

new use for reverse osmosis

Reverse osmosis, a process for separating any substance in liquid or gaseous solution, may help reduce the costs of producing maple syrup. In the not-too-distant future, it may also play an important role in water pollution control, water renovation, water purification and waste reclamation

A major economic factor in conventional methods for the production of maple syrup is the cost of fuel. In order to obtain one gallon of syrup, water must be removed by heating processes from 30 gallons of sap.

Chemical engineers at the National Research Council of Canada have undertaken a research project to determine whether these high fuel costs can be reduced substantially with a process known as reverse osmosis. If this method proves to be practical, it will represent a major saving for tree farm operators in Eastern Canada whose production last year amounted to 2,706,000 gallons of maple syrup valued at about \$11,500,000.

W. S. Peterson of the Chemical Engineering Section of NRC's Division of Applied Chemistry, is currently experimenting with maple sap using a reverse osmosis cell. With this arrangement, heating costs per gallon have been reduced from approximately 50 cents to five cents.

Reverse osmosis is a technique originally developed to purify sea water. In principle, it can be used to separate any substance in liquid or gaseous solution. Essentially, it involves the use of a porous membrane whose chemical nature can be made such that it has a

preferential attraction for the solvent and a similar repulsion for the solute in a solution.

In Mr. Peterson's experiments, sap under 1,500 pounds pressure was forced past the surface of the membrane held inside a stainless steel pressure chamber. Water is forced preferentially by pressure through holes measuring in the neighborhood of a few hundred millionths of a centimeter in diameter. The chamber has two separate outlets, one for the water and the other for the concentrated sap or syrup.

By this method, 75 to 90 per cent of the water is removed from the tree sap. The remainder must still be boiled away since maple sugar producers have found that the maple syrup flavor is imparted through the boiling process.

Although the heating costs can be reduced 10-fold using present reverse osmosis technology, the process is still not economical for use by small-scale syrup producers, according to Mr. Peterson.

While the membrane itself can be purchased for as little as 20 cents per square foot, the cost of the membrane in a spiral module form — the form most favored in the maple sap industry — runs about \$5 a square foot. A major processor has estimated that this

cost of fabrication would have to drop to about \$1 a square foot in order to make reverse osmosis economical to use with maple sap.

In his experiment, Mr. Peterson uses the Loeb-Sourirajan type of porous cellulose acetate membrane. This type developed from the pioneering work of Dr. Srinivasa Sourirajan of the Chemical Engineering Section.

EARLY WORK IN U.S.

Dr. Sourirajan first started work on the reverse osmosis process in 1956 at the University of California. He has continued to expand the scope of the process since joining NRC in 1961.

In his initial experiments involving removal of salt from sea water at the University of California, Dr. Sourirajan obtained only a few drops of water a day from a square foot of membrane. In 1958, he was joined by Dr. Sidney Loeb and within two years had developed the process to the point where it was capable of desalting sea water at a rate of five to ten gallons per day per square foot of membrane.

After joining NRC, Dr. Sourirajan made further improvements to the technique and increased the potable water yield from sea water to 25 gallons daily. A similar advance has also been achieved in the United States.

