurities, the oil polluted soils and the solid oil-polluted phase, gives the chance to receive to 60% of fluid hydrocarbons which can be used (after the corresponding completion) as engine fuel.

Introduction of electrohydropulse technology of processing of oil slimes and oil containing technogenic raw materials in the industry will allow not only to cut down expenses on waste disposal, but take essential profit as well.

Oil separation from oil slimes and oil containing technogenic raw materials requires larger expenses because of use of import expensive inventory and demulgator, thus separation effectiveness is not always sufficient. Efficient application of electrohydropulse technology in processing of oil slimes and oil containing technogenic raw materials allows not only to cut down expenses on waste disposal, but together with oil product from oil slime it is possible to commercialize. As the content of oil, as well as water share, can vary from 10 to 90%, and the content of solids from 1 to 10%.

The specified advantages provide this technology with marginal economic efficiency.

Thus, it is established by us that this electrohydropulse technology allows to vary technological indicators of the process. It gives it the considerable flexibility and possibility of processing of various oil-containing wastage. Besides, the developed technology is waste-free.

## REFERENCES

1. Kuvykin N. A. Bubnov A.G., Grinevich V. I. Dangerous industrial wastes. - Ivanovo: the Ivan. the state. chemical tech. un-ty., 2004. - 148 p. - ISBN-1-21783-23-19.

2. Bashirov V. V., etc. Technique and technology of stage-by-stage removal and processing granary slimes. - M.: Vyssh. sc. 1992-120p. -1-16-7687800-6.

3. Kussaiynov K., Satybaldin A.Zh. Influence of elektrohydroimpulse processing on structure of high-viscous hydrocarbon compounds. Eurasian phisical tehnical journal – 2008. Vol 5, № 1(9).- C. 53-58.

4. Krupets V. I. Ussov A.F., Zuckerman W.A. Electrohydropulse disintegration of materials: M.: Publishing house of the Kol Russian Academy of Sciences, RAS center, 2002. - P. 324.

Article accepted for publication 25.05.2015