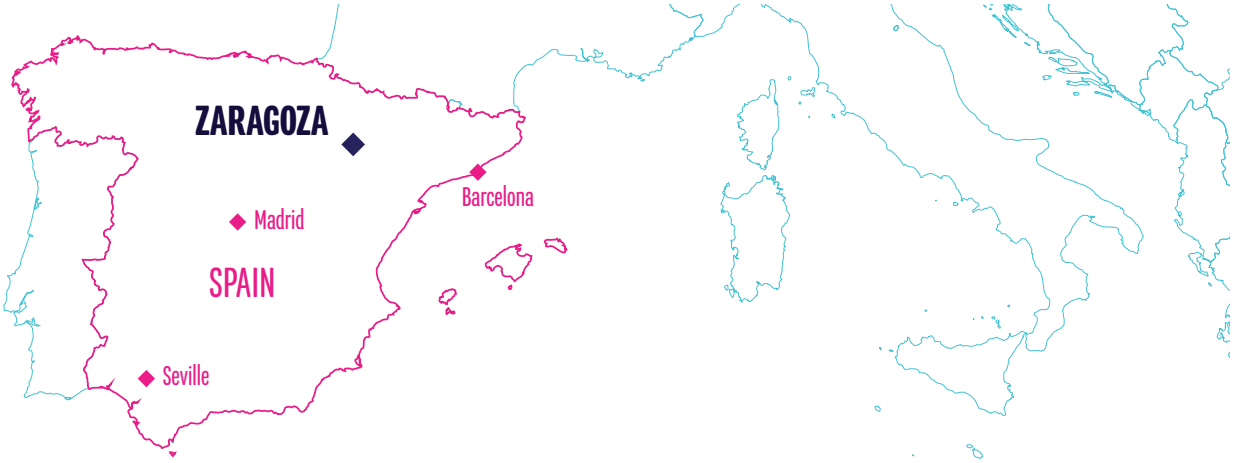
ZERO BRINE

ZERO BRINE PILOT DEMONSTRATION

INDUSTRIAS QUIMICAS DEL EBRO (IQE) IN ZARAGOZA, SPAIN



1. Industry context

Synthetic amorphous silica are used in a wide range of industrial applications. Due to their physico-chemical properties, they are used in synthetic resins, plastics, rubbers, cosmetics, nutritional products and drugs, for example, as fillers or anti-caking agents. Synthetic amorphous silica are produced either by a wet process – precipitation of a water glass solution with acids (precipitated silicas, silica gels, silicates) – or by high temperature hydrolysis of chlorosilanes (pyrogenic silicas).

In the production of silica by a wet process, high amounts of water (≈40m^3 per each tonne of silica) are consumed, as well as sulfuric acid (H_2SO_4) and sand. As a result, around 35m^3 of wastewater containing a high concentration (20 g/L) of sodium sulphate (Na_2SO_4) are produced. This wastewater is normally discharged to natural water sources such as rivers and seawater after passing through wastewater treatment plants.

It is estimated that 620,000 tonnes of precipitated silica is produced per year in the EU and 21,700,000 m^3 of wastewater is discharged.

Industrias Quimicas del Ebro (IQE) is seeking novel methods to recover resources (water and sodium sulphate) and minimize the wastewater generated, while reducing the cost of water supply and wastewater treatment. Even so, as it is stated in the BREF for the inorganic chemical industry sector, the concentration of sodium sulphate in wastewaters from the production of precipitated silica is too low for its recovery to be economically viable through available methods (spray drying, precipitation of gypsum or membrane dialysis, etc.).

2. Impact of the ZERO BRINE technology

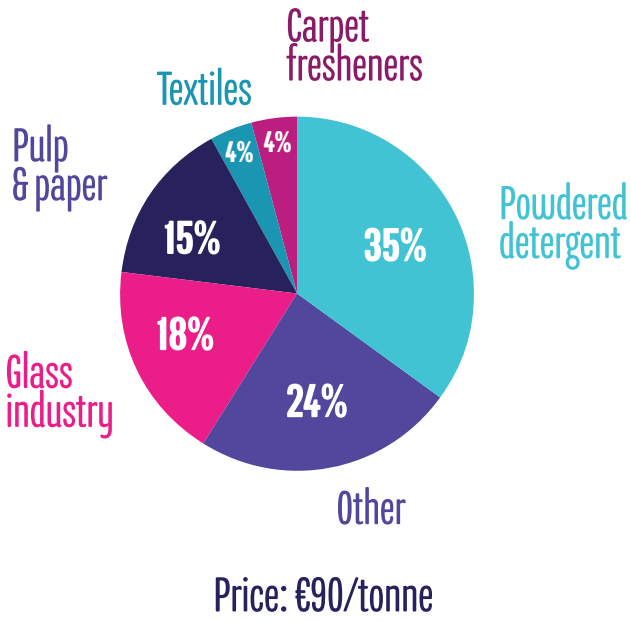
ZERO BRINE aims at providing a technological solution for the saline wastewater problem for the silica industry. The technology applied in the ZERO BRINE project would enable IQE to recover up to 80% of wastewater generated, producing water suitable for its reuse in the same company, thus reducing freshwater consumption. In addition, the technology allows the recovery of raw materials: sodium sulphate, which is a valuable product for various industrial sectors, like the powered detergent or the glass industry.

The ZERO BRINE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730390.

3. Business opportunities

The ZERO BRINE solution can be applied not only to the silica industry, but also to other industries which generate saline discharges containing high concentrations of sodium sulphate. This is the case for the pulp and paper industry, where sodium sulphate is one of the main reagents and also by-products of the pulping processes, especially the kraft process.

Na_2SO_4 – Uses & Market Shares



Price: €90/tonne

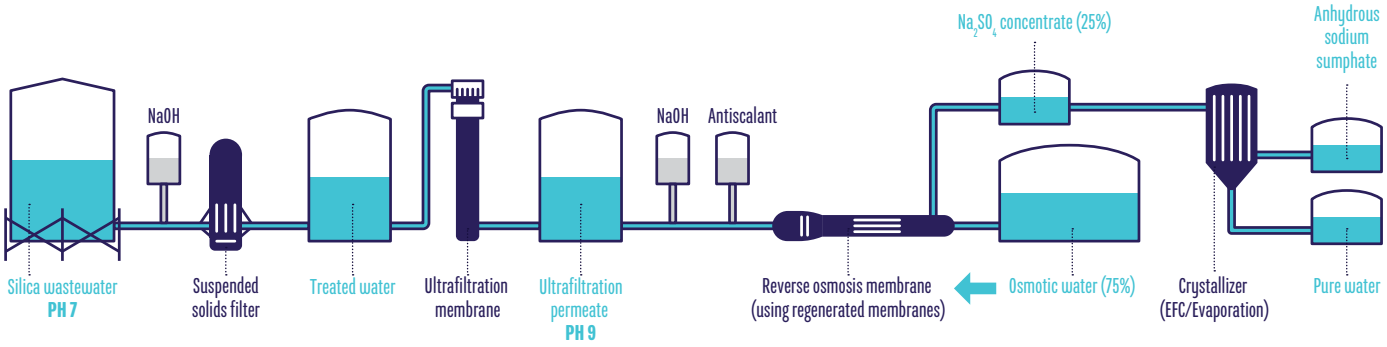
An important business opportunity is the production of sodium sulphate that is a valued product for various industrial sectors, like the powdered detergent or the glass industry.Business opportunities of ZERO BRINE are not limited to saline wastewater containing sodium sulphate. The technology developed and tested in ZERO BRINE can also be applied to recover valuable inorganic compounds other than sodium sulphate. The potential users are all industries with a high concentration of inorganic compounds in their effluents that could be recovered instead of discharged into the environment, such as desalination plants, salt mining, and chemical industries.

4. Technology + proposed scheme

The ZERO BRINE process is based on: a) a first membrane-based process using tailor-made membranes produced by regenerating end-of-life reverse osmosis (RO) elements from desalination plants otherwise destined for a landfill; b) treatment of the concentrate stream produced in the first stage by crystallization to achieve Zero Liquid Discharge. In order to avoid scaling problems during treatment with membranes, a pre-treatment to remove aluminium and iron is applied.

Regenerated membranes are able to achieve a suitable quality of water, equivalent to the current quality in the industry that could also be reused in the production process. In addition, a high saline concentrate is obtained to be treated by crystallization, either Eutectic Freeze Crystallization (EFC) or Evaporation. The concentration of wastewater using membranes reduces the energy consumption of the crystallization stage.

The ZERO BRINE process has been demonstrated at IQE at pilot plant scale.



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5. Key results and conclusions

The technology applied in the ZERO BRINE project would enable IQE to recover 20,000 tonnes per year of sodium sulfate and 80% of the wastewater generated (1,000,000 m^3 per year).

The concentration of saline wastewater using regenerated membranes before the crystallization process allows the reduction of treatment costs up to 70% when compared with the direct evaporation of wastewater.

The preliminary business plan elaborated for the development of the ZERO BRINE proposal foresees savings in the cost of water supply and wastewater treatment of around €460,000 per year and turnover of €1,800,000 per year from the sodium sulphate recovered.

Table 1 - Impacts of the ZERO BRINE technology on water, emissions, energy, and resource recovery in industry

	Expected reduction in:			
	Water	**Emissions**	**Energy**	**Recovered resources**
Silica factory	• 30% reduction in overall annual water consumption at IQE	• 100% reduction of brine discharged to the environment • 60% reduction of sodium sulphate (Na2SO4) releases into the Ebro River 6,000 tons/year CO2 reduction or 5 kg CO2/ m^3 of wastewater	• 72% reduction by waste heat (EFC technology compared to direct evaporation)	• 75-90% water recovery suitable for internal use • 90% recovery of sodium sulphate (Na2SO4) or 20,000 tons/year for external valorisation (>99% purity) • Sodium hydroxide (NaOH) (94% purity) and sulphuric acid (H2SO4) (72% purity) for external valorisation

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