STAND-ALONE SYSTEM FOR THE PURIFICATION OF BRACKISH WATER DIRECTLY POWERED BY PHOTOVOLTAIC SOLAR ENERGY

DESCRIPTION OF THE TECHNOLOGY

The problem of water scarcity is undoubtedly one of the greatest challenges that the world's population faces in the coming years. This problem is particularly severe in regions where the access to water and electricity is expensive or even non-existent. In these areas, it is essential to use water from aquifers, most of them overexploited and contaminated with dissolved salts. Among the known technologies of desalination, Electrodialysis (ED) is a technology that has been proven and widely used in desalination processes of waters coming from various sources (brackish wells, seawater, industrial effluents or others). Moreover, the combination of the ED with other techniques such as disinfection (electrochemical or not) and/or filtration (micro, ultra or others) can be used to produce treated water suitable for various uses (drinking water, irrigation, flushing or others).

On the other hand, photovoltaic solar energy is a widespread renewable energy source with extensive environmental and economic benefits. In general, solar installations are based on photovoltaic solar panels and they store energy in battery racks. The energy can be consumed on demand regardless of the availability of solar irradiation. These facilities are of great interest for use in remote locations as power supply systems in an autonomous and reliable way. Photovoltaic solar panels have already been used in ED desalination processes. However, most of these systems use battery racks for energy storage or use inverters to transform it into alternating current (AC) with the consequent increase in investment and maintenance costs as well as the decrease in the efficiency of the process (DC to AC conversion). Although electricity can be supplied directly, up to now there is no precedent where the entire electrical power supply of the system is carried out using a photovoltaic solar plant or other discontinuous power source without a battery rack.

The Applied Electrochemistry and Electrocatalysis Research Group at the University of Alicante has developed an Stand-alone system for the desalination and disinfection of water by Electrodialysis (ED) and the necessary water pre- and post-conditioning steps, directly powered by a photovoltaic solar plant (or other discontinuous electrical power source) without using battery racks.

In general, the system consists of a unit of desalination by electrodialysis and a water disinfection unit composed by:

i) Water collection system by pumping, conditioning of water (pre-treatment) and storage in a tank.

ii) Water desalination system by electrodialysis comprising pumping equipment and electrodialyzer.

iii) Water disinfection system (post-treatment) comprising pumping equipment.

iv) Photovoltaic solar field that supplies electric power to the system.

v) Power processing system for the power supplied by the photovoltaic solar panels.

vi) Automation and control system.

The characteristics of the stages of pre- and post-conditioning of the water depend on: i) the origin and physicochemical characteristics of these waters (brackish water wells, seawater, sewage or industrial wastewater treatment plants or others). Therefore, these stages may incorporate filtration (micro, ultrafiltration, etc.) and disinfection techniques (electrochemical, reagents addition, UV, etc.).

The system performs the desalting treatment by electrodialysis. Desalination can be carried out for any type of electrodialysis: batch with recirculation or continuous modes of operation, cascade, electrodialysis reversal or others. Also, the size of the electrodializer can be adapted according with the required needs. The system is highly flexible, so that its final configurations depends on the final application of the treated water.

From the point of view of its application, the system allows the desalination of water coming from different sources such as seawater, brackish well water, sewage or industrial wastewater treatment plants or others.

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MARKET APPLICATION SECTORS

The system can be used to obtain water suitable for various uses (human consumption, irrigation, wash-down or others) from the treatment of waters coming from diverse origins: seawater, brackish wells, wastewater treatment plants, industrial processes or others.

Potential customers can include:

- Industrial developers of water treatment systems.
- Consulting and engineering companies in the environmental sector interested in incorporating this new desalination system among its wastewater treatment activities.
- Food and Industrial companies in general wishing to incorporate this brackish water desalination system.
- Irrigation communities, golf courses, housing developments, etc.

TECHNICAL ADVANTAGES AND BUSINESS BENEFITS

- Allows the autonomous desalination, disinfection and purification of water in remote locations isolated from the mains.
- Is sustainable and environmentally friendly. The process is free of CO2 emissions and does not contribute to climate change.
- Substantially reduces the investment cost and the amortization of these systems by eliminating the high cost of batteries, regulators and inverters.
- Reduces maintenance time and costs by avoiding the use of batteries. Also avoids economic and environmental costs associated with the disposal of spent batteries.
- Can be applied to the desalination of water coming from different sources such as seawater, brackish well water, sewage or industrial wastewater treatment plants or others.
- Has a high availability allowing the accumulation of treated water for periods of failure of the renewable energy sources
- Improves the efficiency of use of the electric power generated by not using batteries or change to AC power, thus avoiding the energy losses associated.
- Allows implementation of operating strategies of the various subsystems, adapting them to the amount of energy available at all times and improving the energy efficiency of the system.
- Allows a mixed feed of different renewable energy sources, being possible the combination with conventional electricity grid when the first are insufficient.
- Is very flexible and can adapt its dimensions and characteristics depending on the requirements, application and specific characteristics of the water to be treated.

CURRENT STATE OF DEVELOPMENT

The system is fully developed and has been successfully tested both at laboratory and pre-industrial scale. Currently the research group has a pilot demonstration plant capable of generating 1 m^3/day of drinking water for human consumption.

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INTELLECTUAL PROPERTY RIGHTS

This technology is protected by the patent application with title “Sistema autónomo de tratamiento de aguas” (application number P201530629; application date: 08/05/2015).

COLABORATION SOUGHT

Companies interested in acquiring this technology for use and/or commercial exploitation through:

- Patent and/or know-how license agreements to transfer use, manufacture or commercialization rights.
- Design and construction of industrial equipment, including automation, according to the technical specifications and customer needs.
- R&D project agreement (technical cooperation) for use of technology or application in other sectors.
- Subcontracting agreement (technical assessment, turnkey plant, training, etc.)

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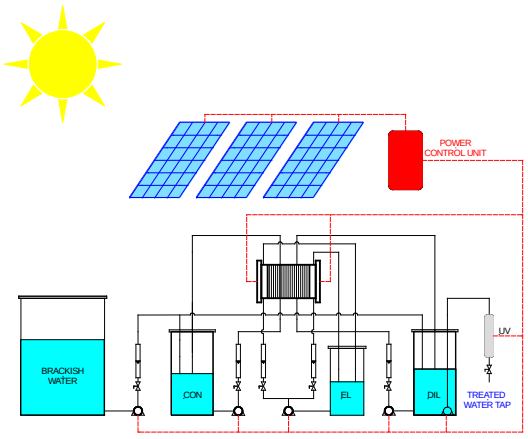

***Figure 1**. General scheme of the system*

***Figure 2**. Demonstration pilot plant*

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