Refinery & Terminal Storage
Automatic Tank Cleaning System

AVKEM oil treatment

Sludge Accumulation

- Oil storage tanks are used all over the world in refineries, terminals and tank farms for storing oil products.
- Tanks are subjected to periodical cleaning operations due to sludge accumulation, inspection and maintenance.
- Sludge accumulates due to slow sedimentation of high gravity petroleum products.

AVKEM® oil treatment

Sludge Accumulation

This leads to numerous problems in the management of the depots including:

- Loss of operational capacity
- Loss of working time
- Acceleration of corrosion in the storage tanks.

AVKEM® oil treatment

Traditional approach

Traditional cleaning systems are based on the manual removal of sludge

This entails many challenges during execution involving:

- High Health and Safety **risks**.
- High volumes of **waste** to be disposed of.
- Prolonged tank **shutdown time**.

AVKEM oil treatment

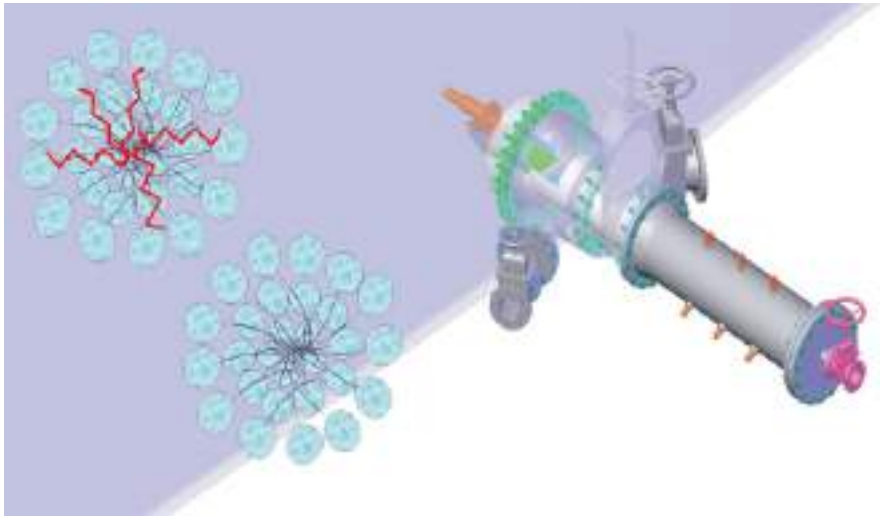
Innovative approach

OUR CONCEPT: SLUDGE IS VALUABLE

Our system allows to recover up to **95%** of the hydrocarbons present in the sludge while minimizing the volume of final waste to be sent for disposal.

The system is based on:

- Hydro-mechanic rotating modules
- Novel engineering process
- Biotechnological compounds (Biosurfactant)
- Energy



AVKEM® oil treatment

Automatic Tank Cleaning Process

1. Sludge mapping and characterization
2. Cold tapping
3. Jetting modules and Motopumps installation
4. Circulations
5. Separation
6. Oil recovery & water disposal
7. Solids clean out

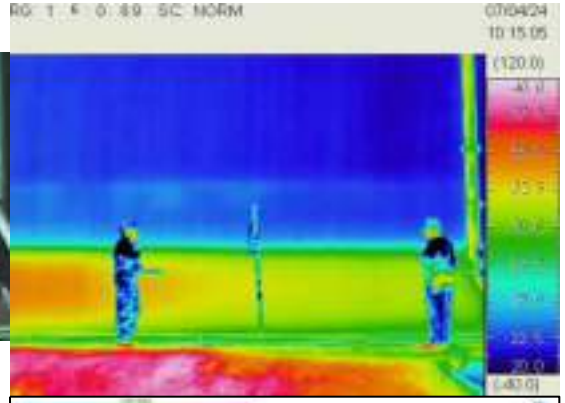
AVKEM® oil treatment

STEP 1

Sludge mapping and characterization

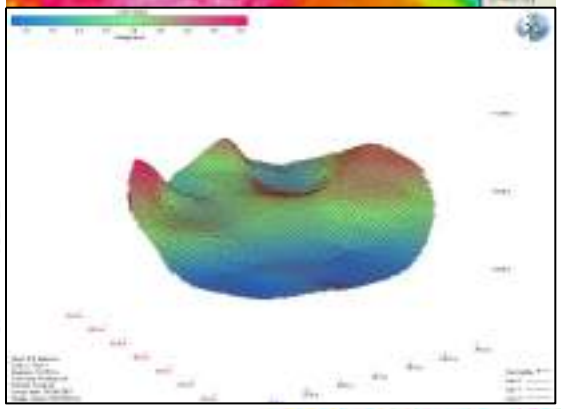
Mapping:

Thermographic, density and viscosity profiles are taken to determine the quantity of the sludge



Characterization:

Sampling, density & viscosity profiles and analysis of the sludge enable the optimal tank cleaning strategy to be developed.



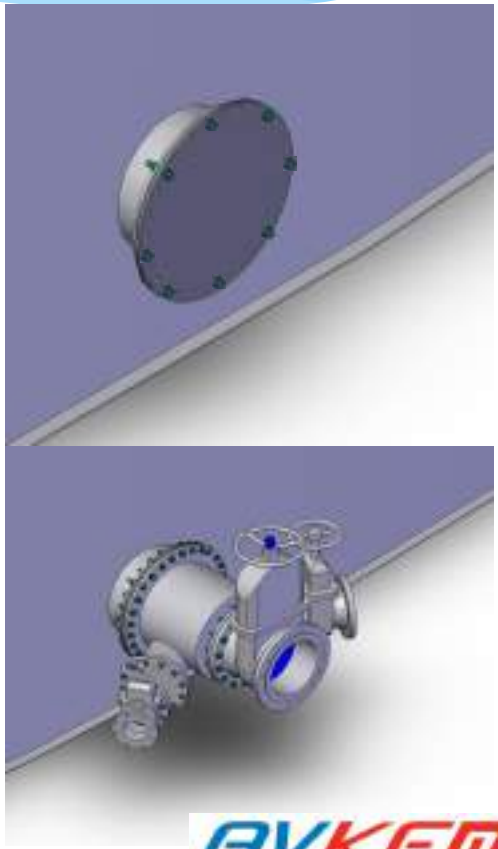
AVKEM oil treatment

STEP 2
Cold Tapping

Without opening the tank, several bolts are removed from the lateral man-way, leaving 8 bolts in place.

The manhole adaptor, with a gasket, is placed over the man-way and bolted down. The adaptor has 8 larger holes to fit the man-way plate bolts.

Two side valves (10” and 6”) and one 16” (front) valves are installed on the adaptor. The valves are closed and the assembly is pressure tested.

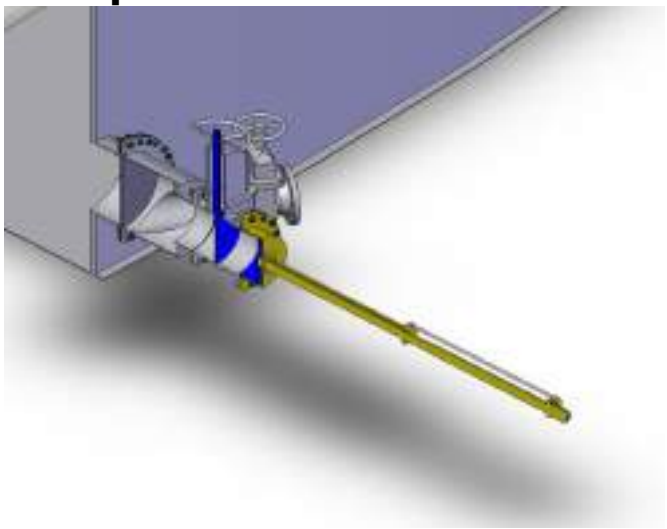


AVKEM® oil treatment

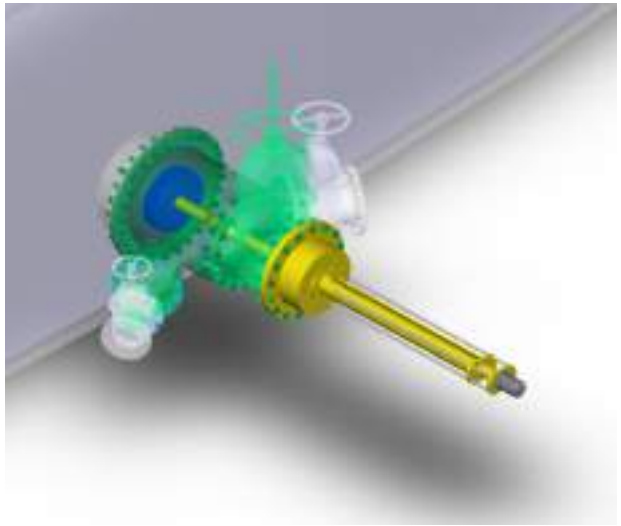
STEP 2

Cold Tapping

Without taking the tank out of service, a cold tapping device is used to cut penetration in the man-way



The cold tapping device is bolted in place



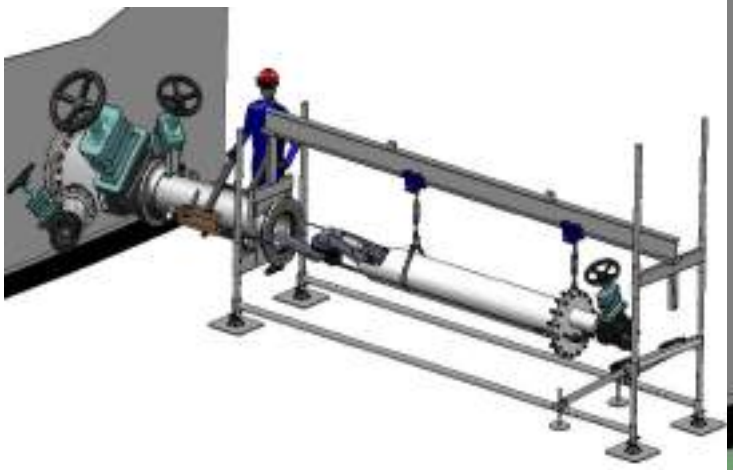
The main valve is opened and the saw cuts into the man hole plate.

AVKEM oil treatment

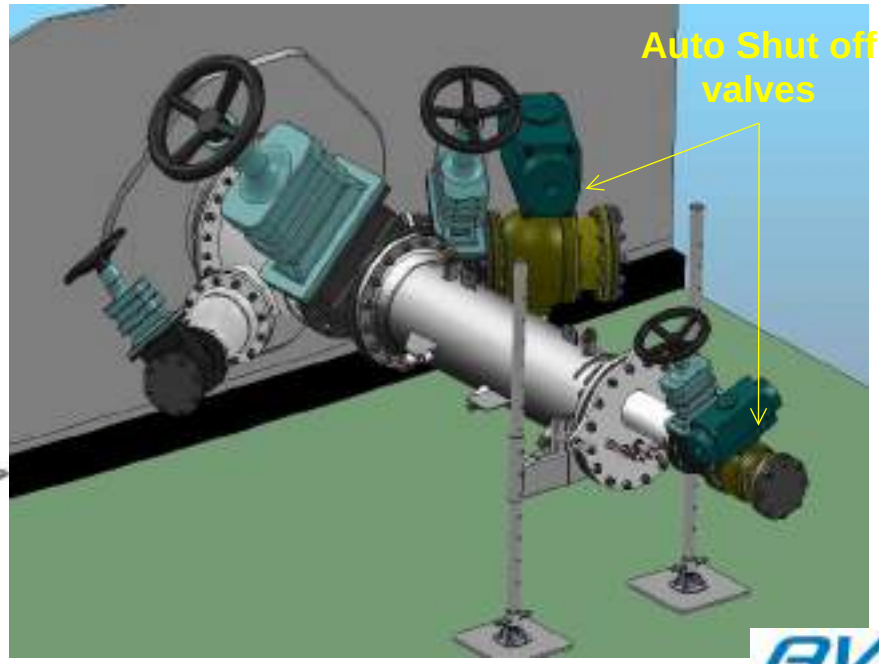
STEP 3

Jetting Modules and Motopumps Installation

The cold tapping device is removed and the jetting modules installed. At this time, the tank is still in service.



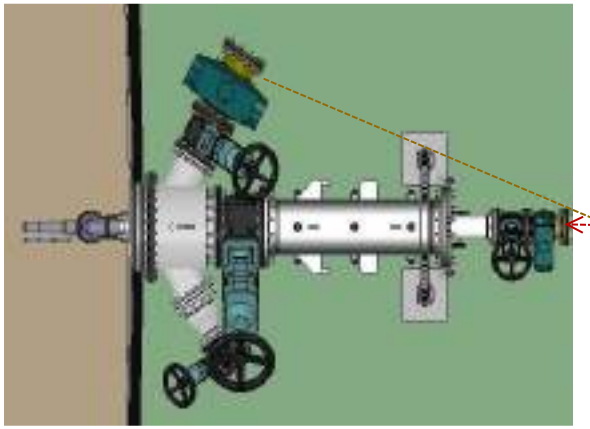
Module's introduction device



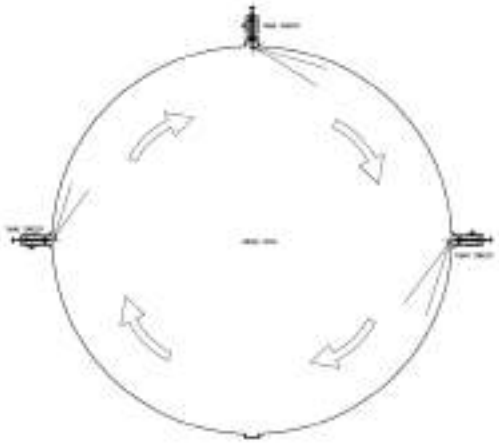
AVKEM oil treatment

STEP 4

Circulations



Biosurfactant



The position of the jetting tool is controlled manually:

- +/- 20° vertically
- 180° horizontally

The washing and dilution effect of fresh crude oil or other suitable distillate is used at a ratio of 2:1 to 3:1 (depending on the sludge quantity).

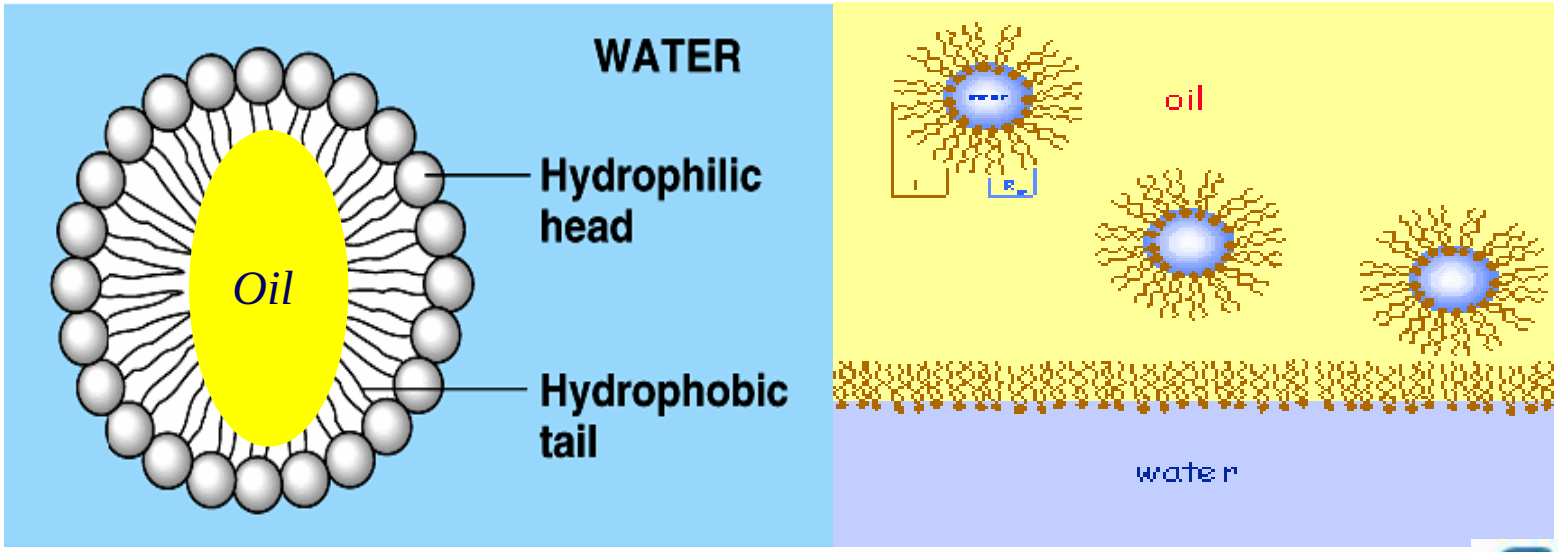
AVKEM oil treatment

STEP 5

Separation

Biosurfactant action:

- allows oil, fats and hydrocarbons to disperse into water through reduction of surface and interfacial tension
- A temporary stable emulsion is formed which afterwards breaks allowing the hydrocarbons, water and solids to separate in layers

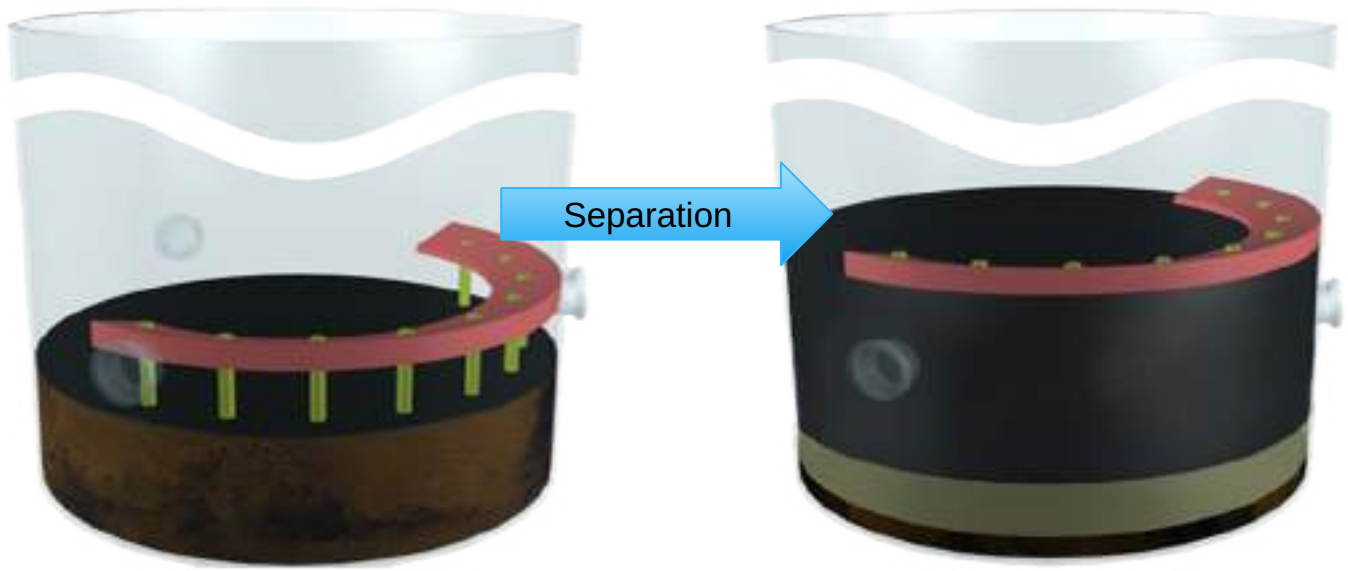


AVKEM oil treatment

STEP 5

Separation

At the end of the circulation, oil and water are separated from the solid phase.



Sludge consisting of sand and gravel mixed with oil and water

Sludge now has up to 95% of the hydrocarbons removed and returned to the oil phase.

- Hydrocarbon can be recovered from the 10” valve
- Water can be reused or sent to the water treatment plan

AVKEM oil treatment

STEP 6

Oil recovery and water disposal

After circulation and separation, the content of the tank is pumped out.

The oil phase can be pumped directly to the desired location.

The recovered oil quality is continuously monitored in our mobile lab.

The water phase is pumped back to the waste water tank or different designed location.

Also the water quality is monitored.

The biosurfactant has not detrimental effect on the oil quality and environment.

AVKEM oil treatment

STEP 7
Solids clean out

Option 1 – Desludging

If the objective of cleaning is to recover the valuable storage capacity in the tank and there is no need to remove the remaining small amount of solids, the tank can be put back in service.

Option 2 – Final clean to "Gas Free"

If "Gas Free" condition is required for tank maintenance or inspection then degassing and final clean out of the tank is needed.

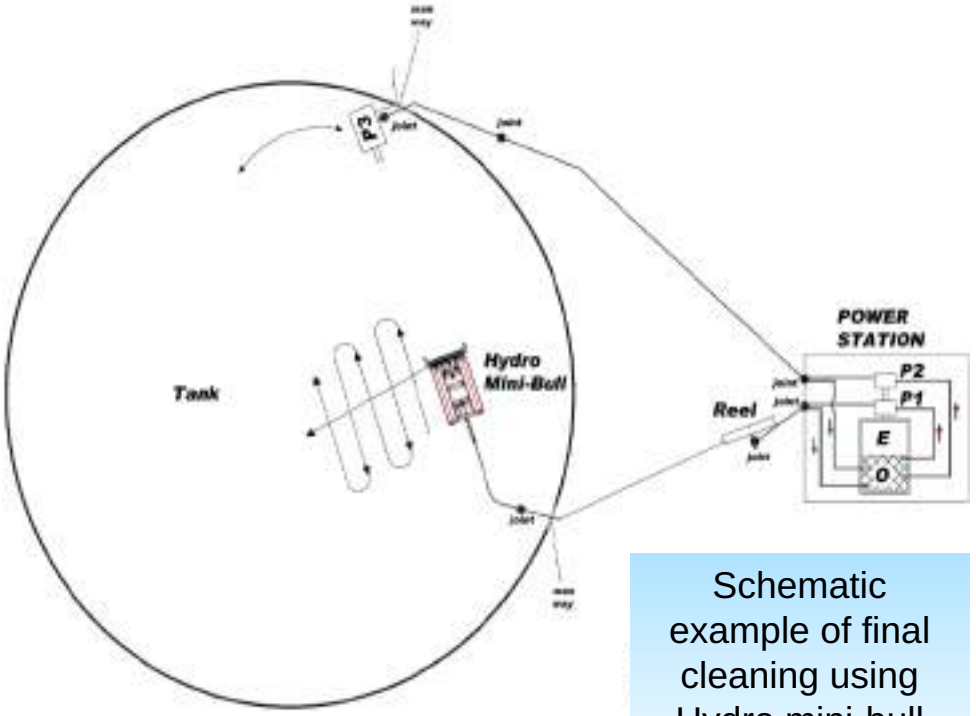
The nozzle size is changed to allow water washing.

AVKEM oil treatment

Final Cleaning

Man entry for final cleaning is required.

To minimize the confined space entry time, we operate the Hydro mini-bull system that collects the residual sludge



Schematic example of final cleaning using Hydro mini-bull

AVKEM oil treatment

Advantages

Main advantages of our system are:

- tank downtime minimized as remains in service during the desludging phase.
- Up to 95% of all hydrocarbons are recovered from the sludge.
- Minimization of the final waste to be disposed.
- High QHSE standards: no man operation on the roof of the tank and minimal confined space entry.

AVKEM® oil treatment

Other Advantages

- no need for secondary tank
- process can be applied whichever is the sludge level and the oil level without extra cost and extra time
- uniform landing of the floating roof avoids mechanical troubles
- no need to remove the legs or to tap the roof
- no need to use nitrogen for inertization
- mechanical modules can be left installed for future cleaning operations and to prevent sludge accumulation
- zero emission of VOC' s during all operations

AVKEM® oil treatment

Case Study – 1

The Situation

Tank Information

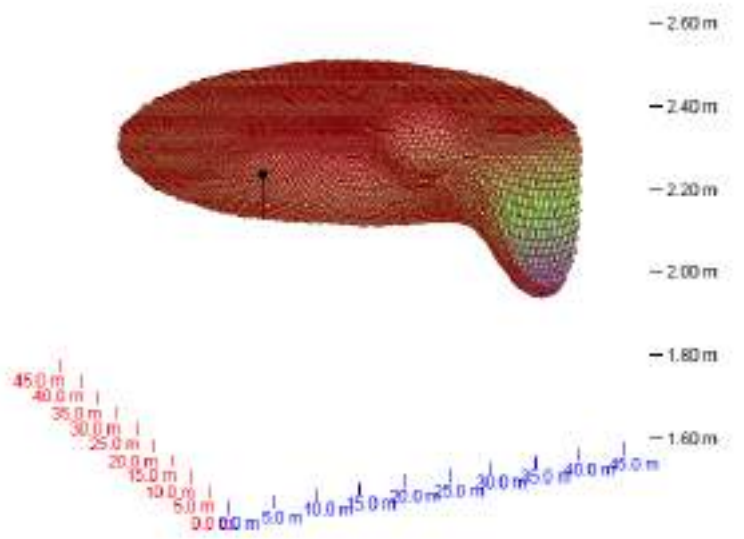
Tank	Product	Diameter	Total Height	Min operation height	Total volume	Total operating volume	Estimated initial sludge volume
#		m	m	m	m3	m3	m3
1140	Condy	48	19.5	1.8	35,000	33,098	4,000

The situation

The TK 1140 condy tank needed to be cleaned for internal inspection and maintenance.
Last time, this tank was cleaned 20 years ago manually.

At that time the tank contained 4,000 m3 of sludge (3,600 m3 of sludge + 400 m3 interface)

Initial composition of the sludge was:
Oil (%Vol) = 83.7% (3348 m3)
Water (%Vol) = 2% (80 m3)
Asphaltenes (%Vol) = 7% (280 m3)
Solids (%Vol) = 7.3% (292 m3, average from all collected samples)



AVKEM oil treatment

Case Study – 1
The solution

Triple circulation

To better design the proper operation process for this specific tank, we run lab test to simulate the BioRecOil process. A complete auto-tank cleaning operation was simulated with 3 circulation and oil recovery circles.

Appling the simulation results to our field operation, we were able to achieve the following results:

	Total circulation time	Volume of biosurfactant injected	Biosurfactant concentration on the total volume	Roof level	Sludge reduction
	hrs	m3	ppm	m	%
1st circulation	71.5	0	0	6.5	60
2nd circulation	76.5	0	0	4	80
3rd circulation	66.5	3	500	3.5	>95

AVKEM oil treatment

Case Study – 1
The Results

Final waste = 170 m3 + 60 m3 added water

With a waste reduction compared with the initial sludge >95%

Total oil recovered = 3,500 m3 (22,000 bbls)

We recovered > 95% of the oil from the initial sludge volume with a value of 2,420,000 USD (@ 110$/bbl)

AVKEM® oil treatment

Case Study – 2

The Situation

Tank Information

Tank	Product	Diameter	Total Height	Min operation height	Total volume	Total operating volume	Estimated initial sludge volume
#		m	m	m	m3	m3	m3
804	Crude Oil/Slop	51.82	18.26	2.35	44,000	32,098	2,500

The situation

The TK 804 crude oil tank, used in the last few years as slop tank, needed to be cleaned for internal inspection and maintenance.

Last time, this tank was cleaned 20 years ago manually.

At that time the tank contained:

2,500 m3 of sludge (2,000 m3 on the bottom and 500 m3 of paraffines floating between water and oil layers)

7,000 m3 water

2,000 m3 crude oil

The sludge composition was mostly paraffines with low concentration of solids (<2%) and 10% water.

AVKEM oil treatment

Case Study – 2
The Solution

Double circulation

After draining as much water as possible from the bottom of the tank, to avoid additional oil/water emulsion during the desludging, we decided to proceed with a double circulation to dissolve as much paraffines as possible in the crude oil, lowering the volume of the waste to be removed in the internal cleaning. At the same time, during the second circulation, we injected our biosurfactant enhancing the oil-water-solids separation in the original sludge and recovering higher volume of valuable crude oil.

	Total circulation time	Volume of biosurfactant injected	Biosurfactant concentration on the total volume	Oil recovered from sludge	Residual sludge volume after circulations
	hrs	m3	ppm	m3	m3
1st circulation	64				
2nd circulation	49	2	300	2013	230

AVKEM oil treatment

Case Study – 2
The Results

Final waste

During the internal cleaning A total of 229 m3 of sludge were removed and sent for post-treatment to separation tanks heated by steam coils. This allows us to recover extra 135 m3 of oil and send for disposal only:

93 m3 of final waste

With a waste reduction compared with the initial sludge >95%

Oil recovered

We recovered 2,013m3 of oil after the double circulation and an extra 125 m3 after the post-treatment for a total of:

2,148 m3

with crude oil volume recovered from the original sludge >97%

Feedback from Client: **"***Overall very satisfied with the safety performance and spirit*"

AVKEM oil treatment


Questions?