TECHNOLOGY

# Reverse Osmosis Purifies

## A simple chemical membrane and a pump in proper alignment can yield 1,400 gallons of fresh water a day using the principle of reverse osmosis—By Barbara Tufty

➤ THE ASTRONAUT winging through space, the soldier sloughing through brackish water in Viet Nam, the shipwrecked survivor on the lonely ocean—all these men could easily pump a canteen of fresh drinking water from impure water in half an hour by hand.

This would be accomplished by using a newly developed process for reclaiming waste, ocean or brackish water by means of a simple chemical membrane and a pump, said Glen Newby, manager of the reverse osmosis section of the General Atomic division of General Dynamics, San Diego, Calif.

A portable desalting unit producing 1,400 gallons of fresh water a day utilizing the simple, reverse-osmosis process was exhibited at the First International Symposium on Water Desalination sponsored by the Department of the Interior in cooperation with the Department of State.

Key to the new reverse-osmosis process is a semipermeable membrane, only five-thousandths of an inch thick, made of cellulose acetate. This membrane, resembling the plastic materials housewives use for wrapping food, filters out salts and other dissolved solids.

Several hundred square feet of the membrane can be rolled up in one cubic foot of a pressure tube, said Mr. Newby. From 3,000 to 6,000 gallons of fresh water a day can be produced for every cubic foot of membrane.

The process involves reversing a basic mechanism of nature called osmosis, whereby water flows from a less concentrated solution through a semipermeable membrane into a more concentrated solution. This process is constantly taking place in cells in all forms of life.

By applying pressure on one side of the membrane, scientists can reverse this flow—hence the name, reverse osmosis. Salts and other chemicals and waste materials are stopped by the membrane barrier while the pure water passes through to the other side.

Scientists have created various synthetic membranes in the laboratories, but only recently have they been able to develop material and equipment to make this reverse-osmosis process practical on a large scale.

General Dynamics engineers estimate that a plant could be built to produce nearly 6,000 gallons of fresh water per day from each cubic foot of membrane at a cost of 25¢ to 30¢ per 1,000 gallons.

One experimental plant operated by General Dynamics and the Los Angeles County Sanitation Districts engineers has been producing fresh water for more than 2,500 hours in Pomona. Another experimental unit is being operated at the Point Loma disposal facility near San Diego. Work is also being carried on at General Dynamics' laboratories under contract with the Office of Saline Water of the U.S. Department of the Interior.

The reverse-osmosis process is relatively simple to set up, operate and maintain, compared to the conventional methods of desalination, Mr. Newby said. The membrane, pressure tube and pump are the essential materials, he pointed out; and the technique operates at ordinary room temperature and requires only relatively small amounts of energy which can be supplied by hand-power, electricity, gas, diesel or steam.

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## Desalination Advances

➤ THE UNITED STATES will share technical and scientific secrets of converting polluted water to fresh with the rest of the world.

At this time of water crisis, when fresh water is urgently needed throughout the world to grow food and help three billion people survive, President Johnson is calling on U.S. water engineers to embark on accelerated desalting programs and to share their brains and experience with other nations.

More than 1,500 delegates from 64 nations, including Russia, Britain, Spain and Israel, attended the six-day First International Symposium on Water Desalination in Washington, D.C., sponsored by the Department of the Interior in cooperation with the Department of State.

Man will conquer poverty, famine and disease only as he masters the problem of water supply, said Stewart L. Udall, Secretary of the Department of the Interior.

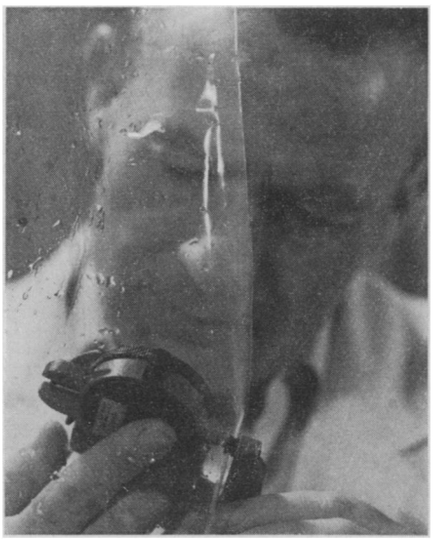
Conversion of sea water into fresh water on a scale large enough to yield an important supply is a technical reality.

Up-to-date desalination plants are now producing fresh water for about $1 per 1,000 gallons. Reducing this cost to about 30¢ per 1,000 gallons is a goal of many water engineers.

Preliminary reports from a study of a West Coast plant to produce 150 million gallons of fresh water a day indicate that a well designed plant using nuclear energy can produce fresh water for 22¢ per 1,000 gallons.

There are essentially three processes for desalting water, using distillation, membranes or crystallization.

In the distillation process, pure water is evaporated from brine containing contaminating salts or minerals. In the multistage flash evaporation system sea water is heated to about 200 degrees F., then "flashed" into vapor, leaving salt and other impurities behind. The vapor is condensed against cool tubes where it is collected as fresh water. This method is used in large systems such as those in Kuwait, on the islands of Curacao and Aruba in the Netherlands Antilles, and at the U.S. Naval Base in Guantanamo, Cuba.



General Dynamics

*REVERSING OSMOSIS—A sheet of semipermeable memberane made of cellulose acetate five thousandths of an inch thick is inspected at General Dynamics' General Atomic division in San Diego, Calif., in research on the simple desalination process known as reverse osmosis for purifying waste, brackish or sea water.*

The heat energy of the sun is sometimes used to vaporize sea water lying in large shallow basins under a glass or plastic covering. Although such a solar still is not used in any major desalination project, smaller plants are being built where sunshine and space are plentiful and conventional fuel costs are high.

The second major process operates with a membrane and is based on the principle that certain membranes permit some materials but not others to pass through them. The two most important membrane processes are called electrodialysis and reverse osmosis.

The electrodialysis process uses electricity and pairs of membranes, one of which will pass only negatively charged ions, such as chloride ions, and the other of which will pass only positively charged cations, such as sodium. When the current is turned on, the negative chloride ions travel through one membrane and the positive sodium cations travel through another, leaving fresh water behind.

The third main process is crystallization. Water is frozen into ice crystals that are removed from the brine and then melted. Gas hydration is a chemical reaction separating fresh water from a salt solution by the use of hydrate-forming materials, mainly propane, which combine with the water in complex crystals that reject salts.

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