Life Zerosilibrine

This project, framed within the theme of “Resource efficiency, sustainability and Circular Economy”, is a pilot project that addresses an innovative process for the **management and treatment of the discharge generated in the production of precipitated silica**, an environmental challenge without an economically viable solution at present.

The main objective of this project is **to verify the results obtained on a small scale (2 m³/h) on a pre-industrial scale (40 m³/h) in a real environment** and validate them before the **construction of a complete industrial facility** that will allow the implementation of a **zero liquid discharge (ZLD) process**.

OVERVIEW

The production process of precipitated silica generates as a by-product a highly conductivity saline stream that **is discharged into natural channels** after passing through wastewater treatment plants. In the production of precipitated silica, the main salt generated is **sodium sulfate** (Na_2SO_4) that must be separated from the product by washing, generating a **high consumption of water**. For each ton of precipitated silica produced, 0.75 tons of Na_2SO_4 are generated as a by-product in a discharge of 40 m^3 of saline effluent.

PILOT PROJECT

A process based on reverse osmosis has been developed on a small scale that has allowed to solve the problems of membrane blockage that made this technology unfeasible until now (Zero Brine – H2020, G.A. Nº 73090).

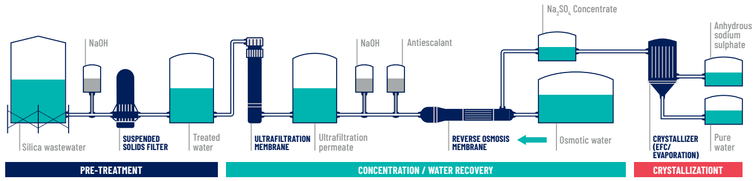
SUSTAINABILITY

The project will mitigate the environmental impact caused by the discharge of the by-product generated, reusing 100% of the water in the production process itself and recovering sodium sulfate as a high purity product with commercial interest.

CIRCULAR ECONOMY

It guarantees the use of secondary resources (precipitated silica discharge) as an alternative to natural and material resources: well water for the manufacture of precipitated silica and primary extraction of sodium sulfate.

Process for the treatment of precipitated silica wastewater.



Actions

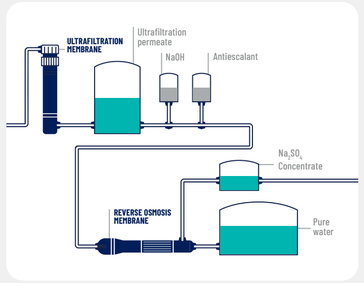
B. IMPLEMENTATION ACTIONS

B1: DESIGN AND CONSTRUCTION OF THE OSMOSIS PREINDUSTRIAL PILOT INSTALLATION

Based on the results obtained in the H2020 ZeroBrine project, **an industrial ultrafiltration pilot equipment and reverse osmosis pilot equipment will be designed and built** with a treatment capacity of 40 m^3/h of precipitated silica brines.

B2: TECHNOLOGICAL VALIDATION AND OPTIMIZATION OF THE REVERSE OSMOSIS PROCESS

The process will be optimized to obtain the maximum performance of effluent permeated with the quality to be used as process water (< 500 µS/cm) and a concentrated effluent with a minimum content of 120 g/L of sodium sulphate. In addition, **both ultrafiltration and reverse osmosis membrane cleaning cycles will be optimized** for the proper operation of the installation. Finally, their service life will be validated. Own use in precipitated silica process of concentrated brine will be studied to substitute raw materials.



Treatment of wastewater by Ultrafiltration and Reverse Osmosis.

B3: ANALYSIS OF OPERATING COSTS OF THE CONCENTRATION PROCESS VIA REVERSE OSMOSIS: ECONOMIC VIABILITY OF THE TECHNOLOGY

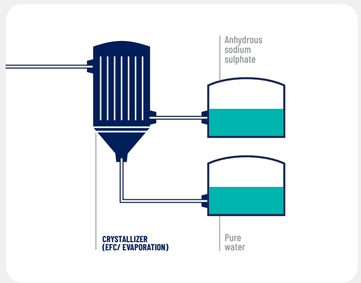
An analysis of the operating costs of the process will be carried out to validate the economic viability of the technology. It will be taken into account: process parameters (electricity consumption, number of chemical cleaning cycles, consumption of reagents…), useful life of the materials (membranes, pumps…) and concentration and flow of the permeate and concentrate effluents (reinvestment as process water, reduction of discharge rates and reduction of energy consumption in evaporator/crystallizer).

B4: TECHNOLOGICAL VALIDATION AND OPTIMIZATION OF EVAPORATION AND CRYSTALLIZATION OF ANHYDROUS SODIUM SULPHATE

With the concentrated effluent generated in the reverse osmosis industrial plant, a study of **evaporation and crystallization alternatives** will be conducted to obtain high purity anhydrous sodium sulphate. A pilot scale evaporator and crystallizer will be designed and built to validate the technology and obtain anhydrous sodium sulphate.

B5: CUSTOMER VALIDATION OF ANHYDROUS SODIUM SULPHATE

Once the **anhydrous sodium sulphate** has been obtained, samples **will be sent to potential future customers**. They will carry out an approval and validation of the product for the potential introduction in the market at the different sectors in which it could be used.



Production of sodium sulfate from reverse osmosis concentrate.

B6: ANALYSIS AND STUDY OF TECHNOLOGY TRANSFER TO OTHER CHEMICAL PROCESSES AND/OR INDUSTRIAL SECTORS

Candidate industries to have similar effluents have been already identified and **will be contacted** (textile, chemical, pharma, etc.) **to provide composition and samples of their effluents**.

The treatment scheme will be firstly evaluated at bech-scale in the EURECAT’s branch of the Brine Excellence Centre established in H2020 ZEROBRINE project. Those more promising effluents will be selected for a short in-situ pilot scale study using an existing pilot plant. Experimental design and results evaluation will be done to evaluate technical, environmental, and economic feasibility of a full-scale installation. Results will be transfer to authorities and reference documents.

B7: MARKET UPTAKE - BUSINESS PLAN

With all gathered data during the project, **a market study will be carried out for the revaluation of the anhydrous sodium sulphate obtained**. Initial idea is to find a win-win business model with primary sulphate extractors so the product can be benefited by their commercial and distribution network. An exploitation plan will be defined for the design of an installation with a treatment capacity of 120 m^3/h. Replication and transfer plan will be generated. Patentability will be studied.

C. MONITORING OF THE IMPACT OF THE PROJECT ACTIONS

C1: SUSTAINABILITY MONITORING AND EVALUATION

Oversee of the project sustainability by the **evaluation of the environmental** (LCA) impact and performance of **a socio-economic assessment** of treatment scheme and **its effect on the local economy and population**. Calculation of **Water Footprint**. **Environmental risk Assessment Study**.

C2: KPI MONITORING

Monitoring and measurement of the identified project performance indicators to quantify the impact of the project on the environmental problem targeted.

D. PUBLIC AWARENESS AND DISSEMINATION OF RESULTS

D1: DISSEMINATION AND PUBLIC AWARENESS OF RESULTS

Dissemination of obtained results will be done for **public awareness** and to **attract the attention of other industries**: communications and publications in international scientific journals, international seminars assistance, conferences and workshops, and specific days. University of Zaragoza will be subcontracted in this task.

E. PROJECT MANAGEMENT

E1: PROJECT MANAGEMENT AND COORDINATION

Management and coordination of the project execution will be held to achieve the overall project objective within time and budgetary limits. IP management with a possible patent filling will be carried out. **AFTER LIFE plan** will be generated.

For more information visit our website:

Main objetives

OBJETIVE 1

Demonstrate technical feasibility of reverse osmosis stage with 40 m^3/h installation recovering 80% volume of the production process effluent of precipitated silica reusing the water recovered in the same production process.

OBJETIVE 2

Validation of the operating costs of the reverse osmosis process and **validation of the economic feasibility** of the manufacture of high purity anhydrous sodium sulphate.

OBJETIVE 3

Validate and optimise evaporation-crystallization stage with small prototype (1-2 m^3/h) from 80% to 100% discharge volume until obtaining a commercial anhydrous sodium sulphate.

OBJETIVE 4

Study andydrous sodium sulpahte by-product characteristics with primary sodium sulphate manufacturer.

OBJETIVE 5

Study potential technology **replicability and transfer** to other chemical processes and/or industrial sectors.

OBJETIVE 6

Creation of a **new business of anhydrous sodium sulphate**. Transferability and replicability models will be studied. Business plan will be generated to exploit all the circular economy business strategy.

Partnerships structure

This project will be leaded and coordinated by IQE and the partnerships structure will be completed with EURECAT. **IQE**, as precipitated silica manufacturer, **will lead industrial activities piloting the pre-industrial plant** and validating **technical and economic feasibility** and related **future business**, while **EURECAT** will contribute with their **expertise in membrane technologies and wastewater treatment**, **environmental monitoring** and the **technical transferability** fo the technology.

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Valorisation of precipitated silica wastewater through circular economy strategy for sodium sulphate and water recovery

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