



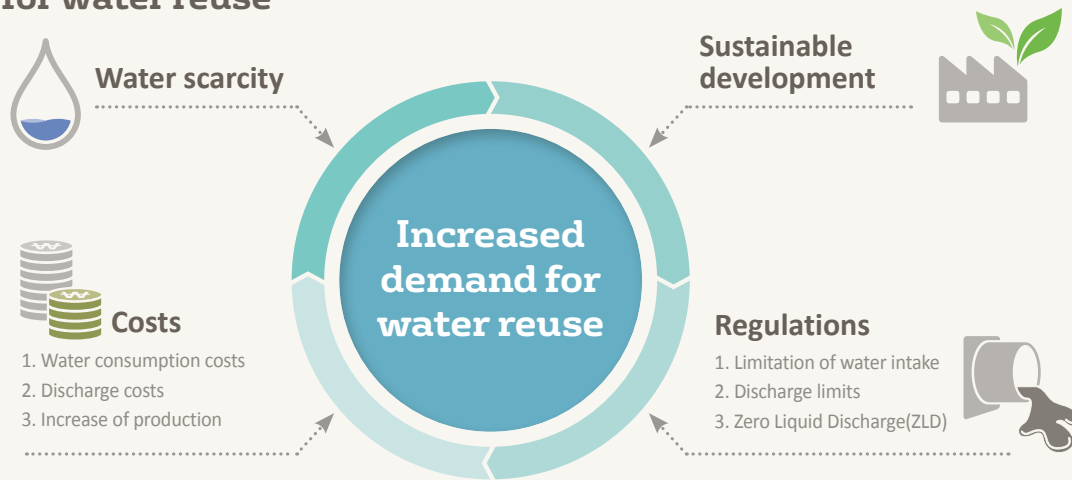
Sustainable water management for **Recycling & Reuse**

Industrial wastewater, a valuable resource

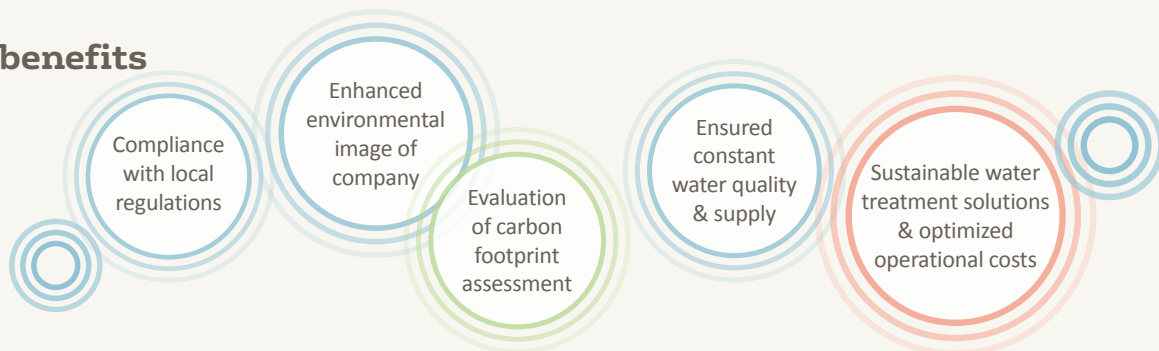


In most industries, such as Microelectronics, Pulp & Paper, Power, Food & Beverage and Oil & Gas, the high volumes of water used during the overall manufacturing process represent a significant expense. Drawing upon its worldwide experience in industrial water cycle management, Veolia has developed standard solutions for water recycling and reuse.

Demand for water reuse



Client benefits



Water quality for reuse and recycling

While the quality requirements vary for the different uses, there are general commonalities across most plants for industrial water, cooling water, process water and boiler feed water.

Application for reuse and recycling	Common quality issues	Pollutants to be removed and/or controlled
Industrial water	Dissolved solid content, iron and manganese content	TSS, Fe, Mn
Cooling make-up water	Corrosion, biological growth and scaling, disinfection in case of aerosol risk	BOD, TSS, Turbidity, silica, pathogens, legionella
Boiler make-up water	Thermal exchange limitation, steam quality reduction, scaling, corrosion	Dissolved solids, hardness, alkalinity, conductivity
Process water	pH, solids, silica, dissolved solids and chloride, pollutant concentration, bacteriology, compliance with process water specification	As appropriate to the application: pH control, dissolved solids, chloride, specific pollutant concentrations

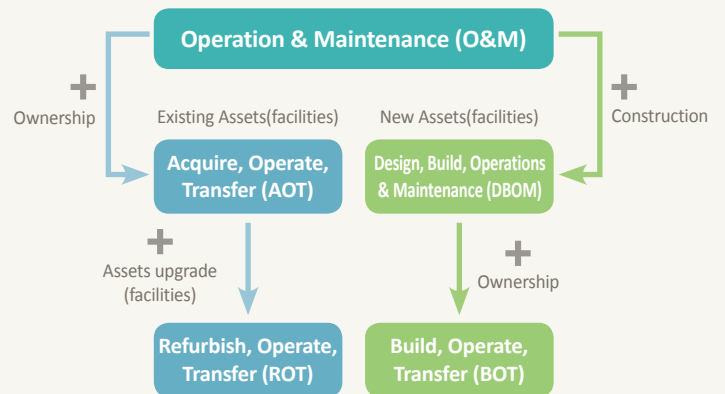
Veolia's Offer

Providing Tailor-Made Contractual Solutions

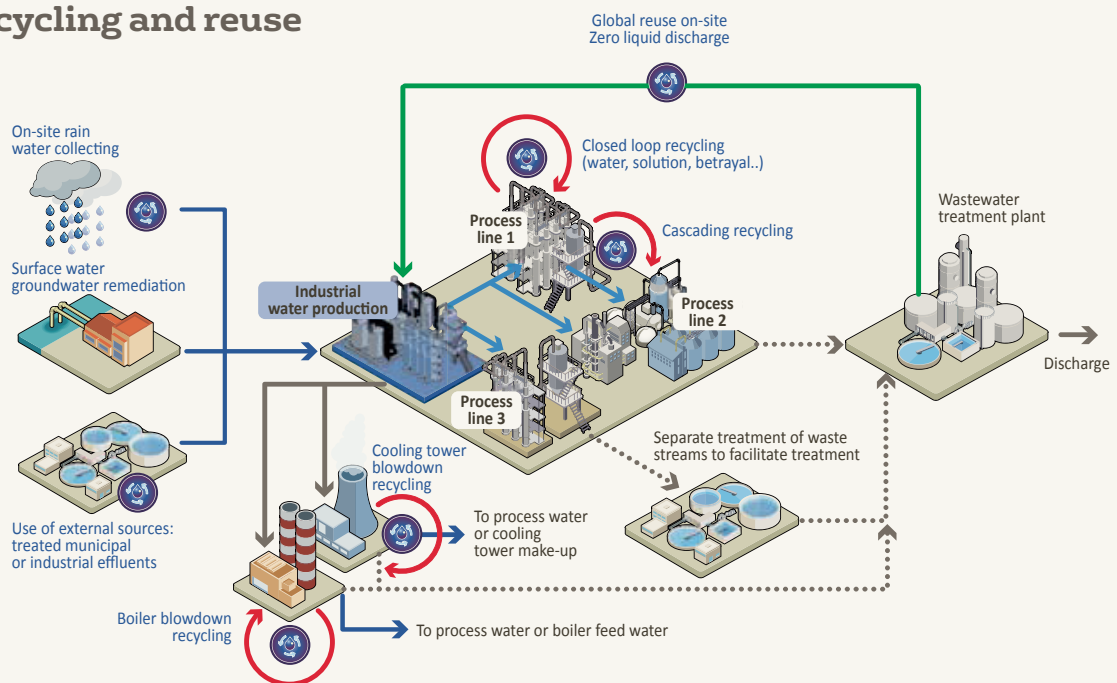


- **O&M:** Operation & Maintenance
- **DBO:** Design, Build & Operate
- **DB:** Design & Build
- **Chemical supply & services**

Veolia's O&M solutions



On-site recycling and reuse



Provisioning

- > Drinking water
- > Storm water
- > Drilling water
- > Desalted sea water
- > Surface water
- > Tertiary effluent

Uses

- > Cooling water
- > Utility water
- > Boiler feed water
- > Ultra pure water
- > Process water
- > Steam production

Rejections

- > Urban cleansing network
- > Natural environment treatments (primary, secondary tertiary)

Water recycling

normally involves only one use, and the effluent is treated and redirected back into the same loop and for the same use. It can also be used when wastewater is treated and used again in the process.

Water reuse

is the use of treated wastewater for beneficial purposes other than the initial use, such as cooling systems, boilers, process water, irrigation, cleaning or ground water recharge.

Zero liquid discharge

is the total elimination of liquid waste discharge from a plant. In place of disposal, internal waste could be recycled, reused or reduced to achieve zero output of liquid waste.



Reliable & environmental friendly solutions offered by Veolia

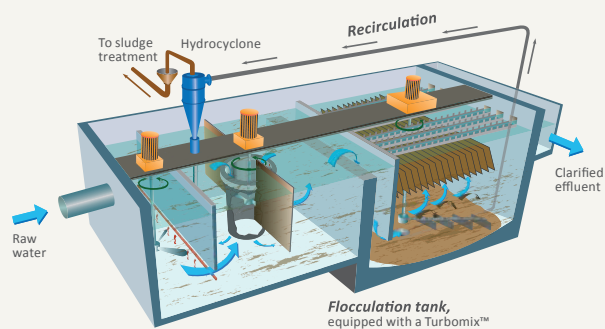


There is not a single specific technology for water REUSE.

The water reuse is very often obtained after association of several processes/technologies applied to each case such as clarification, reverse osmosis, evaporation and chemical treatment.

Actiflo® Turbo - The ultimate clarifier

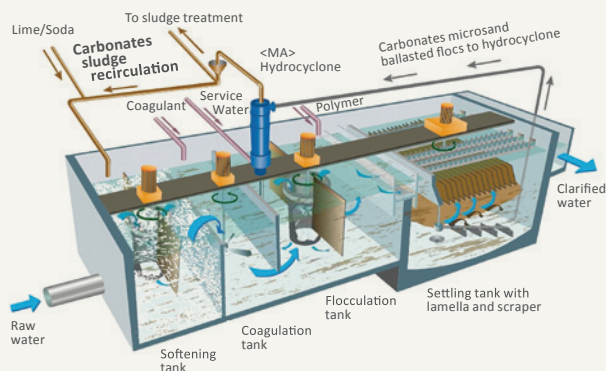
- More than 870 references worldwide
- Over 60 Actiflo® references for reuse applications
- Equipped with coagulation tank, flocculation improved with Turbomix™, a hydraulically optimized settling tank with lamella, a hydro-cyclone for micro-sand recovery
- Increased rise rate: 80m/h for industrial process water, wastewater and seawater
- Cost effectiveness: more compact compared to conventional clarifiers, very short startup time
- Industrial applications
 - Process water: General use, CTMU, pre-treatment for boiler feed, etc.
 - Wastewater: TSS, P, heavy metals, O&G, leachates and reuse



Actiflo® Turbo process

Actiflo® Softening Process - High rate softening solutions

- Actiflo® Softening combines in a single compact treatment unit both clarification and softening operations to remove constituents such as calcium, silica, heavy metals, fluorides, suspended solids, while improving properties such as alkalinity, hardness and turbidity.
- Improve water quality and produce high quality water
- Very small footprint: Up to 10 times smaller than conventional softening processes
- High rise rate: up to 120 m/h
- Enhanced chemical precipitation with Turbomix™ reaction tank
- Minimize coagulant demand due to solids precipitation with calcium carbonates
- Sludge characteristics: up to 8% dry solids; can be easily thickened and dewatered
- Industrial applications: Power industries, water production for cooling tower make-up, water recycling for cooling tower side stream, treatment of produced water for Oil & Gas, SAGD (Steam Assisted Gravity Drainage) water treatment for reuse, wastewater treatment of flue gas desulfurization



Actiflo® Softening process

EVALED™ - Evaporation technologies

- Low energy consumption
- Recycling of high quality distillate from heavily polluted wastewater
- High separation level
- Ideal to achieve ZLD (Zero Liquid Discharge) in combination with RO plants
- Three types of models (series)
 - EVALED™ PC
Vacuum heat pump evaporators (150 kWh/ton)
 - EVALED™ AC
Hot/cold water vacuum evaporators (Cogeneration)
 - EVALED™ RV
MVR evaporators (30-50 kWh/ton)



EVALED™ PC – E series

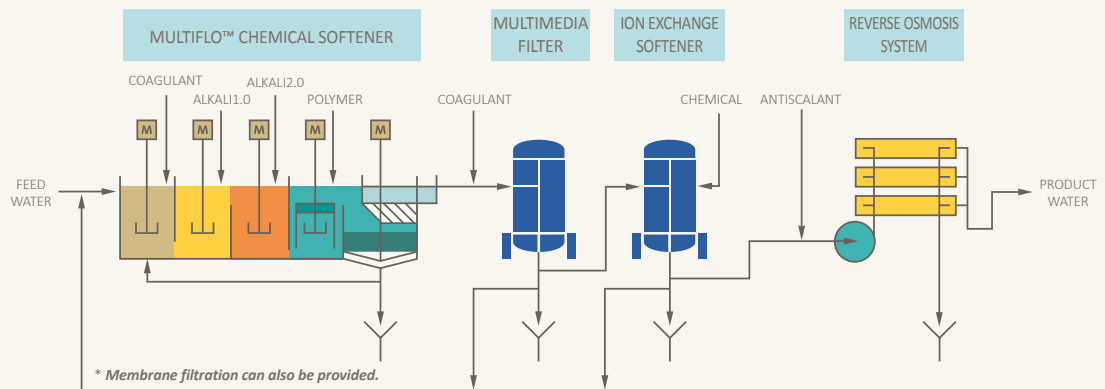
SIRION™ Mega - Reverse Osmosis systems

- Production of high purity water
 - From to 5 to 30m³/h
 - Lower operating pressure, cost savings due to low energy consumption membranes
 - 1 or 5µm pre-filtration included
 - Appropriate recirculation rinsing reduces membrane fouling
- Applications:
 - Boiler feed
 - Industrial process water
 - Cooling water
 - Reuse / recycling
 - Healthcare
 - Biotechnologies
 - Electronics
 - Hospitals
 - Chemical industry
 - Primary metals



OPUS® Process - Reverse Osmosis membranes for high water recovery

- High Water Recovery Rates
 - Effective Fouling/Scaling Control
 - Ability to Handle Variations in Feed Water Quality
 - High Salt Rejection; Silica > 99.9%, Boron > 99.4%, TOC > 99%
 - Continuous Clean-In-Place (CIP) Process
 - Low Energy Consumption
 - Long Membrane Life
- Applications:
 - **Oil & Gas**
Produced water treatment, refinery wastewater
 - **Mining, industrial wastewater reuse**
ZLD Application
 - **Power**
Cooling tower blow-down treatment, make-up water



OPUS® multiple treatment processes, involving chemical softening, media filtration, ion exchange softening and reverse osmosis technologies

HYDREX™ Chemicals - Water treatment chemical solutions

- Protect water treatment systems against scale deposition, corrosion, fouling, etc.
- Reduce unnecessary downtime
- Ensure optimum productivity
- Prevention and reduction of environmental risks
- Energy saving
- Applications:
 - **1000 series:** Total boiler water treatment chemicals
 - **2000 series:** Cooling water treatment chemicals
 - **4000 series:** RO water treatment chemicals (Effective membrane antiscalants and cleaners approved by major membrane manufacturers)
 - **6000 series:** Drinking water and wastewater treatment chemicals
 - **7000 series:** Biocides control chemicals



Veolia's recycling and reuse: Industrial references



Clients' benefits offered by Veolia's O&M services

01

Reducing operation costs through reuse and recycling water treatment technologies

02

Minimizing environmental impact for sustainability

03

Offering of technology knowhow and expertise to enhance the value of resources

Automotive



General Motors Cactus Plant in San Luis Potosi, Mexico

- Zero Liquid Discharge process design, basic engineering and equipment supply
- High quality water for reuse
- High recovery rate with low waste volume (convert 90% of the tertiary wastewater into reusable water)

General Motors Pontiac, Michigan, USA

- Operation and maintenance of the new wastewater treatment plant since 2001 (DBOOM)
- Environmental regulation compliance

Chemicals



Air Products, Tamaqua, Pennsylvania, U.S.A

- Co-product recovery and reuse
- Significant cost savings (KOH recovery of 85% to 90%)
- Environmental benefit and recognition: the project won the 'Governor's award for Environmental Excellence for the State of Pennsylvania'

LG/Lotte Petrochemicals, Daesan, KOREA

- 20 years of the long-term partnership, the largest reverse osmosis units in Asia with 84,000m³/day capacity
- Demi water: 41,120m³/day, cooling water supply: 1,861,224m³/day (circulation rate basis), potable water: 5,235m³/day



Food & Beverage



Sabim, Sablé-sur-Sarthe, France

- Outsourcing of the wastewater treatment facilities for the meatpacking house
- Biological treatment for grease/oil removal
- Wastewater biological treatment with aeration
- Sludge-thickening unit on a gravity table, designed to achieve 6-7% dryness



Metals



Dongbu steel, Dangjin, and Incheon, Korea

- Supplying sufficient quantity of high quality cooling water for production of steel products for 15 years
- Implementing on-line monitoring of operation to assure stable operation and quality
- Cooling water: 511,872m³/day, treated wastewater: 5,376m³/day, demi water: 883m³/day
- Reusing over 50% of process water to protect the environment and reduce costs



Pharmaceutical



L'Oreal BeautyCos production factory, based in Suzhou, China

- Reduction of greenhouse gas emissions, water consumption and discharged transportable waste by 50% by 2015
- Energy and chemical consumption are reduced.
- Sludge production is significantly decreased.
- Stabilization of the effluent quality and optimization allowing tertiary treatment and reuse
- The water impact index is reduced by 35%.
- By implementing a reuse system, the overall water consumption of the factory could be further reduced by 32%

Pfizer Nutrition, Suzhou Industrial Park, Jiangsu, China

- Full scope of performance guarantees and expertise in O&M of the wastewater treatment plant
- Innovative solution based on sludge composting and recycling for land application
- Secure a constant quality of treated effluent to allow reuse as cooling tower make-up
- Wastewater: 2,400m³/day



Mining



CONSOL Energy Inc., mine water treatment facility, Mannington, West Virginia

- Zero liquid waste discharge acid mine drainage water treatment facility in Northern West Virginia
- 10 year operations period, with 5 year renewal options of DBO project
- Chemical precipitation, reverse osmosis and thermal technologies
- Applying the water impact index to the mine water treatment facility to maximize the recovery of clean water



Power



E.D.F, Civeaux Nuclear Power Plant, France

- Partnership with Électricité de France (EDF), the one of the largest electricity producers in the world
- 2 generating units, Production: 7 billion kWh/year
- Temporary solutions for the upgrading of feeding demineralization units (secondary loop)
- Rental of mobile units, staff for the operations and maintenance, guarantee of the production levels

APS(Arizona Public Service) Redhawk Power Station, Arlington, Arizona, U.S.A

- Providing natural-gas, coal and nuclear generated electrical power to the region
- Designed to remove water contaminants and recycle high-quality water back into the process
- Effectively recycling the waste created by cooling tower blow-down and producing high quality water while adhering to the Zero Liquid Discharge mandate

Macquarie Generation, Bayswater Water Treatment Plants, New South Wales, Australia

- The more efficient water reuse is guaranteed by the improved water quality and the increased recycled water volume
- Design, Construct, Operations & Maintenance
- Optimize & improve the reliability and availability of existing water treatment plants
- Increased the salt removal capacity and reduced the salinity of Lake Liddell
- Capacity 2,640 MW (power station), 120 ML/day (WTPs)



Pulp & Paper



Smurfit-Stone Container Corporation, Hopewell, USA

- Design and build of the new evaporator system
- Production: 300,000 tons/year



Oil and Gas, Pulp and Paper SAPREF refinery, Mondi paper mill Durban, South Africa

- Municipal wastewater reuse for process and cooling water production



Micro-electronics



SK hynix, Icheon - Cheongju - Gumi, South Korea

- Ultra-pure water, potable water, wastewater treatment services
- Reducing costs and protecting the environment: An average of 40% and up to 60% of the process water is recycled
- Operating state-of-the-art wastewater treatment facilities to meet legal standards on the quality of treated wastewater



Showa Denko HD Singapore

- Water management capabilities: ultrapure water, reclaim water, wastewater, utilities
- Guarantee the consistent, high-quality and sufficient water supply
- A special facility was constructed for recycling reclaim water, and within two years of operations, the plant now uses 50% of reclaim water.

Microelectronics Industrial area, Kranji, Singapore

- Supply of high quality water (40,000 m³/d) from municipal wastewater treatment (Cost effective solution compared to seawater desalination and transportation)

Oil & Gas

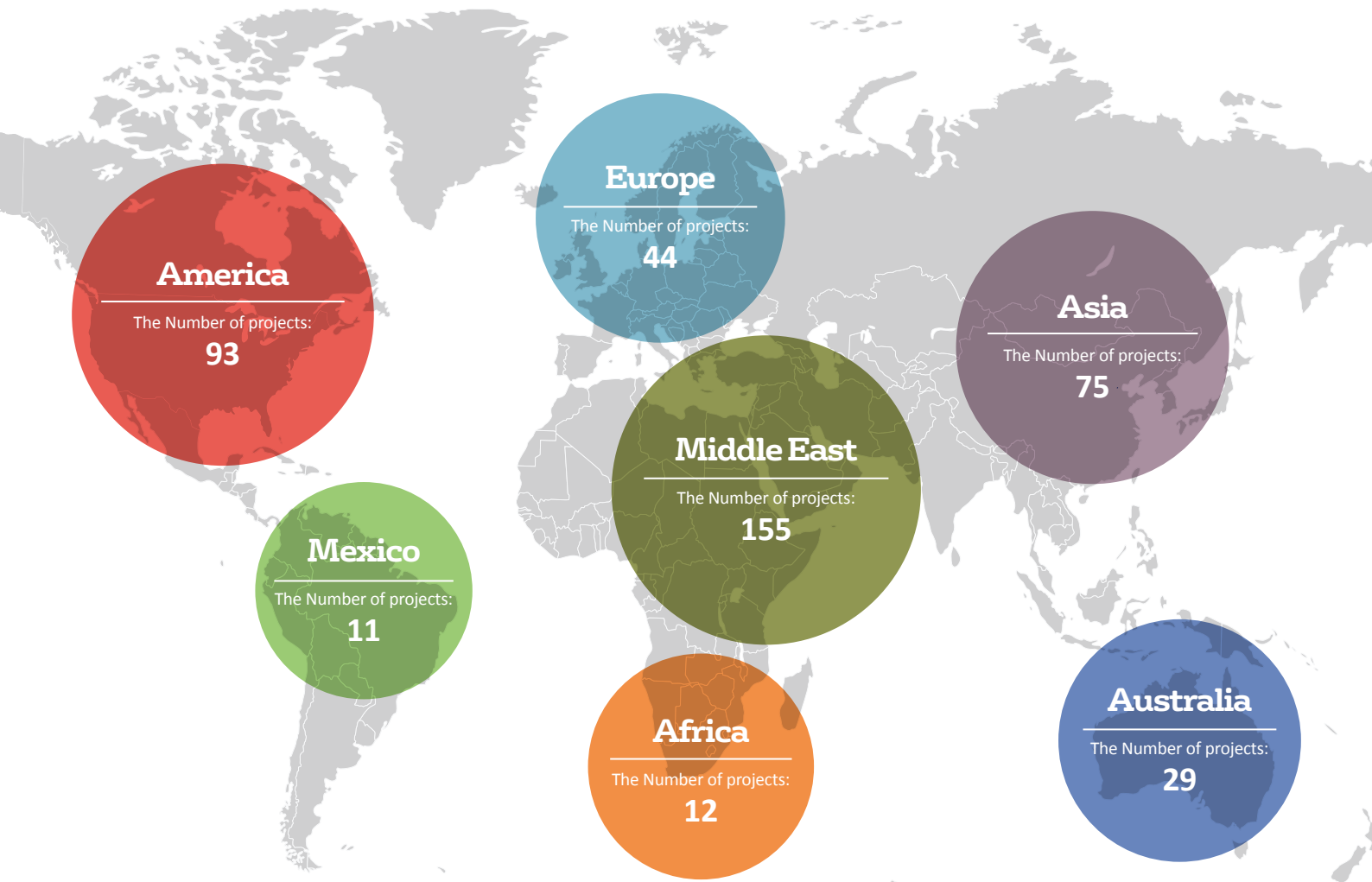


SHELL Qatar, Pearl GTL complex, Qatar

- Design and build contract for an effluent treatment plant
- Treatment of the cooling water blow-down for reuse in the process
- Optimization of water cycle management and Zero Liquid Discharge
- Sludge treatment using evaporation and crystallization processes which allow low volume production of dewatered sludge and salt crystals



Over 400 water recycling & reuse projects around the world by Veolia!



Veolia Korea

East 16F, Singnature Towers 100 Cheonggyecheon-no, Jung-gu, Seoul 100-230 Korea

Tel: +82.2.6323.2900

www.veolia.co.kr

Veolia Korea Water Reuse References

Waste Water Reuse Project, LG Siltron

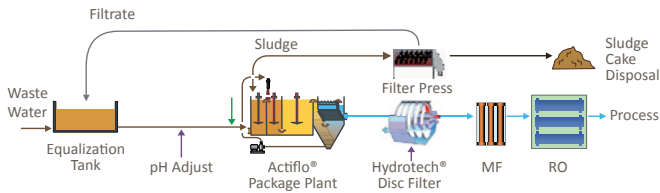
Key figures

Client: LG Siltron **Capacity:** 40m³/hour
Construction: October 2005 / March 2006 / October 2007 / December 2007
Technology: Actiflo® / Hydrotech® Disc Filter / MF and Reverse Osmosis (RO)-combined system
Scope: Design, construction and commissioning
Guaranteed water quality:
 Turbidity < 0.1NTU, Conductivity < 50µs/cm

Background

Veolia constructed Actiflo® Package, Hydrotech® Disc Filter, Micro Filter(MF) and Reverse Osmosis (RO)-combined system for the semiconductor silicon wafer manufacturing processes in LG Siltron, Ltd.

Veolia's Technology and System Overview



Actiflo® for reuse applications

- ▶ Actiflo® applied for the purpose of pre-processing in the reuse system.
- ▶ High removal of SS from waste water through coagulation with the addition of metallic salt (Al³⁺, Fe³⁺, etc.) and ballasted flocculation.
- ▶ SS of waste water subject to reuse to be removed by over 90% and supplied as raw water to reduce loads on the following treatment processes.

Item	Unit	Raw Water	ACTIFLO	HYDRO TECH	MF	R/O
Flow	m ³ /d	1,000	1,260	1,180	1,000	700
Turbidity	NTU	1,000	<15	<10	<1	<0.1
SS	mg/l	100	<10	<10	<1	<1
Electric Conductivity	µs/cm	500	-	-	-	<10

Water quality at each step of the reuse process using Actiflo®

Benefits

- ▶ Reduction in water costs with the reuse of waste water generated from silicon cutting and polishing process.
- ▶ Turbidity, dissolved solids and electric conductivity were assured above the required water quality, proving excellent performance of Actiflo® and reuse water processing facilities.

C3 Organic Waste Water Reuse, SK Hynix

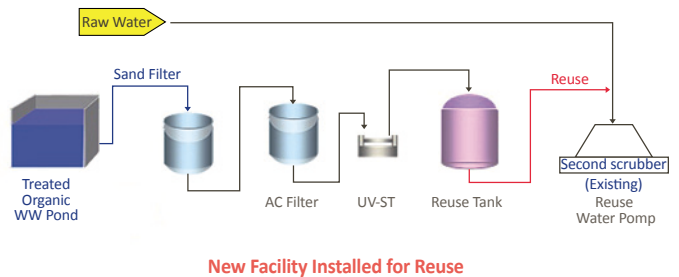
Key figures

Client: SK Hynix **Year of Contract:** 2010
Capacity: 2,000m³/day **Recovery rate:** 98.5%
Scope of project: BOT

Background

Veolia has designed, installed and managed the operations of the sand filter, activated carbon, UV sterilizer, reuse tanks, additional pumps, etc. to reuse the treated and segregated organic waste water from WWTP C3 (2,000m³/day) as scrubber water on the site of Cheongju, SK Hynix, Veolia's client.

System Overview



New Facility Installed for Reuse

- ▶ 750m³/day used as scrubber water by reuse facilities treating organic treated water.
- ▶ Quality of water processed for reuse: Below the quality of organic waste water (TOC 3 ppm↓, CODCr 3 ppm↓, and Turbidity 1 NTU↓), prevention of increase of microorganisms.

Process



Benefits

Through the successful implementation, SK Hynix committed to improving local environment by reducing raw water, saving costs, and minimizing discharge organic waste water.



BG Waste Water Reuse Project, SK Hynix

Key figures

Client: SK Hynix
Capacity: 3,000m³/day
Scope of project: BOT

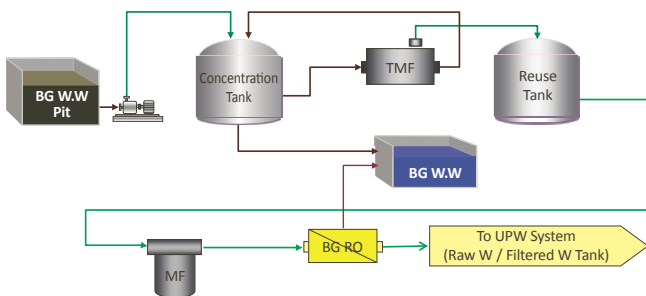
Year of contract: 2013
Recovery rate: 90.25%
 (2,707.5m³/day)

Background

In accordance with the plan of SK Hynix to reduce raw water, Veolia has constructed a reuse water system for 4 months from April to July, 2013 to reuse a segregated waste water generated by P&T3 Back Grinding Fab.

- ▶ Saving cost to produce UPW (Ultra Pure Water) necessary for semiconductor manufacturing processes
- ▶ Reducing operating costs of waste water treatment facilities
- ▶ Resolving a challenge involving increase of burden on local water treatment plants resulting from increased use of water on SK Hynix Cheongju site

System Overview



Overview of Reuse system, BG Waste Water

- ▶ **Process:** TMF (SS: 0.5ppm↓ / SiO₂: 10ppm), RO (SiO₂: 3.68ppm)
- ▶ Guaranteed Water Quality for particular and soluble SiO₂ removal

Item	Unit	BG Raw W.W.	Design	Average
SiO ₂	ppm	100~1,000	3.68↓	1.34

Benefits

- ▶ Veolia aims to improve client satisfaction by saving costs on industrial process water, waste water treatment utility (steam, cooling water) and etc..
- ▶ Solving problems with increase of burden on water resources, resulting from an increase in use of raw water on SK Hynix Cheongju site.
- ▶ Reducing environmental pollution and contribution to low-carbon green growth.
- ▶ Improving operation condition of the existing UPW system in accordance with supply of high-quality reused water.

Reuse Pilot Test, Samsung Electronics

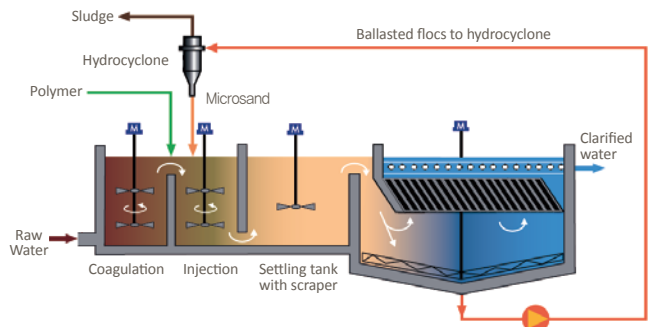
Key figures

Client: Samsung Electronics
Capacity: 5m³/hr
Scope: Pilot test for pre-treatment of reuse facilities
Contract: July 2011 ~ October 2011
 (round-the-clock, 3 months)

Background

Actiflo® Pilot Plant was selected by Samsung Electronics on its Giheung Campus for reuse at WTP. The pilot was maintained for three months for the purposes to secure adequacy of Actiflo® facility-applied design, optimum amount of chemicals to be injected, estimated construction costs, and estimation of site area and operating costs.

Veolia's Technology and System Overview



- ▶ SS Design standard: SS 2,000ppm
- ▶ SS Required quality of treated water: <20ppm

Benefits

- ▶ With an aim to confirm adequacy of pre-processing by using waste water arising from the WTP, Giheung Campus, Samsung Electronics, Actiflo® was test-run. Over this period, SS concentration remained at 20ppm or below stably even when very high SS (23,340ppm) is introduced at the feed during exceptional conditions.
- ▶ The test operation shall have Veolia's Actiflo® facility recognized in its performance, establishing a foundation for Samsung Electronics to develop green sustainable business in the future without more water resources withdrawn from the environment.

