Thomas F Butryn's challenge details for challenge:

Solar Prize Round 6

Generated at Thu Oct 06 2022 12:14:18 GMT-0400 (Eastern Daylight Time)

Explanation

Saltwater Distillation System

Desert Water LLC

Over 1.1 billion people lack access to clean water while 2.7 billion people lack sufficient water for at least one month a year. Water is being cut off from farmers in the US southwest which will raise food prices. Population growth and pollution continue to increase the demand for fresh water.

Desalination by Reverse Osmosis

The most widespread method to make clean water from seawater today is desalination by reverse osmosis which has many disadvantages .

Desalination plants require huge amounts of energy. They produce more high salinity brine than desalinated water. The brine is devoid of dissolved oxygen. It is returned to the sea and if it is released into calm water it can sink to the bottom as a plume of salty water that can kill organisms on the sea bed from a lack of oxygen. Brine discharges have resulted in the depletion of fish populations as well as the death of corals and plankton in the Red Sea where seagrass, marine health and water quality are degenerating . Filters and pretreatment chemicals must be purchased and disposed of on a regular continuous basis. Every day, desalination plants around the world dump 150 million m3 of high salinity brine back into the ocean and the energy they use creates 275,000 tons of CO2.

The Desert Water LLC Saltwater Distillation System

The system proposed here, the Saltwater Distillation System (SDS), eliminates these problems. In this SDS project, equipment and a process will be developed to distill seawater into fresh water and sea salt. Any heat source can be used including solar energy or waste heat from a power plant. Outside of the heat source, very little power is required in the process, there is no waste to dispose of and the operation is environmentally friendly once it is built.

The key to this system is that the salt will precipitate and it can be physically removed from the boiling bath. While distilling the seawater, the SDS incorporates mechanical equipment to recover the crystallized or precipitated sea salt. Hand harvesting of sea salt can be seen here Why Icelandic Sea Salt Is So Expensive | So Expensive - YouTube

An SDS facility consists of a heat source with heat transfer equipment, a heating fluid to transfer heat from the source to the SDS vessel, condensers and equipment for water and salt treatment and storage.

Heat Source

If solar power such as heliostats are used to heat the vessel, little external energy is required in the process, there is no reverse osmosis chemical and filter waste to dispose of and the operation is environmentally friendly once it is built. Besides solar, other potential sources to heat the vessel are the hot steam that exits from turbines in steam power plants before it goes to the cooling tower, hot exhaust gases in natural gas turbine power plants, waste gas currently being flared off at refineries and wells, or any other source such as fossil or nuclear, etc. The prototype test vessel will be heated with natural gas.

If located by a power plant near the ocean, the SDS can utilize the hot steam or gas that exits from the turbines to distill sea water into distilled water and sea salt without producing any significant additional CO2. If located near a power plant and a desalination plant such as Carlsbad, California, the SDS can be used to distill some of the 50 million gallons/day of high salinity brine that comes from the desalination process. Here the SDS can stop some of the discharge of high salinity brine back into the ocean while producing usable distilled water and sea salt.

The SDS Vessel

The SDS vessel has an internal wheel with baskets mounted on it that rotate and sweep the rounded bottom of the vessel to pick up the precipitated salt. The baskets are made of screens so they are permeable . They will hold the salt but not the sea water. As each basket rotates from the bottom of the vessel up to the top, it pivots about its mounting point so that at the

top, the open portion of the basket is facing downward allowing the salt to drop out without having to slide out. An extra up and down motion is incorporated near the top to facilitate the salt dropping out of the basket. If need be, manifolds can be mounted above the basket at the top of the circle to blow air into the back of the basket to facilitate the salt dropping out of the basket.

The salt falls onto a conveyor in the vessel. The conveyor is permeable, retaining the salt but allowing the water to drop through it and back down into the boiling bath. The conveyor will deliver the salt to the front of the vessel to the vertical exit chute. The exit chute has two valves which allow the salt to be delivered in batches while maintaining the seal of the vessel. The vessel is sealed and has an entry port for salt water or brine, a mist eliminator to purify the steam, an exit port for steam and the exit chute. A heat jacket surrounds the bath area. A drive is mounted on the back of vessel to rotate the wheel.

The Process

The heat source heats up the heating fluid which is pumped to the sealed vessel. Salt water or brine is pumped into the vessel where the temperature is raised to create steam and precipitate the salt out of the boiling bath. The steam passes thru a mist eliminator in the vessel and then it exits the vessel and is condensed into fresh water. The precipitated salt is physically lifted out of the seawater bath and then removed from the vessel. Sea salt obtained from sea water is suitable for human consumption and is a valuable product which will cover the operating costs and possibly more.

There are unknowns and questions to be answered to develop the prototype test vessel: Should there be pressure or vacuum within the vessel and how is it maintained? What should be the wheel rpm and the horsepower? What type of mist eliminator is required to ensure that only pure steam vapor exits the vessel? Should the steam be used to pre heat the saltwater or brine? How to control the operation?

For the process work, an analysis of mass and heat flow for various system sizes will be used to determine exactly how the process will be done, what auxiliary equipment will be used, what size will it be, how much power does it require, what instrumentation is required and how will the process be controlled and recorded. In the limited prototype test, a full description of the prototype test procedure is required, including safety features. Heat requirements, instrumentation, methods of handling the water, for example batch or continuous, expected results and measurement and analysis of actual results are required.

Initially, a prototype will be built and tested either at the wet lab at Brite Energy Innovators, Ohio's energy tech incubator in Warren, Ohio or a university lab.

Engineering

Based on research, studies and lab work done at Youngstown State University, a new design for the prototype has been established. Engineering is required as follows:

1. Prototype vessel specifications and engineering.
2. Procedures and engineering for the prototype lab test.
3. Procurement of prototype vessel and test equipment.
4. Performance of the prototype lab test at Brite Energy Innovators, Warren, Ohio, or a university lab, analysis of results and detailed engineering report with performance results and recommendations for improvements. This is the essential "Proof of Function."
5. Engineering of full-scale field operating vessel to operate with solar power (or heat from a power plant).
6. Procurement of full-scale field operating vessel.
7. Coordination with engineers at Sandia National Laboratories for engineering, installation and startup of first field test of the complete Solar Distillation System. We have signed an NDA with Sandia National Laboratories in Albuquerque, New Mexico and they have agreed to use their heliostats to test our system.

Below is a preliminary incomplete drawing of a full-scale field vessel. The vessel has a heat jacket and there are three rows of baskets. The prototype test vessel will not have a heat jacket and will have only one row of baskets.

.

The Climate Crisis

The water produced by the SDS is intended for use by humans and animals and for trees and plants including crops and grass. It can also be used to combat climate change by producing "green hydrogen" by electrolysis.

There are millions of square miles of desert on earth and thousands of miles of desert ocean shore lines. With low-cost photovoltaic (PV) electricity, available desert real estate for heliostats and PV cells, and a supply of distilled water, an ideal

secondary application is to build a hydrogen generating plant. It is conceivable to build an SDS to provide water to generate hydrogen which is a serious effort to combat the climate crisis.

The "green hydrogen" can be produced at a low operating cost with no pollution. Hydrogen is renewable and it can be stored and transported. It can do what fossil fuels and nuclear energy can do only cleaner. It is environmentally friendly and is the best solution to the climate change problem.

Large batteries for solar and wind power are expensive, they hold the charge for a limited time and they are not transportable. Using nuclear power to produce electricity or hydrogen causes a serious long term storage problem. Over 90,000 metric tons of highly radioactive waste sits in storage near nuclear power plants in the US at a cost of over a half billion dollars per year. Storage times range from ten thousand and up. There is a serious potential hazard from container deterioration over time and accidental discharge which we are currently witnessing in the Ukraine.

The emphasis today is on more electric vehicles. The electric grid is already overloaded and it takes years for permitting, financing and construction of new power plants, let alone grid updates. Hydrogen vehicles using “green hydrogen” can solve these problems.

Hydrogen is storable, transportable and totally environmentally friendly when made this way. The SDS and the "green hydrogen" economy are the best solution to the climate crisis problem. This is existing technology and is not part of this research effort.

Thomas F. Butryn, BE in ME, PE, MBA, USMC
Desert Water LLC
222 N Bayshore Dr
Columbiana, OH 44408-9347
330 507 6503

Key Needs

- Business Development & Commercialization (5 / 5): *No explanation*
- Hardware Development (5 / 5): *No explanation*
- Product Development (5 / 5): *No explanation*
- Product Design (5 / 5): *No explanation*
- Manufacturing (5 / 5): *No explanation*
- Fabrication & Prototyping (5 / 5): *No explanation*
- Technical Analysis (5 / 5): *No explanation*
- Procurement of Raw Materials (5 / 5): *No explanation*
- Science, Research and Development (5 / 5): *No explanation*
- Funding & Investments (5 / 5): *No explanation*
- Marketing & Promotion (5 / 5): *No explanation*
- Testing and Validation (5 / 5): *No explanation*

Matches

1. GoSun: 88.40%
2. Larta Institute: 87.36%
3. Solar Inventions: 87.15%
4. Circuit Launch: 87.06%
5. Positive Deviancy: 86.80%
6. EST Venturi Systems LLC: 85.80%
7. New Mexico Clean Energy Resilience and Growth: 85.28%
8. Zpryme: 85.10%

9. Georgia Institute of Technology: 84.69%
10. BlochSoft Technologies Inc: 84.58%