

Processes for valorizing waste brines through the production of magnesium hydroxide and drinking water



Lorenzo.ventimiglia@unipa.it

Desalination

Concept

Water is a fundamental resource for life, but there are places that lack it, where the only solution is industrial production through seawater desalination technologies such as reverse osmosis. These technologies also produce waste streams, brines. These are rich in minerals that it is possible to extract. Particularly magnesium for its high concentration in brines but also for its high economic value as you can see in fig.1, extracted in the form of hydroxide. Magnesium is classified as one of the minerals whose supply is critical by the European Union. A new source of magnesium can lead the European Union to depend less on countries producing this mineral such as China.

Furthermore, valorising the brine would reduce the environmental impact of its disposal, which is currently done by pouring it into the sea.

Scientific approach

The project involves the design, implementation, and modeling of several pilot plants that together form a chain for brine valorization, shown in fig.2. This consists of a vacuum column for the recovery of carbonates in the form of CO2, a crystallizer for the production of magnesium hydroxide that can be introduced to the market, a crystallizer for the precipitation of a mix of magnesium and calcium hydroxides, a system of static mixers for the dissolution of CO2 and the mix of hydroxides in the permeate of a reverse osmosis plant, producing potable water, and finally an electrodialysis unit with bipolar membranes for the in situ production of the reagents needed for the whole process.

The chain will be built at the Lampedusa industrial site so as to treat brine and permeate currents from a real reverse osmosis plant.

Techno-economic analyses will also be carried out to evaluate a hypothetical industrial scale-up.

Research objectives

the objective of this project is the design, modeling and implementation of a pilot-scale process for the valorization of brines through the production of magnesium hydroxide with characteristics that it can be placed in the target market. in addition, the creation of a circular economy scheme that reduces the environmental impact of disposal of brines at sea by obtaining the minerals necessary for the remineralization of permeate from in situ reverse osmosis plants, so producing potable water.



Fig.1:Price of metallic elements (2018-2019) versus their concentration in a retentate from a reverse osmosis desalination plant from seawater with an average recovery of 40%.



Fig.2: Block Flow Diagram of the desalter brine enhancement chain.