Abstract Title	Closed Circuit Reverse Osmosis contributes to drinking water robustness in Flanders coastal region
Topic	O Improving water quality x Resilient water systems O Circular solutions: Reuse, Recover and Recycle O Transitions in water, agro/food and energy
Challenges and Solutions	In the Water Production Centre (WPC) De Blankaart drinking water from surface water is produced. In summer, surface water quality is low: during drought periods, salinity and micropollutants frequently exceed the treatment limits, thus preventing raw water intake for drinking water production. CCRO is a novel treatment technology capable to treat challenging water qualities and therefore secures drinking water production.
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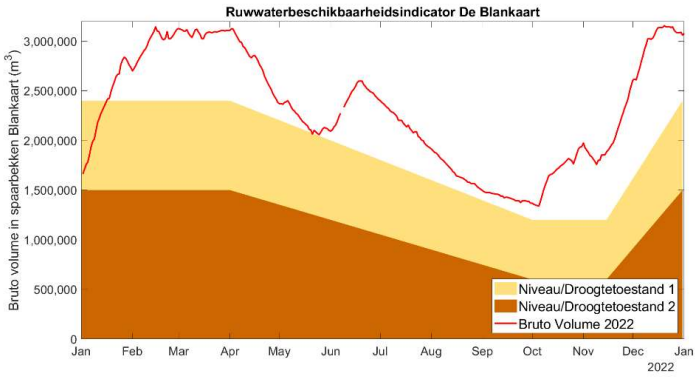
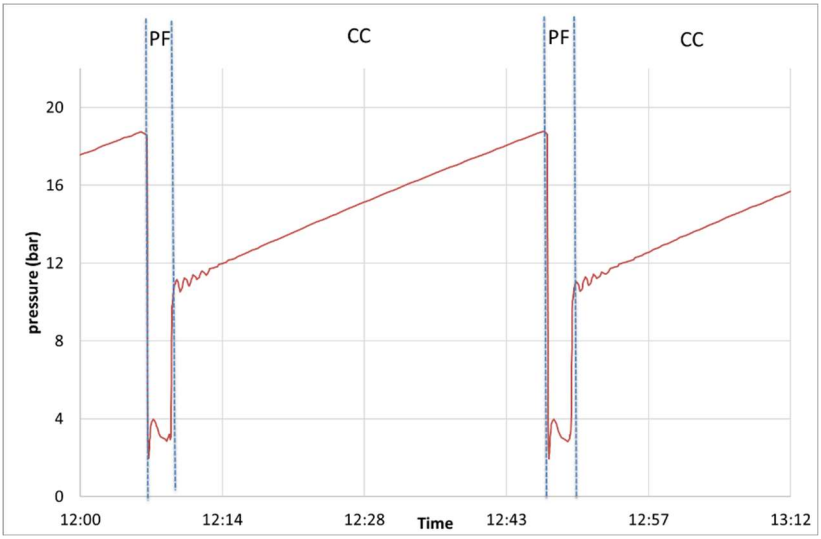
Abstract	Flanders faces water challenges as a result of a combination of high drinking water demand due to the dense population, high irrigation demand for agriculture, groundwater overexploitation, water quality deterioration, water scarcity caused by droughts and climate change. The drinking Water Production Facility (WPC) De Blankaart of De Watergroep (Diksmuide, BE) produces drinking water from surface water. At the WPC, water availability is limited due to seasonal impact and surface water quality deterioration. High concentrations of chlorides (>250 mg/l), nitrates (> 60 mg/l), and organic micropollutants (> 10 µg/l) result in insufficient quality for acceptation in the WPC. Extensive periods of low or no water intake can cause water shortage in the long term, jeopardizing the drinking water supply and increasing the costs due to non-productivity. The water volume in the reservoir “De Blankaart”

	is presented in Figure 1 for 2022. Notwithstanding a preventive reduction of the daily production and substitution of the lack of water by supply from other regions, the water volume in the reservoir came close to a critical level. Within B-WaterSmart, it is investigated if a lower dependence on the raw water quality can be achieved by means of a Closed Circuit Reverse Osmosis (CCRO) installation. CCRO results in extensive removal of chlorides and acts as a barrier to micropollutants, increasing the performance of the installation and thus relaxing the tolerance levels for intake of raw water to the reservoir. CCRO differs from conventional RO systems by a cyclic operational mode. In contrast with conventional RO, the pressure is not constant over time. Due to the cyclic operation, the pressure follows the osmotic gradient in the system (figure 2) resulting in lower energy consumption. Main benefits are a higher flexibility towards varying incoming water quality, low sensitivity for scaling and high water recovery. Especially a high water recovery is a key success factor for De Watergroep given the water scarcity and limited storage capacity. For conventional RO systems with a typical water recovery around 70-80%, potential benefits of relaxation the intake limits would be eliminated by the higher water losses in the production. In the period September 2022 until June 2023 a CCRO pilot (10 m^3/h) was run at the water production plant of the Blankaart, Diksmuide. After initial challenges, the location (after the sand filtration) appeared to work well when a two-step prefiltration was installed. The water recovery of the CCRO was gradually increased from 85% to 95%. Even at this high water recovery the CCRO process remained stable and no indications of scaling were observed. The chloride retention was about 90% and micropollutants (pesticides, pharmaceuticals, PFAS) were retained to concentrations below drinking water standards. CCRO is a promising and potentially highly efficient membrane technology. Especially the high water recovery is essential for successful integration. Applications like the intake of off-spec water qualities as well as the use of alternative water resources might be envisaged. De Watergroep will, based on this findings,

	further elaborate the regional vision on climate robust drinking water supply.
Figures/diagrams/illustrations	 Figure 1: Available water volume in the water reservoir The Blankaart in 2022. The red line represents the watervolume.in the reservoir. The yellow and brown areas are alarm levels as defined in the Flemish drought plan.  Figure 2 : Pressure variation during the cyclic operation of the CCRO. During the permeate flush phase (PF) the system is filled with fresh feed and the concentrate is flushed. At the beginning of the closed circuit phase (CC), the pressure is low. During the CC phase the pressure gradually increases to overcome the increasing salt concentrations in the loop.