

Certificate

Environmental Approval

The BLABO® Tank Cleaning System

This approval certifies that Danish Technological Institute, Environmental Division has evaluated the BLABO® tank cleaning system designed by Toftejorg Technology A/S, Denmark.

The environmental evaluation focuses on:

- wastewater
- emissions to the atmosphere
- solid waste
- occupational health and safety
- risk of fire and explosions.

The result of the evaluation of the BLABO® tank cleaning system is that it will improve the total environmental performance.

Aarhus 30 January 2003

Danish Technological Institute
Environmental Division



Flemming Egtoft Knudsen
Project Manager, M.Sc.

Teknologisk Institut
Miljødivisionen
Teknologiparken, DK 8000 Århus C



**DANISH
TECHNOLOGICAL
INSTITUTE**

Note: The certificate is an 8 pages long report describing the process in details.



CERTIFICATE

Open
Teknologisk Institut
Miljødivisionen
Teknologiparken, DK-8000 Århus C

Environmental Approval The BLABO[®] tank cleaning system

Prepared for:

*Toftejorg Technology A/S
Baldershøj 28
DK-2635 Ishøj
Danmark*

30. January 2003

Summary

Danish Technological Institute, Environmental Division has evaluated the BLABO[®] tank cleaning system designed by Toftejorg Technology A/S, Denmark. The environmental evaluation focuses on wastewater, emissions to the atmosphere and solid waste, and includes occupational health and safety as well as risk of fire and explosions.

The BLABO[®] tank cleaning system is designed to combine the emptying and cleaning of tanks with the simultaneous separation of the sludge from the cleaning of oil tanks (especially crude oil and heavy fuel oil tanks and vessels). The sludge will typically contain oil, petroleum wax, water and inorganic particles.

The result of the evaluation of the BLABO[®] tank cleaning system designed by Toftejorg Technology is, that it will improve the total environmental performance by reducing the consumption of tank cleaning fluids because of re-circulation of the media during the cleaning process, as well as the recovery of the hydrocarbons from the tank sediments for reprocessing in the oil refinery or use as fuel.

The environmental impact of the BLABO[®] tank cleaning system is low. The amount of wastewater generated is low and has low concentrations of hydrocarbons and solids. The system can meet with legal requirements in the EU, provided the resulting solids are used as fuel or disposed of according to local waste disposal regulations.

Presentation

Danish Technological Institute is an independent non-profit institution approved by the Danish Ministry of Economic and Business Affairs to provide technological services. Her Majesty Queen Margrete II of Denmark is patroness of Danish Technological Institute.

It is organised in 6 divisions one is Environmental Division. The Environmental Division is accredited by DANAK, the national accreditation body in Denmark to perform environmental testing of wastewater and air emissions.

The writer of the approval is Master of Science in chemical engineering specialised in environmental management and has participated as environmental specialist in the certification according to ISO 14001 of 16 individual industrial companies and as trainer in environmental management in Denmark, Malaysia, Poland, Russia, South Africa and Thailand. Has previously worked at an oil refinery and in the natural gas sector.

Objective

The objective of the evaluation is to document and verify the environmental impact when using the BLABO[®] tank cleaning system designed by Toftejorg Technology for the cleaning of oil storage tanks.

The certificate of approval is based on documentation on equipment and processes relevant to the tank cleaning system presented and received at the inspection at Toftejorg Technology Headquarters in Denmark on October 3rd 2002. The documentation includes descriptions and drawings of processes and equipment, factory test certificates for machinery and certificates of conformity for electrical equipment.

Process description

The system can be divided into two principal sections:

1. The **Tank Cleaning Machines (TCM)** are installed on the tank itself via existing flanges or specially cold-tapped holes and perform the actual cleaning of the tank interior using low-pressure, high-flow rates of re-circulating media or wash water. The choice of appropriate TCM type and the number of TCM used for a particular cleaning job are determined by the type and size of tank to be cleaned.
2. The **BLABO[®] Process Modules** are situated on the ground by the tank and are connected to the TCM and to each other using quick-connection piping. The modules contain the process equipment required to perform the tank emptying, the cleaning media re-circulation and the separation of the sludge into solids, hydrocarbon and water fractions. Depending on the system configuration and the scope of the cleaning job, between two and four containerised process modules are used.

Tank Cleaning Machines

The Toftejorg tank cleaning machines (TCM) have been designed and developed to ensure the most effective tank cleaning in the shortest possible time with a minimum consumption of cleaning fluid.

The TCM is based on far reaching, low pressure, high impact jets, cleaning in a precise indexed pattern and using re-circulated oil liquid as cleaning media. Toftejorg have found that tank cleaning performed with low pressure, high (re-circulated) flow rate cleaning machines is more efficient, faster and consumes less cleaning fluid than traditional high pressure cleaning.

The tank cleaning machines are installed either permanently or temporarily, usually on the roof of the tank, through existing man-ways or flanges, or through specially cold-tapped holes. They are produced in a variety of designs for various industrial

applications. In oil tank cleaning, TCM selection depends on the tank type, size and contents.

The Toftejorg Single Nozzle Sweepers (SNS) are the main “work horse” of the BLABO® tank cleaning system. They are hydraulically driven and especially developed for use within the low clearance heights and high diameters found in emptied floating roof tanks. They are particularly suitable to handle the difficult-to-clean sludge frequently found in “black oil” tanks with a diameter up to 100 m.

Toftejorg Rotary Jet Head (RJH) tank cleaning machines are multiple-nozzle cleaning machines which are powered by the flow of the cleaning media itself through the nozzle. In BLABO® applications, the machines are normally used for the cleaning of fixed-roof tanks.

Process Modules

The BLABO® Process Modules are located on the ground near the tank being cleaned, and contain process equipment required to perform the tank emptying, cleaning media re-circulation and separation of the sludge into solids, hydrocarbon and water fractions. All equipment in these modules is designed for safe operation in EEx Zone 1. Depending on the system configuration and the scope of the cleaning job, between two and four containerised process modules are used.

The following sections provide a brief description of each of the BLABO® Process Modules, including the key components of each module and its application within the tank cleaning process.

The Suction Module is used to remove the liquid-solid mixture from the bottom of the tank to be cleaned and to pump the sludge on to the Re-circulation Module. The module contains a centrifugal suction pump equipped with upstream pre-filters to prevent solids from entering the pump.

The Skimming Module is primarily used to separate oil and solids from the circulating water during the water wash phase. The module contains an integrated coalescer for this function. Solids in the water phase settle on the bottom of the inlet side of the module and are manually removed after the cleaning procedure. Oil is collected in a separate compartment and pumped to the refinery for reprocessing. The oil-free water is re-circulated to the tank cleaning machines for re-use in the tank cleaning. The skimming module significantly reduces the total water consumption compared to other cleaning methods, which generally use a once-through water flow.

In the Re-circulation Module, the sludge from the Suction Module undergoes a primary solids separation through hydro-cyclones. The “clean” fraction of the oil is pumped to the TCM (during the oil wash phase) or to the Skimming Module (during water wash phase). When required, the re-circulated media is heated by a heat

exchanger in module. The “dirty” fraction of the sludge from the hydro-cyclones is pumped to the Separation Module for further separation.

The Separation Module receives the sludge fraction from the bottom of the hydro-cyclones in the Re-circulation Module. It may also be used for the treatment of sludge and sediments recovered from tanks, vessels, API and DAF in the refining facilities.

The Separation Module splits the sludge streams into hydrocarbons, water and solids by the use of centrifugal means (decanting/centrifuging). Facilities for flocculant injection are provided to enable more effective separation of solids from the watery sludge during the centrifugal steps.

Steam heated shell and tube heat exchangers are provided for the optional preheating of the feed to the decanter and the centrifuge. If heating is not required, the heat exchangers can be bypassed.

The oily sludge enters the decanter located in the Separation Module. The decanter is a 2-phase (liquid/solids) separator with an accelerated “g” force of up to 3000. Under these conditions, particles as small as 5 microns are removed in a continuous self-cleaning application, where the solids are forced against the inner bowl of the decanter and are removed by a scroll conveyor through the solids discharge ports. The discharged solids are fed onto an external conveyor leading to a solids collection container. Solids accumulated here are used as fuel in the refinery, sold as fuel to power plants or cement plants or disposed of according to hazardous waste disposal regulations.

The lighter liquid phase from the decanter flows out from the liquid discharge port into a tank located in the sub-frame below the module. From this tank, it may be pumped to the oil refinery for re-processing or pumped to a high-speed centrifuge, also located in the module.

The high-speed centrifuge operates with an even higher “g” force than that of the decanter, or about 5000. This acceleration allows for the continuous separation of the light (oil) and heavy (water) liquid phases. The oil outlet of the high-speed centrifuge will meet required specifications for maximum water content and is returned to the refinery for re-processing. The water outlet is pumped to the refinery’s sewer system and wastewater treatment plant.

The Separation Module includes a hot water system containing a mixing device, which mixes steam and cold water to a pre-set water temperature. The hot water is utilised for cleaning purposes and during emergency stops at the decanter and high-speed centrifuge.

Evaluation

Wastewater

The wastewater from the BLABO® Tank Cleaning System is discharged to the refinery wastewater system. The wastewater will have a low concentration of suspended solids and oil after passing the decanter and the centrifuge.

Toftejorg Technology specifies that the oil content will be below 2000 mg/l in the outlet water from the plant.

At Danish Technological Institute it is the experience that a solid/water/oil separation system based on decanter and centrifuge can easily fulfil that specification. Experience from Denmark shows that a decanter and centrifuge system usually can bring down the concentrations to about 0.2 percent solids and 100 mg/l oil and such low concentrations can easily be handled in the wastewater treatment plants.

Considering the small amount of water and the low remaining concentrations of oil and solids the evaluation is that the wastewater from the Tank Cleaning System will not cause any problems in the refinery's sewer system or in the wastewater treatment plant

Emissions to the air

The Tank Cleaning System is a closed system, so the loss of hydrocarbons to the atmosphere is minimised. The operation temperature in the Tank Cleaning System will normally not exceed 80 °C. Therefore the evaporation of hydrocarbons will be low. The level of vapours in the Tank Cleaning System is monitored continuously by gas detectors.

The emissions to the air are therefore evaluated as low.

Solid waste

From the decanter comes a solid waste fraction consisting of the sediments from the oily sludge being treated. The main components are inorganic particles such as sand and rust scales and solid hydrocarbons.

The solid waste has a high calorific value and should therefore be used as a fuel in large furnaces able to handle solid or semi-solid fuels. It can be used in the refinery or it can be sold to electric power stations or to rotary cement kilns.

If no commercial use for the solid fraction can be found, it must be disposed of at a dump where there is no risk of soil or water pollution.

Occupational Health and Safety

Using the BLABO® Tank Cleaning System means that no personnel are inside tank during cleaning operation. The Tank Cleaning System is a closed system operating under automatic control. For personnel safety, there are installed gas detectors with alarm sirens and warning lights in case of emission of hydrocarbon vapours, and a fire-fighting system consisting of fire hydrants, fire extinguisher and fire cabinet.

The maximum temperature of the equipment is limited to 80 °C to protect the rubber gaskets in the system, but hot surfaces are heat insulated, so the surface temperature will not exceed 55 °C

The Tank Cleaning System does not require any special health and safety precautions besides the general precautions in any mineral oil refinery.

Risk of fire and explosions

The risk of fire and explosions is prevented by running the process in a closed system and by the selection of electric equipment. The Process Zone contains only equipment which is explosion-proof (EEx secure), and it includes all the process equipment with the exception of the receiving pit, which is located just outside of the fenced-in process site.

The process equipment is produced in the EU and it is CE approved for use in potentially explosive atmospheres, ex-zone 1. The control panel is certified by UL (Underwriters Laboratories Inc.) International Demko A/S, Denmark. Certificates were presented at the visit to Toftebjerg Technology Headquarter.

Conclusion

The environmental impact from cleaning of oil tanks is reduced by using the BLABO® Tank Cleaning System because most of the hydrocarbons from the tank bottoms are recovered and the use of cleaning fluids is minimised by reprocessing and re-use of the fluids.

The amount of wastewater is low and has a low concentration of contaminants, so it can be handled by the refinery's wastewater treatment plant.

The air emission is low or insignificant because the BLABO® Tank Cleaning System is a closed system.

No personnel are inside tank during cleaning operation. The Health and Safety precautions are the general precautions in any mineral oil refinery.

The process equipment including electrical equipment is approved for use in potentially explosive atmospheres, ex-zone 1.

Aarhus 30 January 2003

Danish Technological Institute
Environmental Division

Flemming Egtoft Knudsen
Project Manager, M.Sc.

*Danish Technological Institute
Miljødivisionen
Teknologiparken, DK 8000 Århus C*