Reverse osmosis (RO)

From the UF filtrate reservoir the water is pumped to the RO system. To prevent scaling, both anti-scalant and acid (pH adjustment) are dosed.

The water first passes cartridge filters with pore sizes of 15 µm; this is an extra protection for the RO membranes. High pressure pumps then feed the 2 RO skids, which are identical. It is a two stage concept with 36 pressure vessels of 8 inch diameter and 6 m length on every skid. On a skid, 32 of the 36 pressure vessels contain 6 high surface area, low-energy, brackish water RO membrane elements (8" BW 30LE-440 DOW) each, in a 2 stage (21 – 11) configuration. It means that the capacity of every skid can be enlarged by filling and using the other 4 pressure vessels.

Each skid contains 7.872 m^2 of membrane area and can treat a maximum of 205 m^3/h of UF filtrate. The recovery of the RO system is minimum 75 % and is varied according to feed water conductivity. The filtrate produced with RO is stored in a RO filtrate reservoir with a capacity of 70 m^3.

Infiltration water and ultraviolet (UV) installation

The infiltration water is composed of RO filtrate corrected for pH by adding sodium hydroxide. UV irradiation (dose of 40 mJ/cm^2) is present as extra disinfection step but it is not operational in normal circumstances.

Infiltration in the water catchment 'St-André'

This infiltration water, 2.500.000 m^3/year, is then recharged in the dune water catchment 'St-André' at a mean rate of 285 m^3/h. The infiltration pond has a surface area of 18.200 m^2. At a minimum distance of 40 meters from the edges of the infiltration pond, 112 extraction wells extract 400 m^3/h of groundwater. After aeration and rapid sand filtration, drinking water is produced. As the total drinking water demand in the area where I.W.V.A. distributes water is currently around 5,5 million m^3/year approximately 45% is fulfilled reusing wastewater effluent.
As a result of this project, the natural groundwater extraction in the 2 existing dune water catchments, St-André and Westhoek, has been reduced by 30 % or 1 million m^3/year. The groundwater levels increased enhancing the natural value of the dunes.

IWVA Kring-Lopend Water is ons Ambacht

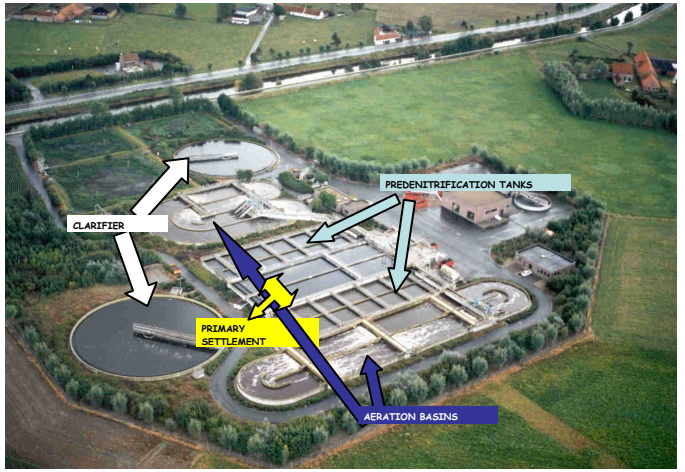
Torreele

Production of infiltration water out of effluent

In July 2002 the Intermunicipal Water Company of the Veurne region (I.W.V.A.) has started producing infiltration water. The source is wastewater effluent; the techniques are a combination of membrane filtration. The water is used for groundwater recharge of the dune water catchment ' St-André'.

The wastewater treatment plant of Wulpen

The flow scheme of the wastewater treatment plant (WWTP) of Wulpen, operated by Aquafin who is responsible for all wastewater treatment in Flanders, is as follows : primary settlement, predenitrification, aeration and finally a clarifier. To reduce the phosphorous content iron is dosed at the inlet of the WWTP. The wastewater is mainly domestic.



The 'Torreele' plant

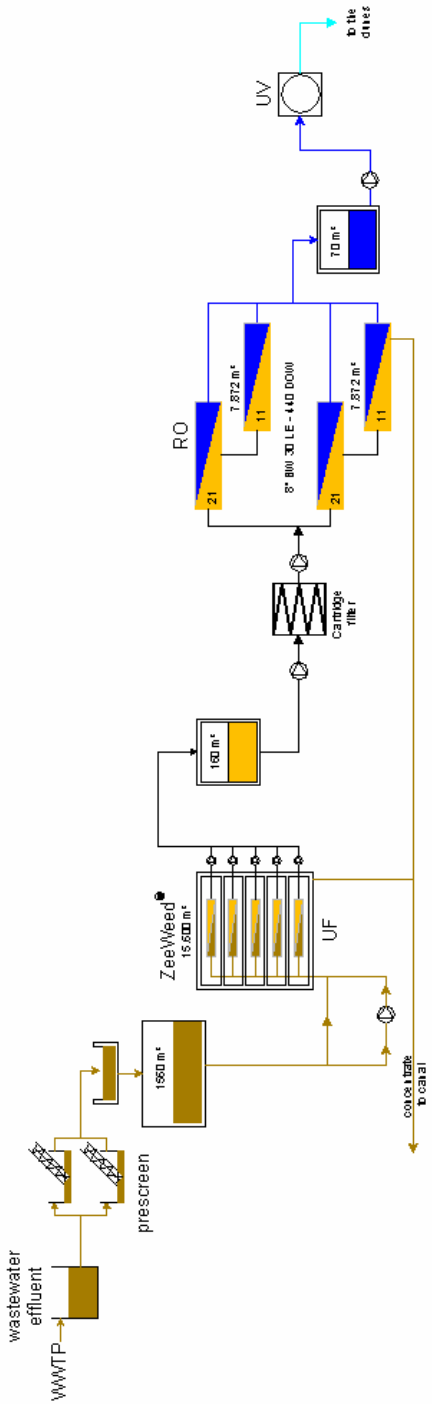
Based on the experience of the pilot tests the I.W.V.A. has chosen the following steps to further treat the effluent : ultrafiltration (UF), cartridge filter, reverse osmosis (RO), ultraviolet irradiation (UV).

The production centre is called ‘Torreele’; this is the name of the local area. In Torreele the pH of the produced RO filtrate is corrected using sodium hydroxide. This water recharges a sandy unconfined aquifer in the dune water catchment ‘St-André’; the residence time of the recharged water in the aquifer is minimum 40 days.

The choice for membrane filtration - ultrafiltration and reverse osmosis are both membrane filtration techniques - was based upon the quality parameters set for the infiltration water. As this water is recharged in a dune area, which is of high ecological value, the infiltration water must have low levels of salts and nutrients. Reverse osmosis is the only technique capable of achieving these goals in one step. As reverse osmosis membranes are very susceptible to pollutants, ultrafiltration was chosen for the pretreatment. Ultrafiltration membranes have pore sizes of 0,1 µm and therefore remove suspended solids and bacteria from the effluent.

On the right the flow scheme of ‘Torreele’ is shown.

The Torreele plant is designed to produce 2.500.000 m^3 of infiltration water each year. The total investment cost was 6 million euro. In 2004 and 2005 respectively 2.155.000 en 2.170.000 cubic meter of infiltration water was produced.



Pre-treatment

The intake of effluent is gravitational. It first passes a mechanical screen with 1 mm openings to remove all bigger particles. Before entering the effluent reservoir sodium hypochlorite (NaOCl) is dosed; this prevents biological growth in the reservoir. The total buffer capacity is 1.560 m^3.

Ultrafiltration (UF)

From the effluent reservoir the pre-treated water flows to 5 parallel UF basins, each containing 3.120 m^2 of ZeeWeed® membranes.
A ZeeWeed®module (ZENON) contains supported hollow fibres with outside-in flow. The permeate is drawn by suction on the inside of the fibres. The fibres are aerated during 30 to 50% of the time; this ‘air scouring effect’ keeps the membranes clean.
The maximum pore size is 0,1 µm. To remove the contaminants out of the UF basins, the membranes are periodically backwashed by a reverse permeate flow.
The basins are built in concrete and open to the air. As they are beneath ground level they can be fed gravitationally.
The UF compartment of the Torreele plant can treat a maximum of 450 m^3/h of effluent. The minimal recovery should be 85 %.

The filtrate of all UF skids is piped to a reservoir with a capacity of 160 m^3. Before entering this reservoir free chlorine and ammoniachloride, reacting together forming monochloramines (NH_2Cl), can be dosed to the filtrate. This is done to prevent bio-fouling on the RO membranes.