

Worlds first osmotic energy plant for solution mining in operation

Jesper Culmsee, Lars Storm Pedersen and Haofei Guo
SaltPower, Sønderborg, Denmark

Abstract

The world's first osmotic energy plant in commercial scale for production of CO₂ free energy in connection with solution mining of brine is being commissioned from April 2023 and the status will be presented at the conference. For a mature and energy intensive industry like vapor salt producers, this technology will enable energy savings in the solution mining part of the process.

The technology to efficiently produce energy from brine and freshwater in an osmotic process is called Pressure Retarded Osmosis (PRO) and since 2015 SaltPower has developed the technology to commercial readiness [1]. This osmotic process requires a constant stream of brine, preferably saturated, a stream of freshwater, and a semipermeable membrane to separate these two streams. The osmotic pressure of saturated brine is about 400 bar (5,800 psi), and due to this, water will naturally migrate from the freshwater side to the brine side through the semipermeable membrane, to continuously dilute the brine and increase the brine volume. In the PRO process, the brine is pressurized to 70 bar (1,015 psi) so that the increased volume can be utilized to produce electrical power in a turbine or used as hydraulic pumping power. The now diluted brine is reinjected back to the cavern for re-saturation to ensure that a saturated brine stream is still delivered to producers of salt or chemicals.

Since 2017 SaltPower and Nobian in Denmark have worked closely together to ensure that the technology meet the demands of a high quality salt producer. In 2020 a 2000 hours test was conducted on a brine stream at Nobians salt plant in Mariager, Denmark [2]. The test was conducted with commercial size components (pumps, turbines and membranes), making scale-up to industrial size reliable and feasible. Together with external tests, SaltPower has used an internal test facility to further optimize the PRO process operation for different case scenarios. Also, this facility uses industrial scale membranes for reliable test results.

SaltPower and Nobian have in unison decided on the best way to implement the PRO technology on one of Nobians brine production caverns in Hvornum, Denmark. This first industrial scale plant will produce a major part of the power needed for pumping freshwater to the cavern and in the process saving electrical power normally used by utilizing a part of the brine produced. It is the long term ambition to further optimize the PRO technology to make the entire solution mining operation energy neutral. We further expect this technology to contribute to cost savings and net energy output when constructing salt caverns for hydrogen storage.