Petrochemical case

r3volution

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The EU-funded R3VOLUTION project is redefining industrial water management in Europe, aiming to enable more than 90% water reuse in water-intensive sectors.

Industries such as petrochemical, biochemical, pulp & paper, and steel produce highly complex wastewaters and lose thermal energy, leading to greenhouse gas emissions and costly treatment demands.

R3VOLUTION transforms these challenges into opportunities by recovering water, solutes, and up to 50% of thermal energy, while removing hazardous substances. The innovative project solutions are being validated at four demonstration sites across key industrial sectors. This brochure introduces the petrochemical demo site.

The petrochemical demonstration case

The petrochemical complex in Puertollano, Spain — led by project partner Repsol — faces two key challenges.

The first is **maximizing water reclamation to reduce freshwater use**. The production process is intensive in freshwater intake, and Puertollano in southern Spain is located in a geographical area affected by water stress risk.

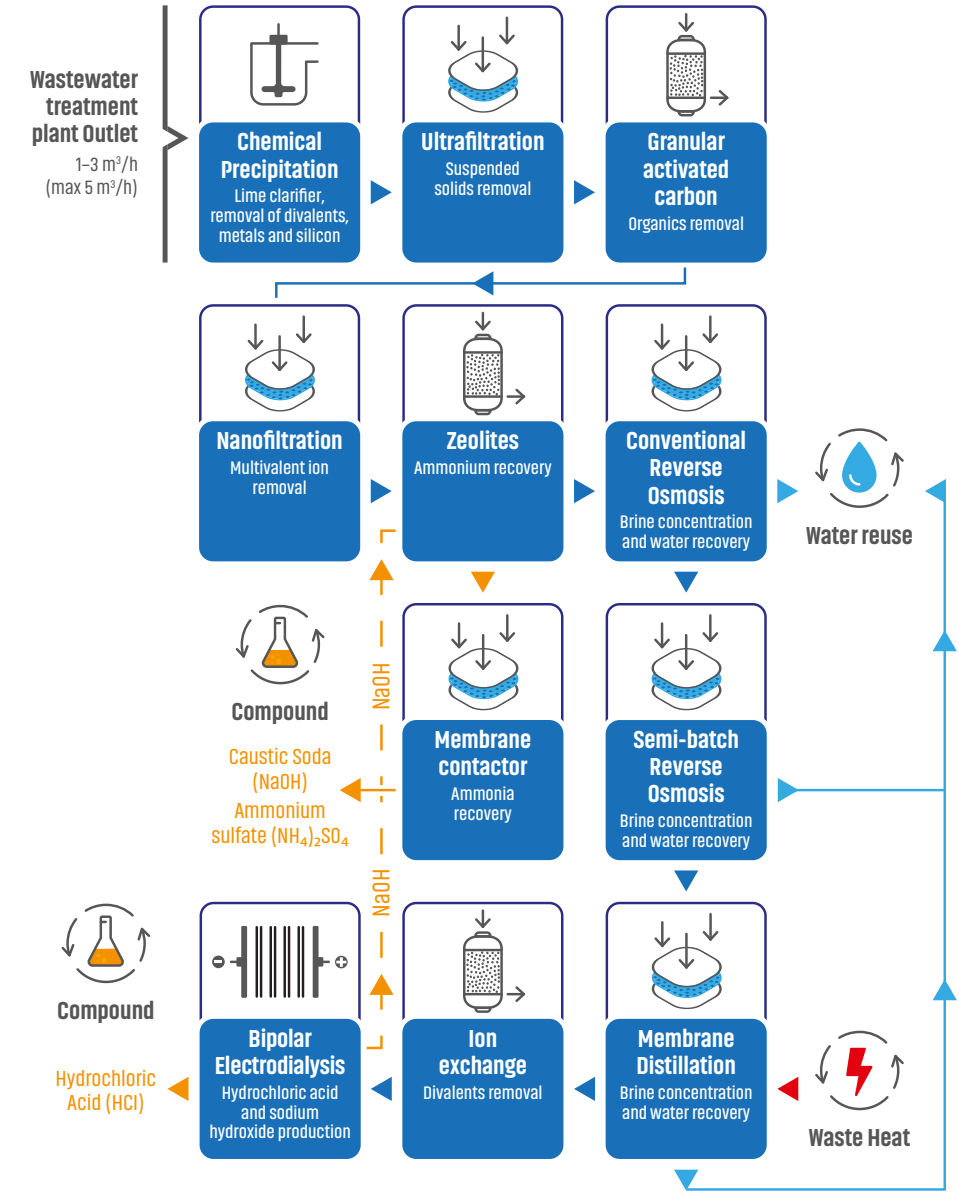
The second challenge is meeting increasingly strict discharge limits. The most critical parameters include chemical oxygen demand, nutrients, suspended solids, and metals. While the wastewater treatment plant currently complies with existing regulations, future limits are expected to be more stringent. To address this, the site is **pursuing a zero-liquid-discharge strategy**.

Our solutions

The primary objective of the treatment scheme for the site is to achieve over **90% reuse of high-quality reclaimed water**, using a process centred on Reverse Osmosis (RO) supported by advanced pre-treatment.

- **Pre-treatment:** Chemical precipitation is employed to remove divalent ions, metals and silicon. Subsequently, organic matter is removed through granular activated carbon and ultrafiltration. Nanofiltration and zeolites are then used to further reduce multi valent salts and remove ammonia.
- **RO concentrate management:** In a second step, the effluent from the zeolite unit is treated by RO followed by a semi-batch RO (SBRO). The SBRO concentrate, already depleted of major scaling species and organic matter, is further concentrated up to tenfold by using ceramic membrane distillation in vacuum mode. At industrial scale, the thermal energy required by the membrane distillation unit could be supplied by waste heat available at the Repsol facility. The resulting stream undergoes ion exchange to remove residual divalent ions and is subsequently treated by bipolar electrodialysis (BPED), enabling the recovery of hydrochloric acid (HCl) and sodium hydroxide (NaOH).
- **Zeolite regeneration:** In the next step, the zeolites are regenerated using the NaOH produced on-site by the BPED, generating an ammonia-rich stream. The stream is treated in a membrane contactor, where ammonia is recovered as an ammonium sulfate (NH4)2SO4) solution, generating a valuable fertilizer product.

Treatment train



- Treatment of raw water
- Water recovery
- Compounds recovery
- Waste heat recovery

The demo case is run by: repsol CETAQUA WATER TECHNOLOGY CENTRE

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Read more about the R3VOLUTION project on our website:

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