Comparison of desalination technologies

Markopulos patents vs. EMAINS (own electromagnetic infrastructure)

The MP (whose patent has since expired) was an EU-funded project. The aim of this project was to generate electricity by vaporising seawater with the help of thermal solar collectors and PV cells to produce drinking water: It consists of a It consists of a vacuum evaporation vessel and a condensation vessel inside it, which is under normal pressure and is immersed in the liquid phase of the evaporation vessel. A vacuum pump conveys vapour from the evaporation vessel into the condensation vessel. There, the vapour condenses on the heat exchanger heat exchanger through which seawater flows and transfers the energy to the seawater to be evaporated. The operation of the system at negative pressure (50 mbar) enables the use of low-temperature heat (33 °C), which reduces heat losses to the environment. According to the patent, the energy balance of this system more favourable than previous systems.

The evaporation vessel is heated by a solar collector, which compensates for the system's heat losses.of the system. This takes place via a separate solar circuit with a fluid heat transfer that flows through the solar collector, the heating device inside the evaporator and through the circulation pump. The electrical components of the system, such as pumps, valves and controls, should be powered by a PV module. The entire system is housed in a container and is therefore very easy to transport and set up at the place of use. According to the Markopulos patent an exemplary embodiment of the evaporation vessel with a base area of 1.2 × 2 m enables a drinking water production capacity of 50 m^3/h. (14 L/sec). A negative pressure of 50 mbar should prevail. This enables an evaporation temperature of 33 °C. In the condenser a temperature of 70 °C is reached in the condenser.

Advantages: The system has a compact design, is easy to transport and can therefore be used decentrally. A sustainable and self-sufficient energy supply is guaranteed when using renewable energies (sun, wind) is guaranteed. Waste heat can also be utilised.

Disadvantages: The stated drinking water production of 50 m^3/h appears dubious. This would require 1.25 million m^3 of vapour to be extracted per hour using a vacuum pump. This does not appear to be feasible.The energy required to generate the vacuum is enormous and represents the main energy requirement of of the plant. Vaporising this amount of water would require 30 MW of power, comparable to a small power station.

However, the system is too small for this with too little heat transfer surface. On the other hand steam production of 50 m^3/h seems feasible with such an apparatus. However, the heat transfer surface also appears to be too small for this, as heat transfer only takes place on the outer surfaces of the condenser and at the openings. The generation of a negative pressure of 50 mbar is energy-intensive and should therefore also be called into question.

Laval nozzle - seawater desalination plant

The system consists of an evaporation chamber and a condensation chamber. The evaporation chamber is heated by direct solar radiation and also by collectors. The chamber ispreferably filled with "briar branches" in order to minimise radiation absorption, the evaporation surface and the set points for the precipitation of salts. The resulting vapour is fed through Laval nozzles cooled with primary water. As it passes through the Laval nozzles, the vapour accelerates, expands and cools (adiabatically) at the same time. As a result, it is constantly "raining" in the condensation chamber.

The system (DE 20 2012 009 318.5) was still to be tested in practice. According to our own research, the patent was withdrawn in 2020

The possibilities and prospects of the EMAINS.

Even a seemingly low output of 1 litre/sec. adds up in a 24-hour cycle to a volume that can fill more than a 75 litre standard container for liquids with fresh water. This makes it easy to recognise the potential that exists if only a part of the volume targeted in the above patent is achieved.

I see the theoretical total capacity of a plant with a length of 1000 km at approx. 83 thousand containers, each with a capacity of 75 m^3 capacity each and a length of 12 metres. As I consider a maximum capacity utilisation of 80 % to be reasonable, that means 66,000 units with a capacity of 5 million m^3 in a 24-hour rhythm, which can be moved at a speed of at least 40 km/h. However, as I expect an output of more than 4 litres/second, only 25% of the capacity provided is required in this case. The rest can be used for other purposes. Be it the conversion of H O into H2 or the transport of other goods, to relieve the burden on roads, rail and air freight.

This provides a sufficiently large buffer that allows empty units to be replaced with new ones filled with salt water. In this way, clusters can also be formed in which further processes can be carried out. For this purpose, terminals with sufficient filling stations must be installed at suitable locations with largely clean seawater.

Since we have to think continentally at least, regions with a lot of tidal range and away from industrial areas and settlements are particularly interesting.
And away from industrial areas and settlements, i.e. where at most a simple pre-cleaning process is necessary to obtain sufficiently clean seawater. Locations with a tidal range have the advantage that the tides can be utilised to enable replenishment without the need for expensive pumps. Can flow in quickly enough by its own gravity. In this case, 20 - 30 stations are sufficient, in stations, where a container can be filled every 20 - 30 seconds, in order to then feed a container into the loop every second.

This is particularly suitable for regions which are increasingly struggling with water shortages. In fact, it is something of a climate generator, which, due to its extreme strength, construction and its own dynamics, it will be interesting to simulate different climatic conditions, to test the limits through experiments. This is an intention that I generally follow with everything I touch. In this case, it is to create a hurricane that would far exceed even the targeted performance of the Markopulos patent.

I once asked the "Oracle of Delphi" of modern times, the ChatGPT, for information on this, which gives the following answer, about this:

Yes, it is possible to artificially create a hurricane under laboratory conditions. The University of Miami, for example, has spent 45 million US dollars on an indoor laboratory that is capable of generating hurricanes up to category 5 (the strongest level, with wind speeds of more than 252 km/h). The laboratory is called SUSTAIN (for SUrge STructure Atmosphere INteraction) and consists of a 23-metre-long, 114,000 litre acrylic water tank, a 1,700 hp fan and a 12-paddle wave generator, which together can generate all kinds of waves and weather conditions. Researchers are trying to find out what causes some hurricanes to intensify into catastrophic monsters. The EMAINS already has most of the prerequisites to fulfil these conditions: A water tank of 75 - 100 m³, which corresponds

approximately to the required one. Instead of a fan, which would then be superfluous fan, increasing the speed and compressing the incoming air helps here. Whether the whether the generation of waves is still necessary, I dare to doubt, as this system is not primarily intended for research purposes, but to produce fresh water as efficiently as possible. For this much lower wind speeds are sufficient for this.
The ChatGPT goes on to say.
During a hurricane, salt water from oceans and estuaries mixes with fresh water and is carried inland by the storm surge. The humidity in a tropical system is pure by evaporation. During the evaporation process, salt water would turn into water vapor. which is a gas. So the salt would remain in the ocean.

In this case, therefore, in the steam boiler, where it is transported by a vacuum into the salt chamber below would be sucked off. Minimal adhesions are then, through occasional rinsing, also incorporated into the chamber transported. Thus enables a continuous cycle, triggered by pressure and negative pressure.

This also means that the highest environmental standards are met in terms of salt separation and an almost maintenance-free system is available, e.g. the boiler can be designed either as a forging or as a casting, which can have corrosion resistance in all conceivable conditions through subsequent hardening with suitable carbon.

Links:
https://phys.org/news/2015-05-lab-hurricane-conditions-demand.html
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019JC015573
https://www.sciencealert.com/scientists-have-figured-out-how-to-create-a-category-5-hurricane-inside-a-lab
https://blogs.helmholtz.de/kuestenforschung/2020/02/22/publications-123/
Informationen zu Osmoseanlagen:
https://www.sciencedirect.com/science/article/abs/pii/S0255270116304329
https://www.spiegel.de/wissenschaft/natur/meerwasser-entsalzung-soll-duerre-in-kalifornien-lindern-a1028165.html Links zu den Förderprogrammen, die bis 30.06.23 eingereicht werden müssen.
https://biooekonomie.vditz.de/public/a_29363_vXLXr/file/data/445_20230315_F_rderprogramm_IndustrielleBio_konomie.pdf https://biooekonomie.vdi-tz.de/public/a_29363_vXLXr/file/data/447_20230315_ErfolgreicheProjektskizze.pd