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Desalination of Water

There is world-wide interest in means for obtaining more fresh water. President Johnson recently indicated his views, in part, by quoting a statement made by President Kennedy: "There is no scientific breakthrough, including the trip to the moon, that will mean more to the country which first is able to bring fresh water from salt water at a competitive rate. . . ."

Much of the U.S. effort aimed at desalination of water has been conducted under the Office of Saline Water of the Department of the Interior. The OSW has sponsored some imaginative work—for example, development of a reverse osmosis process. Given a membrane permeable only by water, it is possible to obtain fresh water from sea water by exerting a differential pressure of about 24 atmospheres on salt water. In turn, it is theoretically possible to obtain a cubic meter of fresh water from sea water by the expenditure of about 0.7 kilowatt-hours of energy, the minimum amount for a reversible process. The present cellulose acetate membranes, however, are not perfect. A pressure of 100 atmospheres is required to produce water at the rate of 370 liters per square meter of membrane surface per day. The effluent, while potable, is not entirely free from salt. The membranes have only a few weeks of service life.

Another process involves formation of clathrate compounds. If propane, under pressure of 3 atmospheres, is bubbled into sea water at about 6.5°C above the freezing point, a light solid composed of 17 molecules of water to one molecule of propane is formed. Salt is excluded. The solid can be removed and the water readily obtained. In a practical process, energy consumption might amount to between 3.5 and 12 kw-hr per cubic meter of water.

Another method, which may be used practically, is freezing. It is attractive because the latent heat is small, and low-temperature processes are relatively free from corrosion problems. Energy cost for a practical freezing scheme has been estimated at 12 kw-hr/m^3.

Without heat exchange, the energy requirement for distilled water is about 700 kw-hr/m^3. With heat exchange this figure has been reduced to 70 kw-hr/m^3 in "demonstration plants," and it could be reduced to somewhat lower values through greater investment for equipment. The price of obtaining fresh water from sea water is heavily dependent on the cost of energy. Recently it has been pointed out that very large nuclear reactors could be particularly efficient. In situations where a dual-purpose electricity and water plant are feasible, costs for distilled water have been estimated at about 6 cents per cubic meter. (Costs of raw fresh water in coastal regions of the United States range from about 0.1 to about 6.0 cents per cubic meter.) In high-cost areas such as southern California, some of the needs probably could be met by desalination through distillation. In the eastern half of the nation, where total supplies are adequate and cheap, better utilization of natural supplies is the practical solution.

It is to be hoped that a balanced approach will be made to the water problem. Adequate emphasis should be given to research and to development, particularly of promising new processes. At the same time it should be remembered that most of this nation's water problems will be solved by wise use of what is naturally available.

—PHILIP H. ABELSON