CASE STUDY

RO | UF | MBR | ANTISCALANT

Water Treatment Chemicals
Löhnen Dinslaken, Germany

# Assessment of Using ROPUR RPI® Antiscalants Projects Significant Savings

## OVERVIEW

In 1961, Wasserwerke Dinslaken GmbH formed a private utility to service the Lower Rhine region and today operates the Löhnen drinking water plant. Nearby the plant is the City of Dinslaken, an area where deep-shaft coal mining was active for nearly a century. As a result, mining-induced subsidence of up to five meters had occurred where the Löhnen waterworks have their supply wells. As a result, the filtration depth from the surface to the groundwater table became insufficient to warrant the removal of particles and pollutants from the surface. A way to augment this problem was to operate large polder pumps and lower the groundwater table by transferring vast amounts of water to the nearby Rhine River. However, with this method, simulations revealed that groundwater intrusion from the river's underground side streams might occur. Densely populated cities situated near the Rhine use the river as a discharge line for clarified wastewater. The intrusion streams would carry increased concentrations of anthropogenic substances, including pharmaceutical residues from painkillers and medication to treat cancer, x-ray contrast chemicals, herbicides, pesticides, and other emerging contaminants of industrial wastewater and surface runoff.

In 2006, the Dinslaken utility began feasibility studies with the Rheinisch-Westfälische Institute for Water (IWW) to find solutions for the Löhne Waterworks to secure high-quality drinking water for current and future communities. The feasibility studies included rigorous pilot tests replicating worst-case scenarios of groundwater contamination. IWW selected Toray RO membrane elements for a two-stage low-pressure membrane process as a viable solution for reducing impurities at low energy consumption.

## THE CHALLENGE

The membrane system design consisted of operating at 87% recovery, a flux of 25 l/m$^2$/hr, and transmembrane differential pressure of around 5.5 bars. However, as hard minerals such as calcium, magnesium, and carbonate ions are present in the source water, operating at these conditions increased the likelihood of premature scaling. Membrane experts from Toray Membrane Europe AG (TMEU) further determined that operating without antiscalants would lead to irreversible membrane damage from crystal surface abrasion, triggering heavy routine cleaning, increased labor, and membrane replacement costs.

| Quick Facts — RO Specifications | |
|---|---|
| Model | TMH20-430 |
| Membrane type | Low-pressure |
| Nominal NaCl rejection* | 99.3% |
| Operating pressure* | 0.69 MPa |
| System array | 10:5 |
| No. of elements per vessel | 6 |
| Design capacity | 1,100 m$^3$/h |
| Design flux | 25 L/m$^2$·h |
| Recovery | 87% |
| Selective membrane material | Polyamide |

*manufacturer's specifications

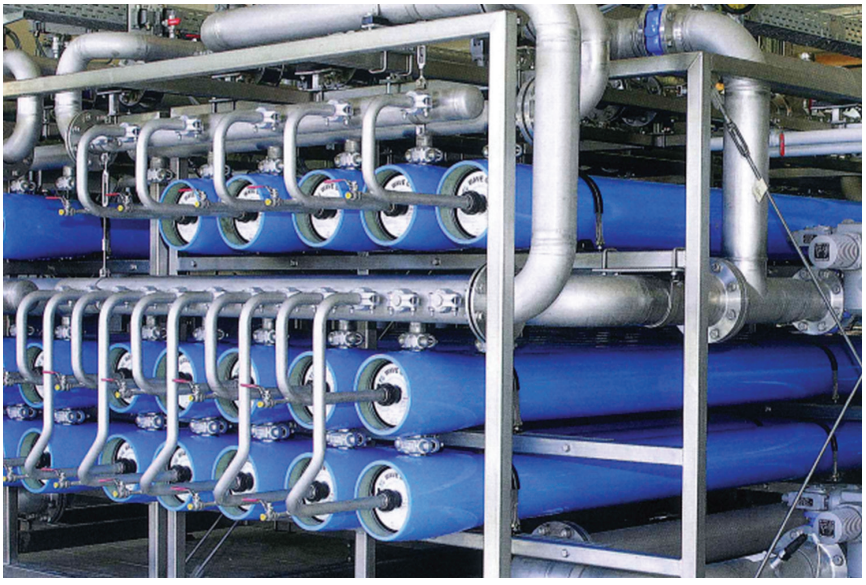

Figure 1: Low-pressure RO system at Löhnen drinking water plant

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## SIGNIFICANT SAVINGS

TMEU used Toray's DS2 software to run membrane performance projections, ROPUR's RPI Calc® for antiscalant dosing simulations, and evaluated other water treatment sites using Toray products. Details from these evaluations helped identify the dosage structure and potential savings by using an effective membrane and antiscalant combination. As shown in Figure 2, using ROPUR RPI® Antiscalants estimated the following results over 12-months:

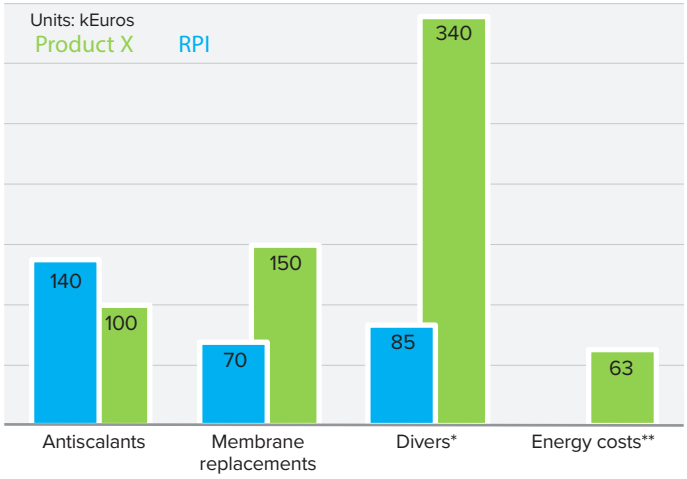
- Less than half membrane replacements indicating extended membrane lifetime;
- 75% less chemical demand, such as the use of biocides and clean-in-place (CIP) frequencies;
- Four times more CIP's and the use of biocides in the absence of RPI antiscalants;
- Stabilized operating pressure through excellent control of scaling leading to annual energy savings of €63,000;
- An estimated gain of €263,000 in water revenue resulting from less downtime and more water produced (Table 1); and
- Total annual savings of 34% representing €620,500.

Lastly, the high strength and purity of ROPUR RPI® Antiscalants require a low dosage (2 mg/L at Löhnen), further contributing to overall cost savings.

## ROPUR ANTISCALANT TECHNOLOGY

ROPUR RPI® ingredients are from the latest generation of poly-phosphonate salts. They produce an efficiency several orders of magnitude higher than comparable products in the market, requiring only low concentrations to be effective. ROPUR Antiscalants keep the membrane surface free of inorganic and organic components and stabilizes filtration flow through the membrane layer at optimum rates by preventing or delaying the formation of $CaCO_3$, $CaSO_4$, Barium, Strontium Sulfate, Silicate, and metallic oxides. This functional property of the antiscalants allows for a constant high flow rate at stable pressures resulting in low-energy consumption and extended membrane life. The daily operation at the Löhnen plant relies on the fine-tuning of parameters like flow rates, hydraulic pressures, pH, and recovery rates, to name a few. The in-depth knowledge and evaluation of membrane processes and the availability of the RPI Calc® for producing dosage calculations helped facilitate energy-efficient and reliable protection of the membrane operations at Dinslaken. For more information on ROPUR RPI® Antiscalants, please visit www.ropur.com.

Figure 2: Annual OPEX at Löhnen plant




*Chemicals, biocides, filters. Simulation is based on the required number of weeks of CIP per year per antiscalant: 4 weeks for competitor and only 1 week of CIP with RPI-4000A

**Due to 10% pressure increase per train as a result of scaling/fouling. Estimated cost to operate at higher pressure is 6300 Eur/train/year.

Table 1: Estimated loss of revenue caused by CIP downtime*

| Item | Competitor | ROPUR RPI® |
|---|---|---|
| Total downtime per year | 4 weeks | 1 weeks |
| Total volume of water not produced | 700,000 $m^3$ | 175,000 $m^3$ |
| Loss of revenue | 350,000 euros | 87,500 euros |

*Calculations based on price of water at 0.50 Eur/$m^3$

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