



# BOOMERANG<sup>®</sup>

FROM BIO-EFFLUENT TO POTABLE WATER

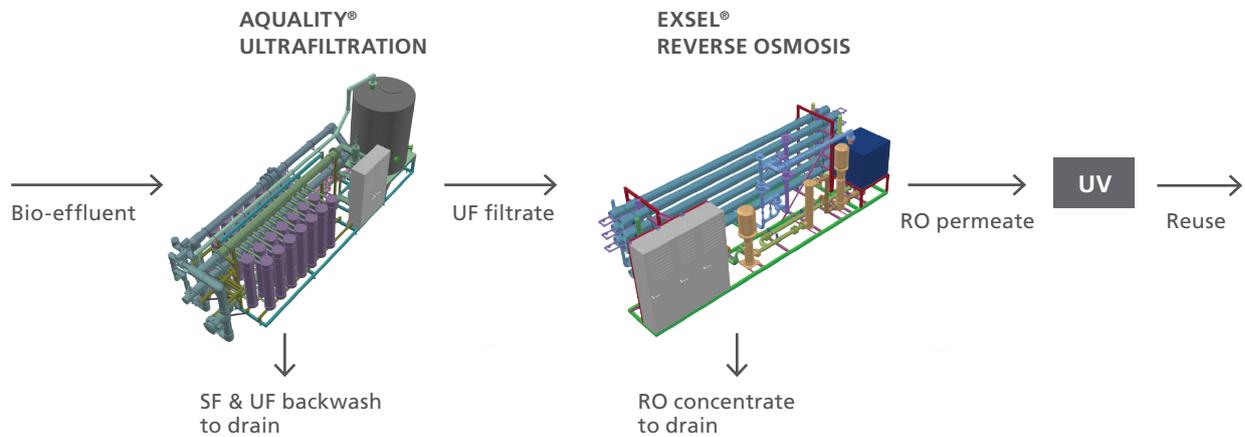


**WATERLEAU**

protecting the 4 elements

# FROM BIO-EFFLUENT TO POTABLE WATER

Waterleau uses state of the art membrane technology for closing the loop in the water cycle. A double barrier membrane concept allows industries to recycle their wastewater to potable water quality.



## EFFLUENT RE-USE - FEASIBILITY

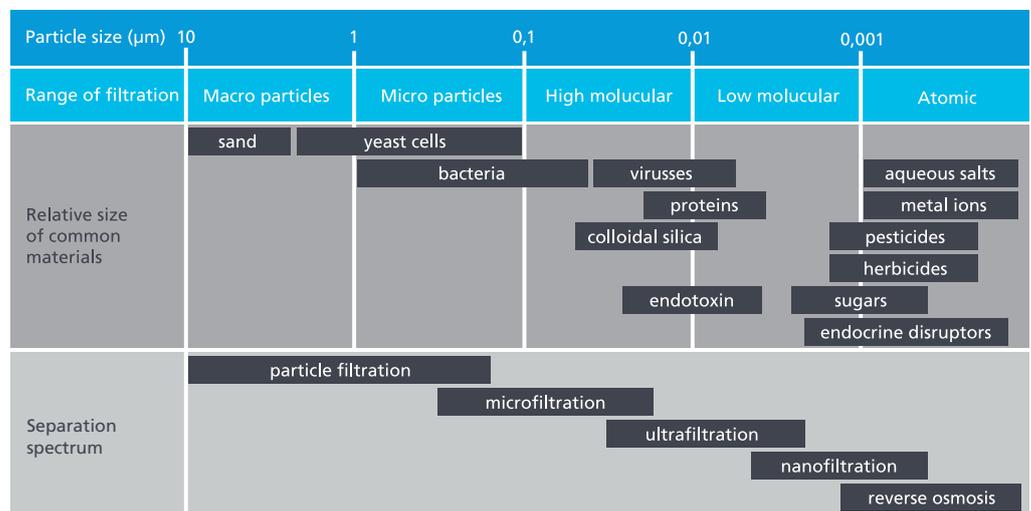
Biological effluent reuse has become a fashion word. Reusing biological effluent in a production process is not always as easy as it seems. Especially in critical reuse applications such as in the food and beverage industry, the ideal scenario is quite complex. In reality three side conditions need to be met in order to allow successful effluent reuse:

- All the production must allow the reuse of biological effluent;
- The available effluent must be of an acceptable quality allowing successful tertiary treatment;
- The generated concentrate stream should still be disposable.

## THE FILTRATION SPECTRUM

The reuse technology train consists of two treatment steps: ultrafiltration and reverse osmosis. For safe effluent reuse in the food industry an EXSEL® reverse osmosis unit is an absolute necessity to remove salts and potential viruses from the feed water.

In order to allow the reverse osmosis to operate in a stable way all suspended solids, colloidal material (and bacteria) need to be removed upstream. Therefore an AQUALITY® ultrafiltration installation is necessary. To protect the ultrafiltration installation from shocks of suspended solids and in order to increase the efficiency of the ultrafiltration a self cleaning strainer is generally installed whenever a raise of suspended solids can be expected.



# ULTRAFILTRATION

Ultrafiltration membranes provide a physical barrier to remove bacteria, suspended solids and harmful pathogens such as *Cryptosporidium* and *Giardia*. This technology has been proven in many water reuse installations worldwide. The resulting water quality is characterized by a low turbidity and SDI value and can hence be fed directly to the downstream reverse osmosis installation, extending RO lifetime and reducing its associated operating costs. The applied membrane type for ultrafiltration membranes is usually the hollow fibre membrane. These membranes can be used in an inside-out as well as in an outside-in configuration.

AQUALITY® ultrafiltration is a pressure-driven unit operation in which particulate, colloids, and macromolecules are separated from a liquid feed stream upon passage through a porous semi-permeable membrane. Small molecules such as water, mono-saccharides, simple alcohol, and all ionic species pass through the membrane while larger molecules, colloidal particulate matter, bacteria, emulsified oils and fats are retained.

Backwashing is typically performed every fixed interval, during which the flow direction inside the membranes is reversed for a short period of time. This is used to remove most of the suspended solids layer that has built-up on the feed side of the UF membrane. In order to improve the efficiency of a backwash these are in general followed by a forward flush, in which feedwater passes through the capillaries at a higher speed, in order to flush out the suspended solids. Backwash and forward flush are all timer controlled actions.

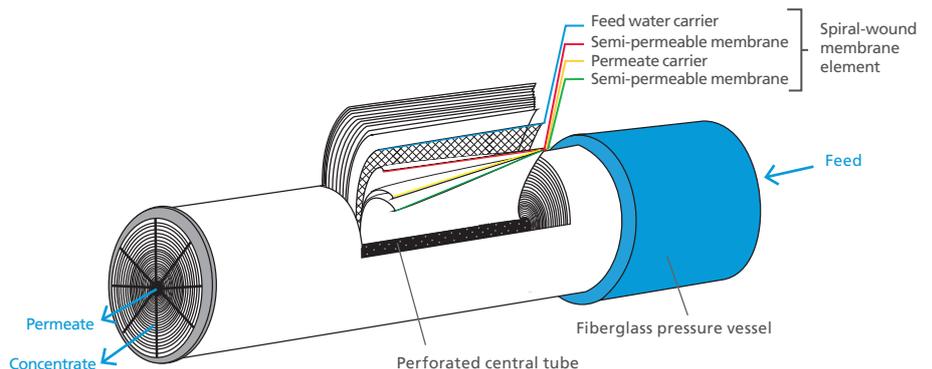


Agfa Gevaert, Belgium - Capacity: 9.600 m<sup>3</sup>/d

# REVERSE OSMOSIS

Reverse osmosis is a cross-flow filtration using high pressure spiral wound fouling resistant membranes. The transport of water through the membrane is mainly by means of diffusion through the membrane from one bonding site to another.

A high rejection reverse osmosis membrane is a thin film composite membrane consisting of three layers: a polyester support web, a microporous polysulphone interlayer, and an ultra thin polyamide barrier layer on the top surface.



The flat sheet membranes are being rolled up around a permeate tube in order to form a spiral wound element. In membrane systems the elements are placed in series inside of a pressure vessel. The concentrate of the first element becomes the feed to the second element and so on.

The permeate tubes are connected with interconnectors and the combined total permeate exits the pressure vessel at one side of the vessel while the concentrate can be fed to another stage.



Sappi, Belgium - Capacity: 1.200 m<sup>3</sup>/d



Yara Ambès, France - Capacity: 720 m<sup>3</sup>/d



BASF, Belgium - Capacity: 1.200 m<sup>3</sup>/d

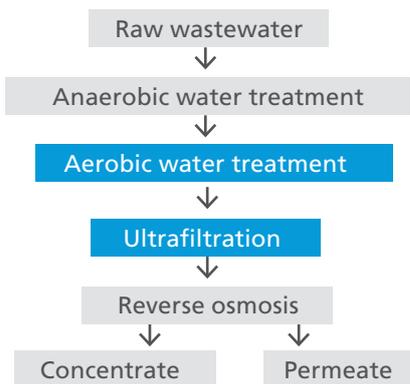


Arcelor Mittal, Belgium - Capacity: 8.640 m<sup>3</sup>/d.

## MBR OR EFFLUENT POLISHING?

In the table below effluent polishing is being compared to a membrane bioreactor in which the UF step has been integrated in the wastewater treatment plant. Both systems have advantages and disadvantages and a decision will depend on civil unit rates, actual situation and potentially existing infrastructure.

### EFFLUENT POLISHING



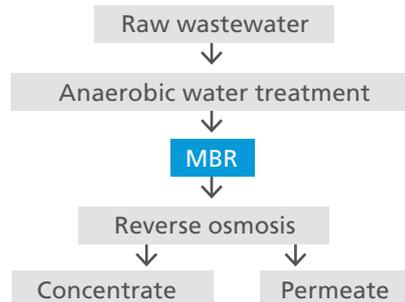
#### Advantages

- Biological treatment and reuse scheme have been hydraulically disconnected
- Reduced membrane surface required as effluent polishing operates at higher fluxes compared to MBR = lower CAPEX
- Lower energy and cleaning requirements as membranes are not submerged in sludge
- Ideal for implementing a reuse scheme in existing plants or for a phased approach

#### Disadvantages

- More and more complex process steps
- Footprint of the wastewater treatment plant shall be higher

### MEMBRANE BIOREACTOR



#### Advantages

- Eliminates the need for clarifiers, tertiary filters and other peripherals along with associated process control.
- Footprint up to 50% smaller due to higher sludge concentrations in a MBR-system
- Fewer process steps
- Allows expansion of existing plants without modifications to the civil infrastructure.

#### Disadvantages

- Due to sludge lower fluxes a larger membrane surface is required.
- In partial reuse the full wastewater flow is to be treated
- Higher cleaning and energy costs

# CASE: BIO-EFFLUENT TO POTABLE WATER IN THE POTATO PROCESSING INDUSTRY

Before applying the water reuse scheme, Farm Frites Lommel, a potato processor specialized in deep frozen potato specialties, was relying on groundwater and drinking water supplies for its production process. These water supplies are getting less attractive due to the fact that the groundwater permits are subject of discussion (hence their future availability is uncertain), the costs of the drinking water as well as the costs of wastewater discharge.

Today's available techniques for wastewater reuse have become broadly accepted and have become economically viable.

Biological effluent is a stable and readily available source for feeding the water reuse installation. With the integration of the water reuse installation, the amount of discharged wastewater as well as the drinking water and groundwater intake can decrease substantially.



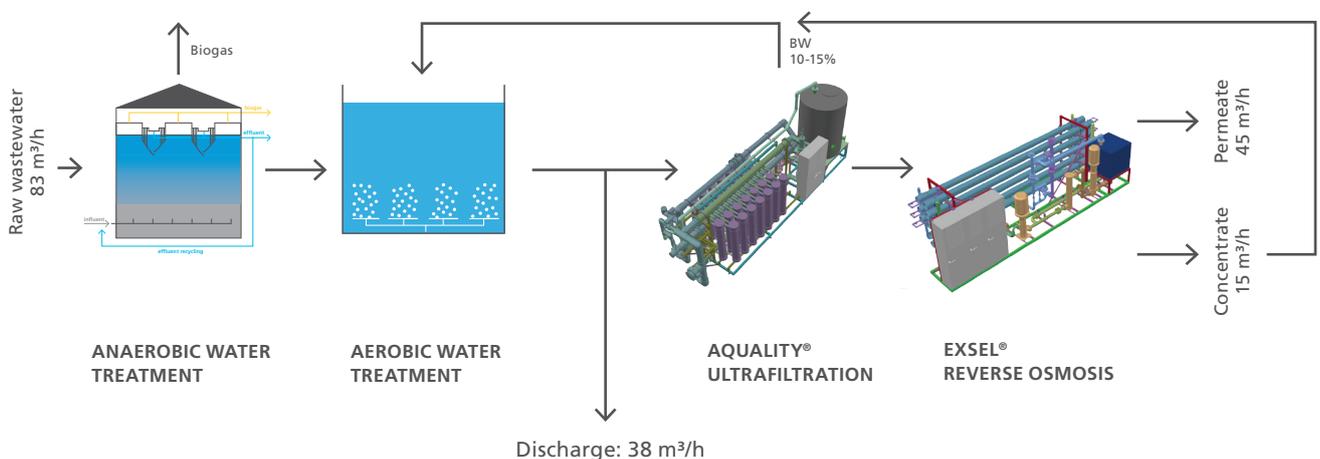
Farm Frites, Belgium - Water reuse: 1.200 m<sup>3</sup>/d

Consider sending the complete treated wastewater flow to the water reuse installation, with the reverse osmosis installation operating at a recovery rate of 75%. In this case the concentrate stream would be characterized by identical values as the original feed water but then all multiplied by a factor 4, as "all" contaminants are retained in the concentrate fraction. The RO-concentrate hence does not comply with the discharge regulations anymore and cannot be discharged. A technically viable alternative is to send the concentrate to an evaporator; however this is a costly alternative.

A more economic alternative consists in treating only part of the treated wastewater. The logical solution would then be to blend the RO concentrate with the remaining fraction of the treated wastewater. For this specific project however, the blended mixture still trespasses the limits in terms of nitrate concentration. To control this parameter, the RO-concentrate is recycled to the biological treatment (denitrification tank). The selected treatment scheme can hence be represented as below.

Since the concentrate is now being recycled to the WWTP, the salt content in the WWTP increases to a higher level. For this particular case the salt content in the WWTP increases from 2.500 µS/cm to 5.500 µS/cm.

Hence adopting this treatment scheme solves the issue of nitrates to be discharged and represents a good solution in case the nitrate concentration is the limiting factor in the reuse scheme.



# BOOMERANG®: TAILOR-MADE SOLUTIONS TO IMPROVE YOUR WATER FOOTPRINT

DESIGN  
ENGINEERING  
CONSTRUCTION  
OPERATION  
MAINTENANCE

## PROTECTING THE 4 ELEMENTS



We all have the responsibility to handle our natural resources in a careful and sustainable way. Waterleau develops environmental technologies and offers sustainable solutions for water, air and waste treatment, as well as for energy recovery. As an EPC contractor and operator, Waterleau counts more than 1500 references for municipal and industrial clients around the world.



**WATERLEAU**

protecting the 4 elements

Nieuwstraat 26, 3150 Wespelaar (Leuven), Belgium  
t. +32 (0) 16 65 06 57 - f. +32 (0) 16 65 06 63  
info@waterleau.com - www.waterleau.com