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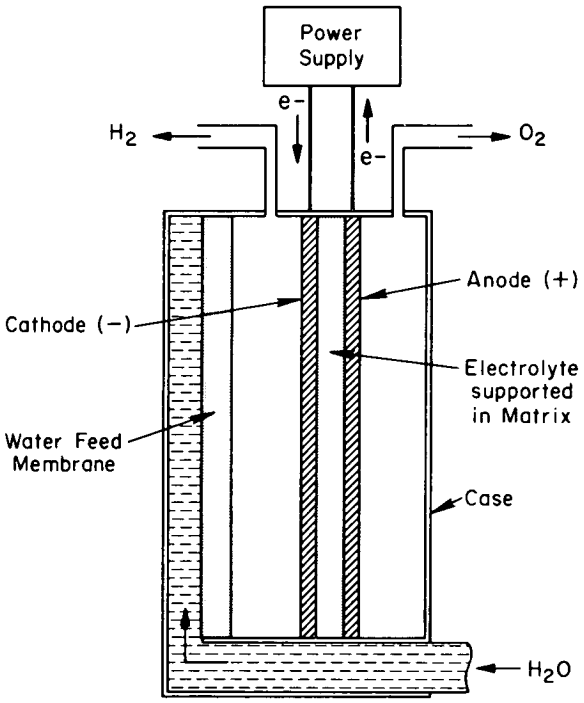
NASA TECH BRIEF

Ames Research Center

Water Electrolysis Module



The problem:

To supply the oxygen requirements of crews by an on-site generator which can operate in aircraft, spacecraft, or submarine cabins.

The solution:

A module which utilizes a static water-feed electrolysis system and has air-cooled fins to remove the heat generated by cell inefficiencies; the module generates 0.15 pounds of oxygen and 0.0188 pounds of hydrogen at a current density of 100 amps/ft².

How it's done:

The electrolysis module consists of 10 electrochemical cells; a single cell of the static-feed water electrolysis module is shown in the figure. Each cell is divided into 3 compartments, viz., water, hydrogen, and oxygen. The oxygen and hydrogen compartments are separated by a porous matrix sandwiched between two catalytically active electrodes; the electrolyte-impregnated matrix is held between these electrodes. A water-feed membrane separates the feed-water cavity from the gaseous hydrogen compartment. During electrolysis, i.e., when electrical power is applied to the electrodes, water vapor diffuses from the feed membrane to the porous cell matrix.

The feed-water manifolds, ports, and compartments, are electrically insulated from current-carrying components, and the method of construction eliminates intercell electrolysis, a direct cause of gas generation inside feed-water passages.

The primary structural material selected for the electrolysis cells is polysulfone plastic, but polypropylene spacers and support screen are used in the water cavities. All metallic parts (except electrodes) exposed to electrolyte are manufactured entirely of nickel or from other metals that are subsequently plated with nickel. The latter method of manufacture was used to obtain thin parts with corrosion resistance and high thermal conductivity.

The water-feed cavity is filled initially with potassium hydroxide electrolyte at the same concentration at that in the cell matrix. As water in the cell matrix is consumed by electrolysis, the vapor pressure of the water in the electrolyte decreases as the KOH concentration increases. The vapor pressure of the water

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in the water-feed cavity is not affected by electrolysis and, therefore, is higher than that of the cell electrolyte. As a result, water vapor diffuses through the feed membrane during electrolysis, through the hydrogen cavity and the pores in the hydrogen electrode, and into the cell electrolyte. The transport of water continues as long as the vapor pressure of the cell electrolyte is lower than that of the water-feed electrolyte. Makeup water is forced into the water-feed cavity from a feed reservoir that is divided into two parts by a flexible diaphragm; the pressure on the gaseous side of the diaphragm is adjusted to maintain the water-feed cavity at a pressure of 1–1.5 psi below the pressure in the hydrogen cavity so as to prevent flooding of the hydrogen cavity.

Notes:

1. The following documentation is available from:
   National Technical Information Service
   Operations Division
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)
   Reference:
   NASA CR-73394, Aircrew Oxygen System Development: Water Electrolysis Subsystem Report.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B71-10203

Patent status:

No patent action is contemplated by NASA.

Source: Franz H. Schubert
TRW, Inc.
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