



This equipment package includes descriptions of the process lines, the technologies used, and the overall equipment configuration. Processing parameters and conditions are presented in summary form. A process material balance and a list of consumables for a specific process line must be developed through laboratory testing based on the information provided by the customer in the technical specification.

PROCESSING OF ACID TARS



Mobile configuration: Each plant module may be fitted with a semitrailer of suitable load capacity for transport on public roads. The plant may also be fitted with equipment for unloading some modules from their transport vehicles during operation.

Time required to prepare the equipment for transport: 1 day.

Stationary configuration: The equipment is supplied with the utility connections needed to link the modules, taking into account possible placement constraints at an industrial site. No transport vehicles are included, but all modules remain mobile.

Time required to prepare the equipment for transport: 2 days.



The six-module line is designed to treat aged, dense oil sludge containing substantial amounts of sulfuric and sulfonic acids. Acid-resistant materials and steels are specified for components in contact with the feed.

MODULE 1 — COLLECTION AND TRANSFER OF LIQUID HYDROCARBONS

Module 1 includes service platforms for equipment lowered into the sludge, floating pontoons and a system for repositioning the pontoons. The collected sludge is heated, screened to remove large solids and pumped to the next treatment stage by a screw or pneumatic-piston pump.

Floating booms collect a thin surface layer of liquid sludge. Both ends lead to dedicated winches. The booms comprise 25 m long, 0.5 m wide sections; their floats detach as the sections are pulled in. Two specially equipped pontoons collect the thick, highly viscous bottom layer. They crush, heat and screen the sludge, move across the lagoon by a pulling system, and pump the prepared material onward.

For acid-tar lagoons, one pontoon takes the liquid surface layer to Module 2. The other collects dense sludge with a high solids content from near the bottom and sends it to Module 6.

MODULE 2 — HYDROCAVITATION AND ACOUSTIC TREATMENT

Module 2 prepares the liquid feed for water separation, emulsion breaking and disintegration of agglomerated high-molecular-weight hydrocarbons. It is also intended to reduce inorganic and organic acids. In a vertical extractor, the sludge is blended with lime slurry and a light hydrocarbon blend. The blend may include emulsified oil, recovered oil product, liquid sludge with a pour point below -10°C , off-specification gas condensate or other liquid hydrocarbon waste.

The feed passes through three treatment stages using acoustic systems and steam-jet hydrocavitation devices. Under specified operating conditions these break water-in-oil emulsions; demulsifier is metered into the stream to improve phase separation.

At every stage, ultrasound acts continuously on the aqueous layer. The original specification attributes reduced acidity in both the aqueous and hydrocarbon phases, as well as hydrogenation of the hydrocarbon product, to cavitation. It proposes dissociation of water into H^{+} and OH^{-} ions and the formation of atomic hydrogen as the mechanism. After each stage, the light-hydrocarbon concentrate is collected separately and sent to Module 3 for final treatment.

MODULE 3 — SEPARATION OF PURIFIED OIL PRODUCT

Module 3 provides final centrifugal treatment of the concentrated light hydrocarbons. It uses an elongated horizontal three-phase centrifuge with screw discharge of solids at 3,000 rpm, followed by a vertical three-phase disc-stack separator at 5,000 rpm. Both machines are specified for oil-sludge service. Cake and separator solids have dedicated discharge systems; heat exchangers and demulsifier and flocculant dosing units support operation.

A separate sealed compartment houses the control automation and electrical supplies for the acoustic equipment and motors. A double sealed partition separates it from the process compartment. Clean-air ventilation maintains positive pressure in the electrical compartment for explosion protection.

MODULE 5 — PREPARATION OF SEDIMENT AND SOIL

Treatment of deposits from the walls and bottom of an acid-tar lagoon begins in Module 5. It is intended primarily to neutralize acids and to prepare and pump a slurry of bottom sediment and excavated soil. In the receiving unit, dry quicklime (CaO) is mixed with the sediment. The material is crushed, heated, screened to remove stumps and large stones, and fed by an open screw conveyor into a 2 m diameter treatment drum.



Steam-jet hydrocavitation devices and acoustic systems operate in the drum. A hydrocarbon blend and lime slurry are added. The combined treatment is specified to neutralize acid, disperse hydrocarbon lumps and wash stones; a pump sends the prepared soil slurry to Module 6.

MODULE 6 — REMOVAL OF HYDROCARBONS FROM SEDIMENT AND SOIL

Module 6 receives dense sludge fractions, bottom sediment and soil slurry. In a vertical extractor, the feed, including asphaltene-resin-paraffin deposits, is blended with lime slurry where needed and a small amount of light hydrocarbon blend.

Two stages treat the solids and two stages treat the liquid fraction. Thickened solids undergo hydrocavitation and steam-jet treatment after each stage. At the second stage, a vertical extractor applies a special solvent and other reagents. The liquid fraction likewise passes through two hydrocavitation and steam-jet stages. As in Module 2, the original specification attributes reduced acidity and product hydrogenation at this stage to ultrasound-driven cavitation.

The separated light-hydrocarbon concentrate is collected after each stage and sent to Module 3 for final treatment. After solvent treatment, a conveyor transfers the thickened soil to Module 7 for final mechanical treatment.

MODULE 7 — SEDIMENT SETTLING AND DEWATERING

Module 7 receives solvent-bearing soil from the Module 6 conveyor. An acoustic disintegrator treats the thickened soil in a high-intensity acoustic field. According to the original specification, cavitation releases residual hydrocarbons from the soil into the gas phase. The resulting emulsion and soil pass through two hydrocavitation and steam-jet treatment stages. Residual water and hydrocarbons are sent to Module 3 for final treatment.

TYPES OF WASTE TREATED

Acid tars; oil-contaminated water; liquid oil sludge containing water-in-oil or oil-in-water emulsions in any proportion; asphaltene-resin-paraffin deposits; dense or solid oil sludge stored for up to 60 years; and oil-contaminated soil.



EQUIPMENT CONFIGURATION PROCESSING OF ACID TARS		
Module		
Module 1	8.0 t — Collection and transfer of floating oil sludge (intake system)	
Module 2	18.0 t — Hydrocavitation and acoustic treatment (integrated feed preparation)	
Module 3	14.0 t — Separation of purified oil product from emulsion (centrifuge and separator)	
Module 5	6.5 t — Preparation of sediment and soil for treatment (heating and blending)	
Module 6	12.0 t — Removal of oil products from sediment and soil (integrated sediment treatment)	
Module 7	10.5 t — Sediment settling and dewatering (water treatment and final sediment treatment)	
Design processing capacity:	<i>Liquid and dense sludge</i>	20 t/h
By feed category	<i>Soil</i>	5 t/h
Characteristics of waste accepted for treatment:	<i>Hydrocarbons</i>	Primary constituent
	<i>Water</i>	≤80%
	<i>Soil</i>	≤50%
	<i>Acid</i>	≤20%
Utility requirements at maximum processing load:	<i>Electric power</i>	140 kW
	<i>Steam</i>	1,500 kg/h
Consumables (indicative values, subject to confirmation):	<i>Demulsifiers</i>	500 g/t
	<i>Flocculants</i>	1,000 g/t
	<i>Hydrocarbon blend</i>	10 kg/t
	<i>Solvent</i>	10 kg/t
Achievable parameters for treated hydrocarbon concentrate:	<i>Water</i>	0.5–1%
	<i>Mechanical impurities</i>	0.05–0.1%
Achievable parameters for treated soil:	<i>Hydrocarbons</i>	0.05–0.1%
Achievable parameters for treated water:	<i>Hydrocarbons</i>	0.0005%
		5 mg/L