AKVOLA TECHNOLOGIES

Industrial Water & Wastewater Treatment

Metalworking Industry Capabilities

www.akvola.com

Proven Technology. Proven Expertise.

ThyssenKrupp · ŠKODA · DAIMLER · 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

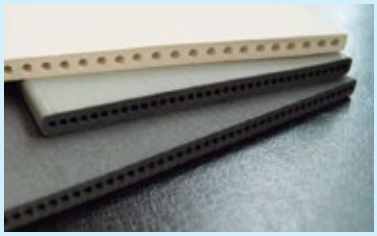
The only way to achieve a sustainable freshwater supply in the long-run is by making wastewater reuse affordable — a complex process that requires increasing amounts of energy. At the same time, energy generation, storage and transformation also requires increasing amounts of water. This mega trend, 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.

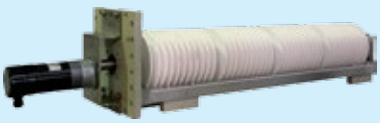
akvoFloat™ Technology

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

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.

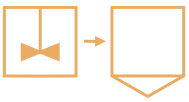
How can we improve your current wastewater management system?

EVAPORATOR

Problem	with akvoFloat™
Lower throughput than the nominal capacity due to influent fluctuations in oil concentration, e.g. from spent metwalworking fluids or washwaters	**akvoFloat™** as pretreatment equalizes amount and concentration fluctuations and eliminates 99% of oil
Frequent unplanned downtimes for cleaning due to high concentrations of oil and solids	Our combination of floatation and novel membrane filtration provides a reliable separation of 99% of oils and solids
Extremely high energy consumption (> 50 kWh/m^3) due to the inherent inefficiency of this thermal process	Our low-pressure driven membrane process with flotation pretreatment translates into a very energy-efficient separation (0,1 kWh/m^3)

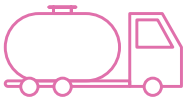
ULTRAFILTRATION

Problem	with akvoFloat™
Pressure-driven membrane process leads to a **high energy consumption** (> 20 kWh/m^3) and a **low membrane lifespan**	**akvoFloat™'s** low-pressure driven membrane process with flotation pretreatment translates into a very energy-efficient separation (0,1 kWh/m^3) and a longer membrane lifespan (> 10 years)
Irreversible fouling of the membranes caused by unforeseen concentration peaks of certain substances (e.g. silicates)	**akvoFloat™'s** ceramic flat sheet membranes can always be cleaned due to its novel open geometry
High external disposal costs due to high amounts of emulsified reject effluent and the lack of a clean oil/water phase separation	Clear separation in (free) oil and water phase enables reuse or recycle strategies and lowers external disposal costs



PHYSICAL-CHEMICAL TREATMENT

Problem	with akvoFloat™
Obsolete technology – high operating costs (personnel, chemicals, etc.), unreliable removal efficiency, high footprint	**akvoFloat™** represents the state-of-the-art and can improve the reliability and cost-effectiveness of existing physical-chemical plants



EXTERNAL DISPOSAL

Problem	with akvoFloat™
Extremely high external disposal costs of 80 – 120 €/m^3	An average 80% reduction in external disposal costs through a significant reduction of externally disposable wastewater and clear separation in (free) oil and water phase

akvoFloat™
Technology Benchmarking

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

Within the metalworking industry it is the most cost-effective water treatment technology for the reuse and discharge of metalworking fluids.




	CONVENTIONAL			akvoFloat™
	External Disposal	Evaporation	Ultrafiltration	
Energy Consumption		40 - 100 kWh/m³	15 - 30 kWh/m³	**0,1 kWh/m³**
Operational Limits		Oil < 12% pH 4 – 8	Oil < 12% Polymeric: pH 6 – 7 Ceramic: pH 2 – 13	**Oil < 20%** **pH 2 – 13**
Sensitivity to influent Fluctuations		high	medium	**low**
Removal Efficiency		99% Oil, TSS	> 90% Oil > 99% TSS	**> 99% Oil** **> 99% TSS**
Recovery Rate		90 – 95%	70 – 80%	**90 – 95%**
Footprint		high	high	**low**
CAPEX		very high	high	**medium**
OPEX (chem*+energy)	80 – 120 €/m³	8 – 15 €/m³	4 – 5 €/m³	**2 – 3 €/m³**
Payback Period		2 – 3 years	1,5 – 3 years	**< 1,5 years**

* includes all necessary chemicals for pre-treatment and membrane cleaning

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Case Study

Evaporator Pretreatment and Treatment of spent MWF

Customer: SKODA
Location: Europe

Previous solution:

- 2x Evaporators (indirect discharge) for washwater and spent cleaning solution
- External disposal for spent metalworking fluids (MWF)

Wastewater conditions:

Parameter	Value
Washwater and spent cleaning solution	
Oil (as TPH*, mg/l)	450 - 8.300
COD (mg/l)	2.600 - 11.800
Spent MWF	
Oil (as TPH, mg/l)	80.000 - 110.000
COD (mg/l)	20.000 - 130.000

* TPH: Total Petroleum Hydrocarbons

Washwater

CHALLENGE

Due to a recent expansion of the customer's production line, the composition and amount of the different wastewater streams changed. As a consequence, the throughput of the evaporators decreased and the frequency of unplanned maintenance and cleaning works increased, causing more wastewater to be disposed externally and higher personnel deployment. Additionally, the amount of spent metalworking fluids was to undergo a significant increase through a further expansion of the production line. The customer needed a solution that could enable the existing evaporators to operate seamlessly at full capacity and at the same time provide additional capacity to treat the increasing amounts of spent metalworking fluids to avoid costly external disposal. The target payback time for such solution was 1,5 years.

SOLUTION

The solution consisted of a 500 l/h **akvoFloat™** system which could be used to pre-treat evaporator influent (washwater & cleaning solutions) during wastewater upsets that caused reduced throughputs, and also to treat the spent metalworking fluids for indirect discharge.
In order to validate the proposed solution, a 2-month field trial was conducted with a 200 l/h pilot unit. The treatment of the washwater and cleaning solutions delivered an effluent with an oil content below 5 mg/l at all times, and equalized the fluctuations in water quality that disrupted the operation of the evaporators. The treatment of the spent MWF by means of akvoFloat followed by activated carbon delivered indirect discharge quality for all parameters, including oil, COD and heavy metals.
The payback time for the turn-key solution was 1,2 years.

RESULTS

- ✔ **Payback time of 1,2 years**
  - Overall water management costs were reduced by 38%
  - The staff deployment could be reduced by 50%
- ✔ **Improved operations and costs:**
  - Evaporators operated at full capacity and no unplanned cleanings
  - No more external disposal necessary
- ✔ **Constantly high akvoFloat™ effluent quality:**
  - Washwater and cleaning solutions: Oil concentration consistently below 5 mg/l.
  - Spent MWF: indirect discharge quality reached at all times
- ✔ **No odour problems**

Case Study
Reduce Wastewater Disposal Costs

SIEMENS

Customer: **Siemens**
Location: Europe
Previous solution: Wastewater disposal by external company

Wastewater conditions:

Parameter	Value
pH	8
COD (mg/l)	119.000
Oil (mg/l)	330
TOC (mg/l)	18.630
AOX (mg/l)	0,6

CHALLENGE

A metalworking manufacturing site needed a one-stop complete solution to treat 1.300 m^3/year of wastewater stored in single IBCs. The wastewater quality between the IBCs varies significantly and was unpredictable. Currently this wastewater is being disposed of externally at a very high cost for SIEMENS.

The customer needs a technology that can handle different influent wastewater qualities and treat it up to discharge quality with a reliable payback (< 1,5 years).

SOLUTION

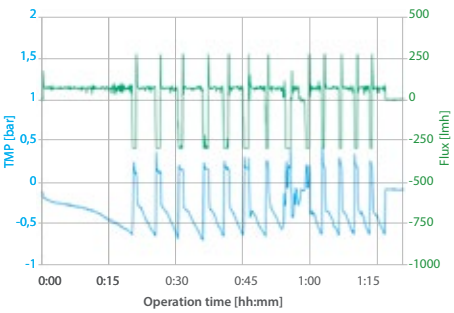
An chemical pre-treatment step prior to the **akvoFloat™** system was implemented for a stable operation of the plant in terms of low membrane fouling and constant permeate flux.

Discharging the treated water directly into the public sewer will lead to a significant reduction of the overall wastewater management costs.

RESULTS

"The technology has shown promising positive results and is still being tested in our operation to determine the optimum operating point and the cost of treatment. We believe that with akvoFloat™ an operating cost reduction is possible because the water can be discharged to the sewerage system."

Head of Manufacturing, Siemens AG



- **High removal efficiency:**
  - COD (94%)
  - OiW (98%)
  - AOX (91%)
  - SLS (85%)
- **High recovery** (> 95%)
- **High flux** (75 lmh)
- Low pressure drop (0,1- 0,25 bar)

Business Case

External Disposal vs On-site Treatment

Project: A metalworking manufacturing site needs a solution to avoid havingto dispose of the wastewater externally with high costs.

Capacity: 350 m^3/year of wastewater stored in IBCs.

Operation	Value
Wastewater volume	**350 m^3/y**
Hours per year	**1.800 h/year**

Option 1: External Disposal

Operation	Value
Disposal by extrernal supplier (€/m^3)	**100**

COSTS
35 K€ per year

Option 2: On-site Treatment with akvoFloat™

Operation	Value
Wastewater discharge (€/m^3)	**4**
akvoFloat™ operating costs (€/m^3)	**3**
akvoFloat™ recovery (%)	**95%**

COSTS
4,1 K€ per year

Savings:

31 K€/year

Payback Time:

less than 1 year

You see Wastewater.
We see potential Savings.

akvola TECHNOLOGIES

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