Certificate

Environmental Approval

Sludge Handling and Treatment

This approval certifies that Danish Technological Institute, Environmental Division has evaluated the sludge handling and treatment procedure of the tank cleaning systems 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 sludge handling and treatment procedure is that it will improve the total environmental performance.

Aarhus 21 October 2002

Danish Technological Institute
Environmental Division

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Note: The certificate is a 6 pages long report describing the process in details.

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CERTIFICATE

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Environmental Approval
Sludge Handling and Treatment

Prepared for:

Toftejorg Technology A/S
Baldershøj 28
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Danmark

21. October 2002

Environmental Division

Summary

Danish Technological Institute, Environmental Division has evaluated the sludge handling and treatment system designed by Toftejorg Technology A/S, Denmark. This environmental evaluation focuses on wastewater, emissions to atmosphere and solid waste, and includes occupational health and safety as well as fire and explosion risk.

The sludge handling and treatment system is designed to process oily sludge from the cleaning of oil tanks (especially crude oil tanks and vessels), API and DAF, so the sludge will besides crude oil contain petroleum wax, water and inorganic particles.

The result of the evaluation of the sludge handling and treatment system designed by Toftejorg Technology is that it will improve the total environmental performance by reducing the content of hydrocarbons in the waste.

The environmental impact of the sludge handling and treatment process is low and it can meet with legal requirements in the EU, provided the resulting solids are used as fuel of disposed of according to 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 an has participated as environmental specialist in the certification according to ISO 14.001 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 of using the sludge handling and treatment system designed by Toftejorg Technology for the recovery of sludge and sediments from cleaning of oil storage tanks.

The certificate of approval is based on documentation on equipment and processes relevant to the sludge handling and treatment 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 sludge handling and treatment system is process facility for receiving, storing and treatment of oily sludge.

The Sludge Treatment Plant is a stationary process facility designed for the treatment of sludge and sediments recovered from tanks, vessels, API and DAF in the refining facilities. The plant performs the separation of the sludge streams into hydrocarbons, water and solids via the use of physical means (sorting/screening, settling) and centrifugal means (decanting/centrifuging). Facilities for flocculant injection are also provided to enable more effective separation of solids from 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 Sludge 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 is pumped by means of a centrifugal pump to the 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.

Included in the Sludge Separation Module is 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 Sludge Handling and Treatment Plant is discharged to the refinery wastewater system.

The remaining waste water from the Sludge Handling and Treatment Plant 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 meet with 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 plants.

Considering the small amount of water and the low remaining concentrations of oil and solids the evaluation is that the wastewater from the Sludge Handling and Treatment Plant will not cause any problems in the refinery's sewer system and it can be handled in the wastewater treatment plant

Emissions to the air

The Sludge Handling and Treatment Plant is a closed system, so the loss of vapour will be low.
The operation temperature in the Sludge Handling and Treatment Plant will normally not exceed 80 °C. Therefore the evaporation of hydrocarbon vapours will be low. The level of vapours in the Sludge Handling and Treatment Plant is monitored continuously by gas detectors.

The emissions to the air is 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

The Sludge Handling and Treatment Plant is a closed system operating under automatic control. For personnel safety, there are 4 gas detectors with alarm sirens and warning lights in case 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 Sludge Handling and Treatment Plant do 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 comprises the sludge treatment 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 Toftejorg Technology Headquarter.

Conclusion

The environmental impact from disposal of oily sludge will be reduced by using the Sludge Handling and Treatment Plant because it will recover most of the hydrocarbons from the sludge.

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.

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.

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