

REMOVING BOTTOM SEDIMENTS IN COMMERCIAL OIL RESERVOIRS WITH MODERN TECHNOLOGIES

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Abstract. The tank is the only acceptable way for storing, collecting and transporting oil and its products. But because of improper maintenance tank may come to a state disrepair. In order to avoid this process, there are regular cleaning of the container carried out using different methods. This article discusses and analyzes methods for cleaning commercial oil tanks in order to identify the most cost-effective, most effective and safe technology.

Keywords: tank, oil, bottom sediments, cleaning.

Introduction:

When storing the paraffinic oil in the tanks, particularly tanks of large volume, bottom sediments are formed and accumulated. Stock bottoms precipitation leads to underutilization of the capacity of oil storage tanks, as well as the occurrence of corrosion-hazardous water under lens precipitate, to difficulty in the examination state of the tank, etc. In addition, the accumulation of sediments leads to complication of process operation reservoirs to increase the material costs in transportation and storage system, and eventually to reduce the technical and economic indicators of oil tanks and transport system as a whole.

Relevance:

To improve the efficiency of use of tank containers the useful volume of oil tanks must be preserved. In the global oil industry, the issue of cleaning bottom sediments and precipitations is relevant. Cleaning tanks from deposits is a dangerous and time-consuming job requiring significant financial costs. This is an unavoidable phenomenon resulting from the deposition of crude oil from suspended and agglomerated components. As bottom sediments thicken and are difficult to erode over time, the tank is periodically cleaned.



Tank cleaning technology:

- Oil pumping
- Preparing bottom sludge for pumping
- Preliminary degassing
- Tank cleaning
- Degassing of gas
- Control of quality
- Disposal of bottom sludges

The frequency of tank cleaning is set by the state technical inspection. It depends on the characteristics of the stored fuel, its type, and in which way it is used for. In practice, various combinations of methods for controlling bottom and pyrophoric deposits are used to

achieve the greatest technical and economic effect. The study and development of new methods to solve this problem is a promising and relevant direction. Diagram 1 shows percentage of minimum and maximum composition of bottom sediments.

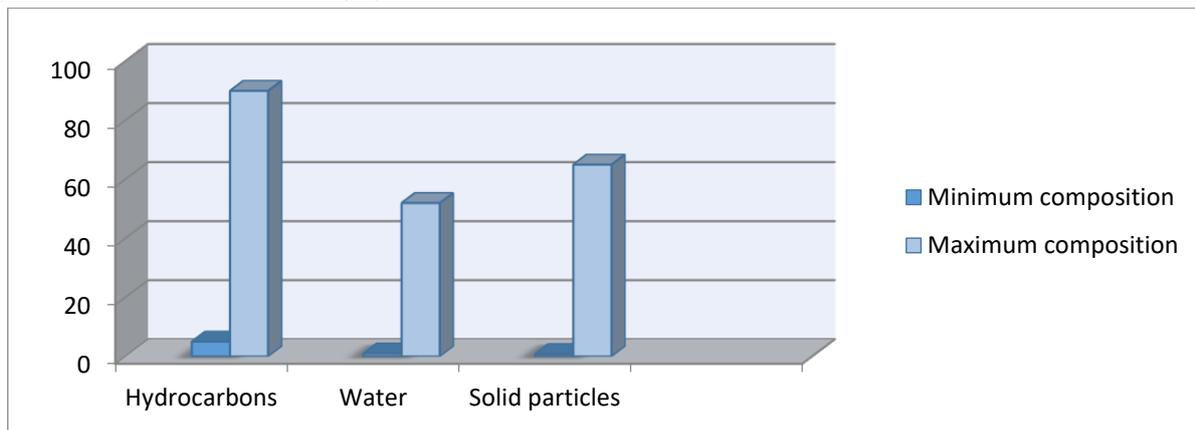


Diagram 1. Composition of bottom sediments

Goals:

Compare the approximate cost of the work and choose the most optimal method for cleaning tanks with volumes from 1000m³.

Oil sludge in tanks is a sand-clay base, impregnated with oil products and water. The content of mechanical impurities in the sludge can reach to 50-

90%, and carbohydrate products- 10-40%. Oil sludge is graphically shown in the diagram 2. The fractional composition of oil deposits is a mixture of asphaltenes (6-25%), paraffins (1-4%), oils (70-80%) and associated water (0.3-8%). The fractional composition is graphically shown in the diagram 3.

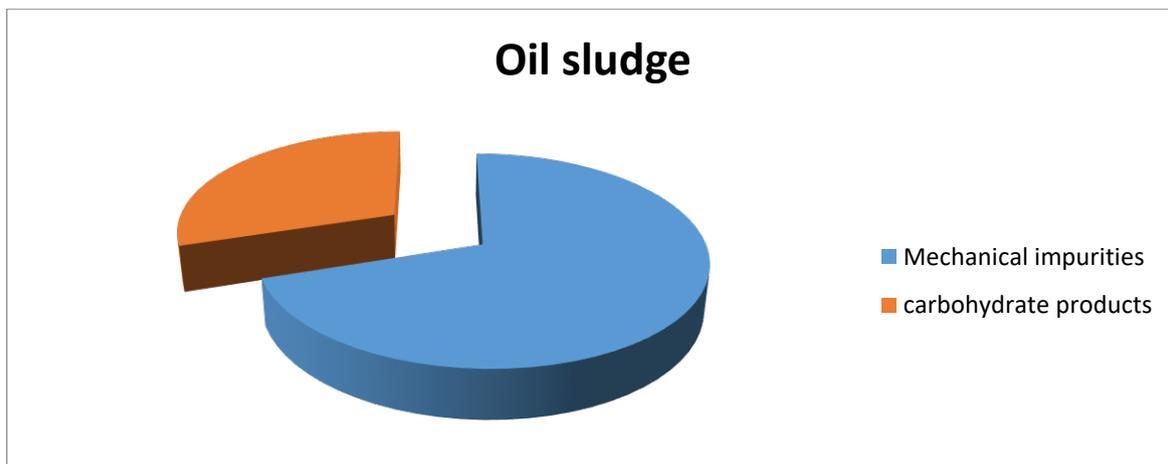


Diagram 2. Oil sludge

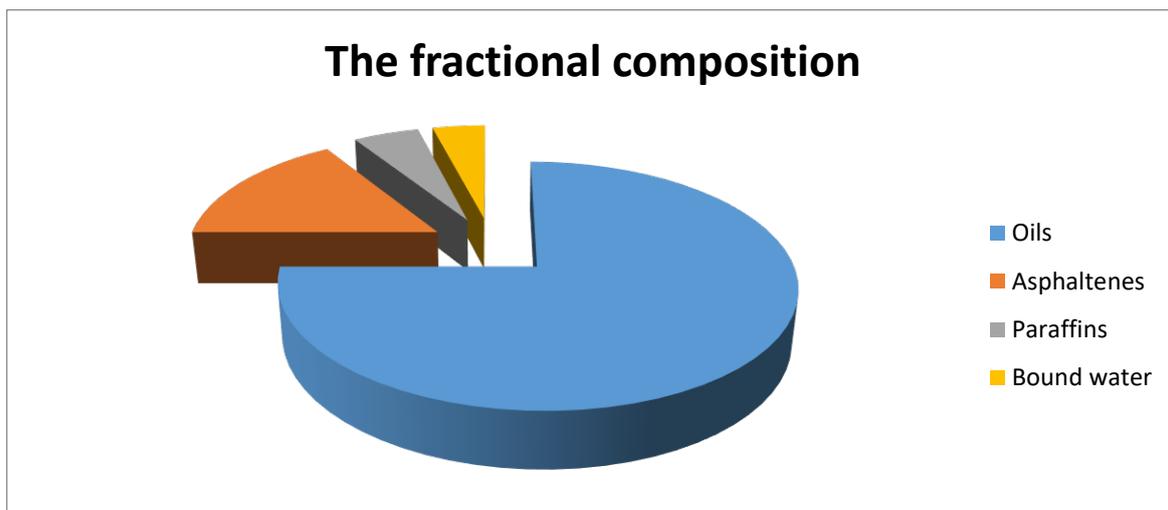


Diagram 3. The fractional composition

Tank cleaning is laborious and responsible process that requires increased attention to the safety and effectiveness of it is implementation. A large number

of methods have been developed for cleaning tanks from bottom sediments, the choice of a method depends on the design of the tank, the nature of the deposits, etc.

The most commonly used methods are manual cleaning, mechanical cleaning, and chemical mechanized cleaning.

Manual cleaning is carried out by entering a person into the tank, removing deposits using a hand tool and removing sludge to eliminate. After that, the tank is washed with water at a pressure of 29-44 psi and a temperature of 86-122 °F and the pre-installed pump pumps out the wash water with sludge. This method leads to long downtime of the tank and requires serious organizational and technical measures aimed at ensuring safety and reducing harm to the health of workers. Also, the disadvantages of this method include the fact that it is difficult to extract hydrocarbons suitable for use from the precipitate with this method. In this regard, despite the cheapness, in recent years, this method is practically not used in world practice.

The mechanized method of cleaning tanks with special mechanical washing machines and robots can significantly reduce cleaning time, downtime of tanks and significantly reduce the consequences of damage to the health of workers. However, the mechanized method of cleaning tanks has a significant drawback, namely the occurrence of a "cutting" effect¹ of the washing jets, which reduces the cleaning efficiency and leads to the destruction of the tank. For example, mechanical tank cleaning offered by Atlantic Waste Solutions (AWS)² consists in circulating bottom sludge and re-weighing sludge using powerful ATEX certified pumps and sophisticated sweeps immersed in the liquid phase of the tank. Mixing components, such as pure crude oil, diesel fuel or water, are added to facilitate circulation and slurry suspension. This mixing process makes it easy to pump the contents of the oil tank into a separate storage area, such as the next tank. Significantly empty tank is now ready for cleaning. The tank prepared for cleaning with the help of robots and remotely controlled high-pressure treatment plants is cleaned of residual oil and deposits. Once precipitate and sediment has been removed, personnel can enter the tank for final cleaning. Internal surfaces, including the lower part of the tank roof, internal roofs, walls and floor, are cleaned with a jet of washing composition with a high-pressure detergent. The final cleaning of the tank allows the air to be cleaned of gas inside so that the tank can be inspected, maintained and repaired. Based on the results of tank cleaning, AWS will arrange for the tank and wall plate to be inspected by an independent licensed inspector in accordance with API

653, using approved methods such as magnetic scanning and ultrasound scanning.

The chemically-mechanized method of cleaning consists of the use of solutions of specially selected detergents sprayed by washing machines at a solution temperature of 113–122 °F. This method improves the quality of cleaning, the intensity of the cleaning process and the minimum use of manual labor. The main advantage of this method, in addition to using low-temperature solutions, is the ability to isolate a liquid hydrocarbon with a content of 5% water. The main disadvantages of this cleaning method include the need to wash out the residual deposits by diluting them with oil, because when mixed with detergent solutions, they are activated and can change the composition of the gas medium in the tank and lead to the formation of high concentrations of explosive vapors in the air. Chemical-mechanized cleaning of tanks from various deposits is currently one of the leading positions in the world practice and is used by many companies. But even the most progressive stripping method, the chemically-mechanized one, does not exclude manual labor and people staying in the gassed zone inside the tank. One of the leaders in commodity tank cleaning is FQE Chemicals³, which has developed its own cleaning method that allows recovery of up to 98% of oil and secondary materials. The cleaning complex includes water cannons (Manway cannons) installed in side manholes, tank cleaning machines, high pressure pumps (high head pump, high head prime-assist pump), chemical tanks (frac tanks for cutter and chemical storage), a separator for the output of liquefied products for further processing and sale (liquefied products to storage, reprocessing, sale). In the first purification step, FQE Chemicals personnel mix the hydrocarbon diluent with the chemical additives selected according to the composition of the deposits (FQE™ Solvent-H) and establish fluid circulation cycles. Sludge deposits, which would otherwise remain solids for disposal, are liquefied and pumped out of the tank for further processing. Liquid circulation is provided by standard pumping equipment, as well as through cleaning nozzles on the roof, which can be routed to anywhere in the tank. At the second stage, the tank is degassed using modern chemical compounds for degassing / decontamination. These compounds are non-hazardous water-based substances that clean the air space and the inner surface of the tank of hydrocarbon vapors and residual oil films. Table 1 shows a comparison of the approximate cost of tank cleaning.

Table 1.

Comparison of estimated tank cleaning costs.

Index	Atlantic Waste Solution	FQE Chemicals
Tank volume, gallon	From 1000	From 1000
The percentage recovery of hydrocarbons, %	-	95-98
Cleaning Cost, \$ US / 1000 gallon	\$279	\$500

¹ Gimaletdinov G.M., Sattarova D.M. Methods for cleaning and preventing the accumulation of sediment in tanks. Oil and gas business.

² Atlantic Waste Solutions. [Electronic resource].

Access mode: URL:

<http://www.atlanticwastesolutions.com/?p=56/>

³ Tank Cleaning Process - FQE Chemicals. [Electronic resource]. Access mode: URL:

<https://fqechemicals.com/processes/tank-cleaning/>

Conclusion.

Based on this, the most effective cleaning method is chemical-mechanized, consisting in the use of a paraffin solvent in combination with stirring and heating of the sediments. Such technology reduces the time and labor costs and allows the hydrocarbon part to be extracted from the sediments. Looking at the approximate cost table, we can conclude that the Atlantic Waste Solutions system is more economically advantageous than chemical cleaning from FQE Chemicals. But if you consider that the Atlantic Waste Solutions installation requires manual tank cleaning, which is approximately \$ 1600, then chemical cleaning is more beneficial not only from an economic point of view, but also from the point of view of ensuring industrial safety.

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