AKVOLA TECHNOLOGIES

Industrial Water & Wastewater Treatment

Petrochemical Industry Capabilities

www.akvola.com

Proven Technology. Proven Expertise.

ThyssenKrupp TOTAL acciona bp SIEMENS

About the Company

akvola Technologies is a water technology company that provides cost-effective and environmentally-friendly solutions based on **akvoFloat™** – a proprietary flotation-filtration process– to clean hard-to-treat industrial wastewater containing high concentrations of oil (free, dispersed and emulsified) and suspended solids. These solutions can be implemented in six major water-using industries: Oil and gas, Refining and petrochemicals, Metalworking, Steel, Food and beverage and Pulp and paper.

In a world of increasingly stringent environmental regulations and increasing wastewater discharge and disposal costs, our goal is to enable industrial users to become excellent water stewards by reducing their water footprint and ensuring compliance at minimal costs in an environmentally-friendly manner. **akvoFloat™** was designed to accomplish this goal.

VISION

The only way to achieve a sustainable freshwater supply in the long-run is by making wastewater reuse affordable — a complex process that requires increasing amounts of energy. At the same time, energy generation, storage and transformation also requires increasing amounts of water. This mega trend, known as the Water-Energy Nexus, poses one of the main challenges of the 21st century. Both industrial and municipal markets require innovative technological solutions for water treatment which are both efficient and sustainable.

At **akvola Technologies** we believe that making wastewater reuse an affordable and sustainable water source is essential to the future development of mankind in terms of economy, environment and society.

VALUES

Sustainability

The triple bottom line (Planet, People, Profit) sets the tone in the way we do business. Our products, services, communication and management measures are all designed to optimize and reduce costs, environmental and societal impacts for ourselves and our stakeholders.

Technological Innovation

We deploy computer-aided design, process intensification and integration schemes, advanced materials and intelligent automation and control to achieve technological superiority.

Agility

As a highly agile organization we are alert to change and move quickly and decisively to meet the challenges that emerge from such change. This allows us to react quickly to changes in the customer's requirements and environment to deliver an effective and timely solution.

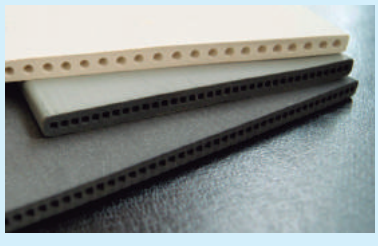
Inclusion

In our team each gender as well as many age groups and ethnic & cultural backgrounds are represented. Our talent pool is equally diverse in terms of professional background, experiences, insights, strengths and special skills. Inclusion puts our diversity into action, enabling a multifaceted mix of people to complement each other in cohesive, high-performing teams.

akvoFloat™ Technology

akvoFloat™ is a separation technology based on a proprietary flotation-filtration process. The process leverages the **akvola MicroBubble Generator™** and **novel ceramic membranes**, resulting in the most energy-efficient design on the market for oil, algae and suspended solids removal in hard-to-treat waters.

Package **akvoFloat™** system

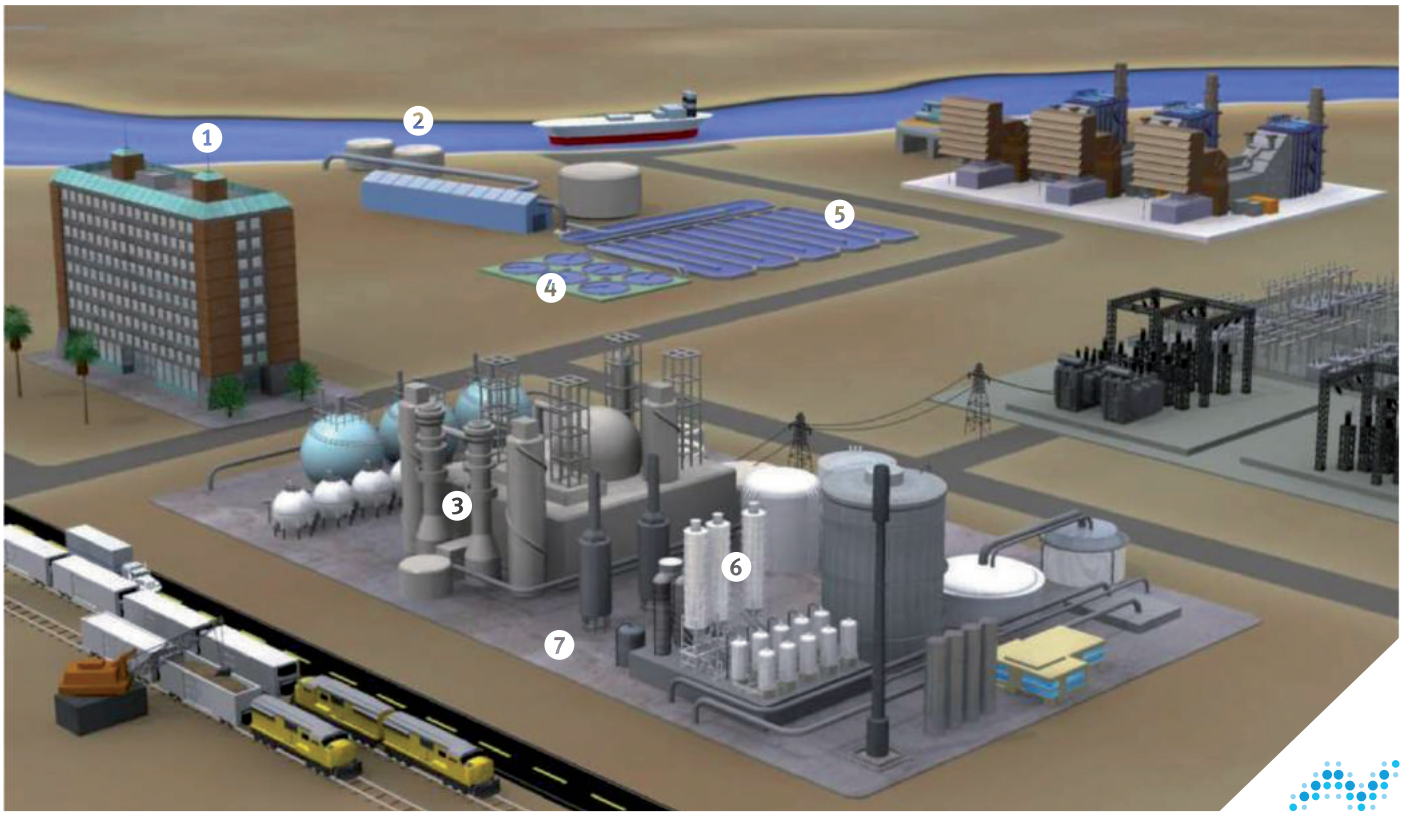


Flat sheet ceramic membranes

akvola MicroBubble Generator™

Large-scale system

Oily Water Treatment Applications



1. Wastewater Discharge

Problem: Non-compliance with discharge limits due to oil, TSS, organics, metals or any hard-to-treat contaminants.

Solution: Use akvoFloat™ to improve primary or tertiary treatment with the most cost-efective technology.

2. Tank Dewatering Effluent

Problem: High crude oil concentracions from tanks endanger WWTP performance.

Solution: Use akvoFloat™ to remove excessive oil from segregated effluent, previous to sending it to the WWTP.

3. Desalter Effluent

Problem: Oill carry-over in desalter brine. High hydrocarbons (i.e. benzene) and oils in this effluent create problems in the operation of the WWTP.

Solution: Use akvoFloat™ to remove excessive oil/emulsions of the segregated effluent previous to sending it to the WWTP.

4. Biological contamination

Problem: Ineffective oil and TSS removal create problems for the Biological Treatment.

Solution: Use akvoFloat™ to improve removal of oils and TSS.

5. Wastewater Reuse

Problem: Pretreatment before desalination (RO/EDR) doen't meet required feed water quality.

Solution: Use akvoFloat™ as a pretreatment technology in order to eliminate oils, TSS, metals and other contaminants with the right CAPEX/ OPEX balance.

6. Reformer Performance

Problem: Poor water separation in the low pressure separator.

Solution: Use akvoFloat™ to improve water separation (demulsifier).

7. Slop Re-Processing

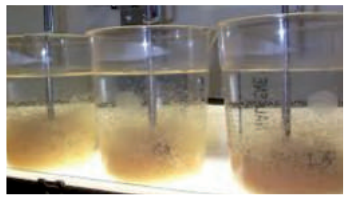
Problem: Low hydrocarbon recovery from slop water.

Solution: Use akvoFloat™ to recover free, dispersed and emulsified oils.

akvoFloat™
Technology Benchmarking

akvoFloat™ is separation technology based on a proprietary flotation-filtration process. It has been designed for the treatment of the industrial process water and wastewater in the most challenging operating conditions.

Our technology can handle any refinery effluent –regardless of the oil and TSS concentration– as a one-stop pretreatment solution for the biological treatment, acting as a reliable absolute barrier. Unlike conventional technologies, **akvoFloat™** can remove dispersed and emulsified oils.



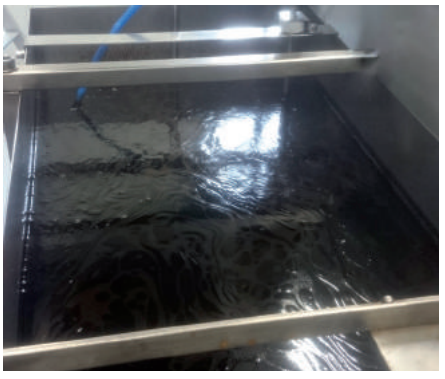
	Conventional	Advanced	akvoFloat™ Technology
Standard Technologies	Coagulation/Flocculation, Flotation (DAF, IGF, ...), Media Filter (DMF, ...)	Membrane (polymeric MF/UF, cross-flow ceramic MF/UF , MBR)	
Operational Limits	N/A	pH =6-7 Temp up to 30 °C (poly)	**pH =2-13** **Temp up to 90 °C**
Influent Quality Limits	medium	oils up to 20 ppm (poly), high (ceramic)	**oils up to 3%**
Influent Quality Variability	medium	medium	**high**
Removal Efficiency	low (no removal of emulsions)	90% (Oils, TSS, ...)	**99% (Oils, TSS, ...)**
Recovery Rate	< 85%	80-85% (cross-flow)	**95%**
Footprint	5x more	3x more	**baseline**
CAPEX	medium	high (flux ≤30 lmh)	**competitive** **(flux 80-150 lmh)**
OPEX (chem+energy)	0,2 - 0,3 €/m³ more	0,15 - 0,25 €/m³	**0,05-0,07 €/m³**
Payback Period	> 5 years	1,5-3 years	**< 1,5 years**

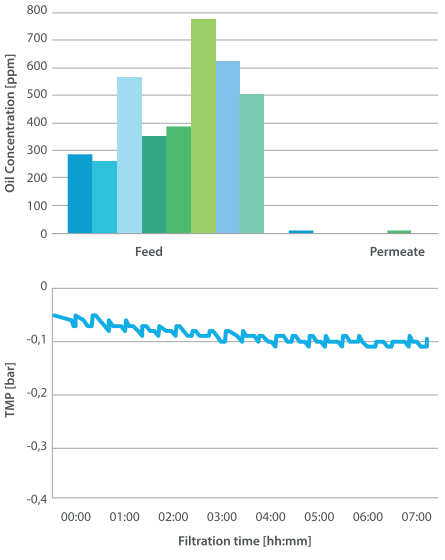
Case Study
Desalter Effluent Treatment

Customer: **BP Lingen Reffinery**
Location: Lower Saxony (Germany)

Conditions:

Parameter	Value
Temperature	40ºC
pH	7,5
TDS (mg/l)	43.551
Oil (mg/l)	800
TSS (mg/l)	500





CHALLENGE

Managing the increasing oil content of wash water associated with the desalter unit as well as tank bottom draws from crude oil reception operations is becoming more challenging for refining companies. BP Lingen refinery has to manage oily hard-to-treat desalter brine that can disrupt the operation of their wastewater treatment plant and negatively impact the bottom line.

Handling oily wastewaters with high and variable contents of oil and TSS with conventional technologies requires complex and costly treatment trains.

BP Lingen wanted to reach minimum oil concentration in desalter brine before sending it to biological treatment with minimal operating costs.

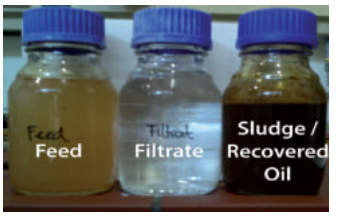
SOLUTION

Pilots tests were done with flowrates of 100-200 l/h. Different membrane materials and geometries were tested, i.e. Al_2O_3 and SiC, hollow fiber and flat sheet.

All membranes removed the oil concentration to below 10 ppm, in most cases below 5 ppm.

RESULTS

- ✔ **High removal efficiency:**
  - *Oil:* **from 800 ppm to 2 ppm** (> 99,75 %)
  - *TSS:* **from 500 ppm to 2 ppm** (> 99,6 %)
- ✔ **High recovery (> 95%)**
- ✔ **8 hours of stable operation** (TMP < 30mbar/h)
- ✔ **High flux (120 lmh)**

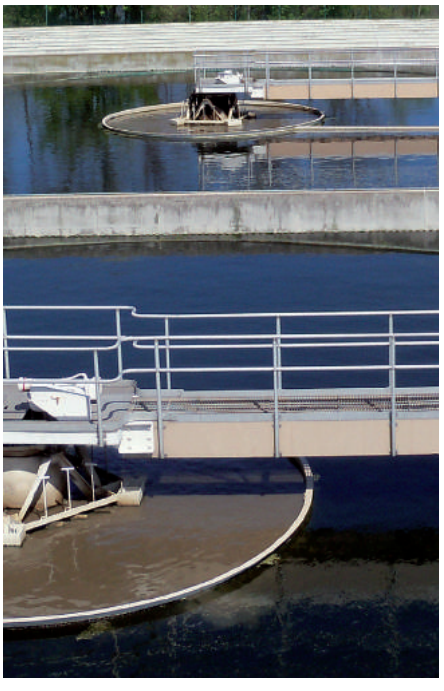


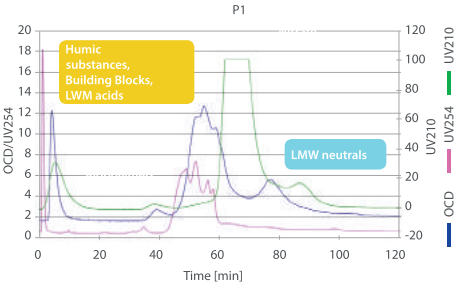
Case Study
Refinery Wastewater Reuse

Customer: TOTAL Petrochemicals
Location: Europe
Technology: Physical, chemical and biological treatment.

Conditions:

Parameter	Value
COD (mg/l)	50
Oil (mg/l)	38
Turbidity (NTU)	15
TOC (mg/l)	20
TSS (mg/l)	0,6
CFU (1/ml)	36.000
TSS (mg/l)	20





CHALLENGE

The sustainability corporate mandate demands actions to reduce water consumption in all refinery and chemical sites worldwide. The goal of the pilot is to develop an integrated solution around the **akvoFloat™** core technology ready for reuse of wastewater effluent as POX boiler water (250 m^3/h) with following CTQs (Critical-To-Quality):

- Solution with high resistance to influent variabilities
- Solution with reliable and simple operation
- Close to ZLD (concentrate streams management optimized)
- Waste to value philosophy (monetize waste)
- Meet RO feed quality requirements
- No use of chlorine-based water treatment technologies

SOLUTION

A technology benchmarking study was conducted comparing all suitable technology trains in terms of capex, opex, removal efficiency, reliability and ease of use. The study concluded that **akvoFloat™** followed by Adsorption and Oxidation processes should be tested in the field – a total of 3 configurations.

A fully automated akvoFloat™ pilot plant will treat a water flow of 1-2 m^3/h (up to 50 m^3/d). An RO unit is also included to complete the treatment chain.

RESULTS - WASTEWATER REUSE

"akvola Technologies suggested a water management study to evaluate different wastewater reuse solutions around their core technology, akvoFloat™. After the screening a real 4 month pilot will be implemented to demonstrate the results. After several previous pilots and tests done, akvola Technologies is one of the best choices we ever made in our site"

Water Process Engineer, TOTAL Petrochemicals

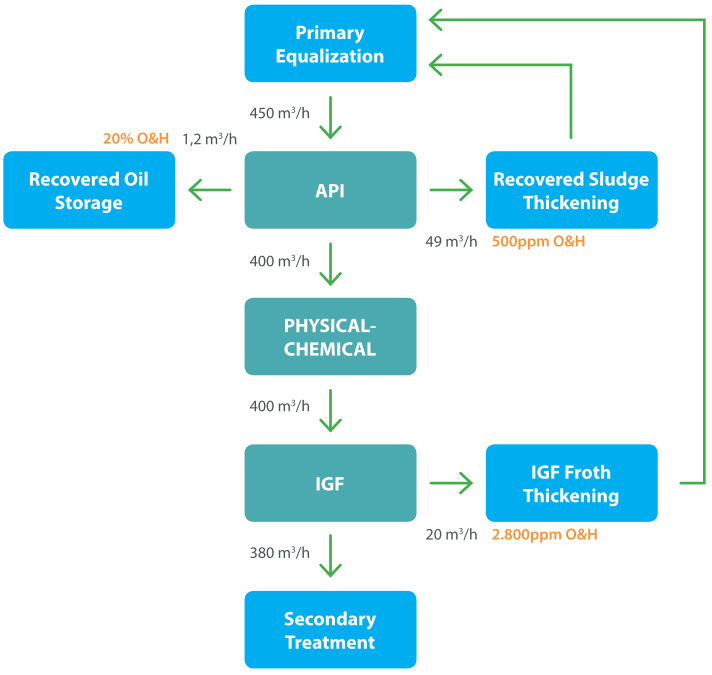
- ✔ **4 months pilot project**
- ✔ **High flux (up to 125 lmh)**
- ✔ Low pressure drop (0,1- 0,25 bar)
- ✔ Achieved RO Feed quality
- ✔ Use of Adsorption and Oxidation technologies downstream of **akvoFloat™** as a polishing step before RO.

Business Case

Project: Petrobicentenario Refinery, greenfield grass root refinery.
Location: Venezuela
Capacity: 320.000 BPSD

Description: This business case analyzes the substitiuion of the conventional treatment train (API + Physico-Chemical + IGF) by **akvoFloat™**. Consequently, the sludge and oil recovery systems are reduced in number and capacity.

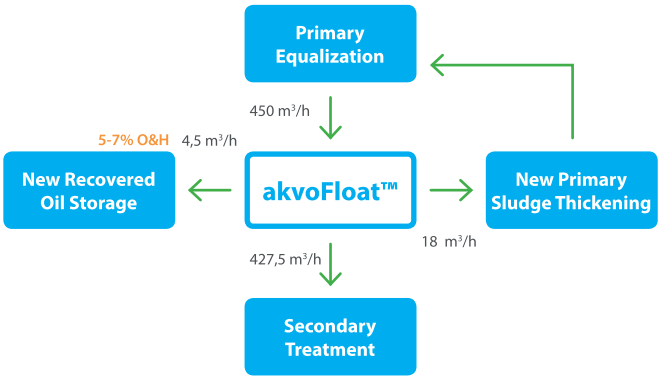
CONVENTIONAL SOLUTION



Economical	
CAPEX*	$3,8 M
OPEX**	0,221 €/m³
Technical Performance	
TSS	from 1.820 to 100 ppm
Oil	from 725 to 90 ppm
COD	from 7.250 to 340 ppm
BOD5	from 3.625 to 200 ppm

* Include only API + Physico-Chemical + IGF and necessary sludge/froth thickening and oil recovery systems. Only equipment is included, not engineering, installation and civil works.
** Includes energy and all necessary chemicals for the treatment chain.
O&H: Oil and Hydrocarbons

akvoFloat™-based SOLUTION



Economical	
CAPEX*	$3,9 M
OPEX**	0,06 €/m³
Technical Performance	
TSS	from 1.820 to < 10 ppm
Oil	from 725 to < 20 ppm
COD	from 7.250 to < 150 ppm
BOD5	from 3.625 to < 75 ppm

* Includes only akvoFloat™ and necessary sludge/froth thickening and oil recovery systems. Only equipment is included, not engineering, installation and civil works.
** Includes energy and all necessary chemicals for the treatment chain.
O&H: Oil and Hydrocarbons

You see Wastewater.
We see potential Savings.

akvola TECHNOLOGIES

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