Refinery oil sludge dewatering with geotextile tubes

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ABSTRACT: Three lagoons (10,000 cubic meters) of heavy refinery oil sludge needed to be removed. The exact contents of the sludge, accumulated over the years in emergencies and processing surplus of the refinery, were difficult to estimate. The sludge, consisting of oil, water and solids, came from several plants in the refinery and heavy solids settled in the ponds. Such sludge is very expensive to remove to a landfill due to its weight, and requires additional preliminary treatment to reduce its high TPH content. The solution: dewatering the sludge in the plant with geotextile tubes and removing the dry solids to a biological treatment plant.The process involves mixing the sludge with wastewater from the plant and pumping it into the geotextile tubes following flocculation.Eleven geotextile tubes were placed in a sink constructed of two layers of 1.5mm HDPE geo membranes separated by Geonet membranes.The liquid pumped from the geotextile tubes, consisting of oil and water, was pumped for mechanical gravitation separation of the oil and water. The water was returned to the water treatment plant and the oil was recycled by the plant.The sludge was pumped at 8% dry solids and reached up to 65% T.S. 105°c (Total Solids). Dry solids were removed to a biological treatment plant to reduce TPH before transporting to a landfill. Benefit: Reducing the volume of the sludge from 10,000 cubic meters to about 4,000 cubic meters, oil recycled to the plant, energy saving, sludge is easily loaded onto trucks for transport. This article deals with the geotextile tube process as an oil sludge dewatering device.

1 INTRODUCTION

Oil sludge is one of the most challenging types of sludge to treat. Refineries routinely produce sludge in the course of the refining process which accumulates in lagoons, tanks and other holding means.

The sludge is composed of oil, water and solids. It is this structure that caused oil sludge to be designated as a hazardous material.

Oil - Total petroleum hydrocarbons (TPH) can be carcinogenic and may seep into the ground water, while the released VOC may produce air pollution.

The solids in the sludge commonly contain heavy metals.

Treating the sludge can recycle the oil into raw material for use by the refinery, with added economic benefit of reducing the quantity of sludge to be removed.

2 SCOPE OF STUDY

This case study of dewatering refinery oil sludge by means of geotextile containers aims to show that this treatment can reduce the volume of the sludge while recycling the oil.

Figure 1.

3 BRIEF REVIEW

Total Petroleum Hydrocarbons (TPH) is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil. Crude oil is used to make petroleum products, which can contaminate the environment. Because there are so many different chemicals in crude oil and in other petroleum products, it is not practical to measure each one separately. However, it is useful to measure the total amount of TPH at a site.

TPH is a mixture of chemicals, but they are all composed primarily of hydrogen and carbon, known as hydrocarbons. Scientists divide TPH into groups of petroleum hydrocarbons that behave alike in soil or water. These groups are called petroleum hydrocarbon fractions. Each fraction contains many individual chemicals.

Some chemicals that may be found in TPH are hexane, jet fuels, mineral oils, benzene, toluene, xylenes, naphthalene, and fluorene, as well as other petroleum products and gasoline components. However, it is likely that samples of TPH will contain only some, or a mixture, of these chemicals.

Some TPH compounds can affect the nervous system, causing headaches and dizziness. TPH has been found in at least 23 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

Oily sludge contains heavy metals that need to be treated before transporting to a landfill. Heavy metal toxicity can result in damaged body and mental and may even cause cancer.

4 THE PROBLEM

Oily sludge is a refinery waste product that accumulates in concrete lagoons. Since the sludge accumulated over many years, it came from different sources, which probably varied over the years. Such sludge, containing TPH, heavy metals, mineral solids and water, must be removed from the refinery with all possible haste.

This combination of hazardous substances is difficult to treat. Sending untreated sludge to a hazardous materials landfill is very expensive, as most of it is in liquid form, containing considerable quantities of water that could be separated, thus reducing weight and saving on transportation costs. The TPH can be recycled and profitably disposed by the refinery.

The sludge ponds also contain various remains from the refinery process, such as plastic waste, woodchips and such.

Since the ponds were quite full, the sludge had to be removed as quickly as possible.

The geotextile container - Geotube® can be employed as a dewatering technology device. It can reduce the sludge volume and remove from it the free water and oil, thus making it more viscous.

5 PRE-PROJECT

For dewatering with the geotextile container, it is important to identify the most suitable polymer. We started with a small laboratory test to locate promising polymers among various suppliers. Having located the 4 best polymers we proceeded to test and compare them by testing each polymer on a 100 liter batch of sludge.

After a few seconds clear water began to drain from the bag. (Figure No.2 - Clear water draining from bag).

After a month, the remaining dry material reached up to 50%, after 3 months, it amounted to over 85% and the material had the texture of dry soil.

6 THE PROJECT

Due to the good results obtained in the test, the solution of fast sludge removal from the ponds by employing the inexpensive geotextile containers was the technology chosen.

Next came the full scale pilot project. Two geotextile containers of 13.7m circumference and 20m length were filled with oil sludge.

The full scale test target was to:

- Measure the dry solids that can be obtained
- Measure the quality of the water that drained out:
    - TSS - 105°c %
    - COD
    - Oil content %
    - TOC- mg/l

Pumping capacity was 120m^3/hr.

Full scale test result:

The liquid that drained from the geotextile container was very clear (Figure No. 2). At first, only water drained out, but a few hours later, oil began to drain out as well. The two phases were easily separated by the separators already in use by the refinery.

A sealing reservoir was constructed of 2 layers of HDPE 1.5 mm.

The entire project consisted of 11 geotextile containers in two layers.

- First layer consisted of 6 containers of 18.3m circumference, 35m length.
- Second layer consisted of 5 containers of 18.3m circumference, 30m length.
- 17,000 m3 of 10% T.S.S was pumped into the geotextile containers, and after remaining there for one year, the volume of dry sludge was estimated at 3,500 m3 of over 50% T.S.S (105oc).

The sludge in the geo container is pasty and the oil is still draining at present.

7 RESULT

- Water quality result:

Date	characterization	T.S.S.
19.8.07	waste water	0.00050%
19.8.07	waste water	0.00680%
22.8.07	from geotube	0.15200%
22.08.07	separator 4	0.14700%
23.8.07	separator 4	0.16400%
26.8.07	from geotube	0.00740%
26.8.07	separator 4	0.00360%

	Units	Sample no' 1	Sample no' 2
COD	Mg/lit	1736	880
TSS	Mg/lit	<5	68
Mineral oil	Mg/lit	1252	2051
TOC	Mg/lit	-	160 (water phase only)

* high limit for tender 2.00000% Total Suspended Solids

- Dry solids in the geo textile container (pilot)

Date	Sludge	T.S. %	AVERAGE T.S. %
19.8.07	Sludge 1 down	46	47.6
19.8.07	Sludge 1 high	55	
19.8.07	Sludge 2 down	53	
19.8.07	Sludge 2 high	51	
19.8.07	Sludge 3 down	43	
19.8.07	Sludge 3 high	38	
26.8.07	Sludge 1	42	43
26.8.07	Sludge 2	44	
2.9.07	Sludge 2	54.6	53.675
2.9.07	Sludge 6	55.1	
2.9.07	Sludge 8	54.9	
2.9.07	Sludge 10	50.1	

Last lab test of the sludge was conducted on July 22, 2009 (one year later of the project).

The results were:

Test	Result	Unit
B.S.W	75	% (volume)
Water	45	% (volume)
Ash	16.59	% (mass)

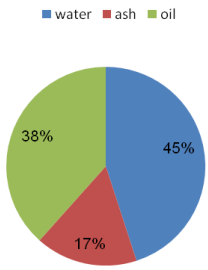

Figure 2.

8 CONCLUSIONS

- Dry solids in the geo textile container reached up to 55% of T.S.
- It is feasible to use geotextile containers to dewater oil sludge.
- This is a very efficient technology for dewatering sludge at high capacity pumping rates and at low cost.
- Energy consumption is low since there is no need to heat the sludge as in conventional dewatering.
- Oil can be recovered from the sludge.
- Water that drained out is clear - less than 0.5% T.S.S.
- After one year of operation, it is clear that the resulting high quality of the sludge is similar to results achieved with conventional mechanical technologies.
- This technology is not as sensitive to variations in the sludge and mechanical damage from stones or other sharp or abrasive materials contained in the sludge.

REFERENCES

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