OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY
FACT SHEET

Large-Scale Potable Water Production

Inorganic Membrane Purification

Military Issues and Technology Impact

Military troops in underdeveloped countries or in areas where the water supply is threatened by hostile forces may be hampered by difficulties obtaining potable water. The use of inorganic membranes to purify available water could be critical in supporting combat efforts efficiently in such terrain. Inorganic membranes have the potential to protect soldiers against the effects of contamination from bacteria, viruses, and chemicals present in local water sources. Advantages of using this technology to purify water include

- rugged and self-cleaning construction;
- significantly longer service life than organic filters;
- capability to filter as small as 0.01 microns;
- low manufacturing cost;
- lightweight and easily transportable;
- availability in small, canteen size as well as 5000-gal/h size;
- fast field setup (trailer-mounted);
- easy operation (1-2 persons);
- reduced reliance on chemicals;
- speedy purification; and
- desalination capabilities.

Technical Concept

Filtration occurs by preventing passage of particles as small as one-tenth the size of the pores through the filter. Three separate stages of filtration should be considered, each trapping increasingly smaller particles:

1. bacteria filter — 5000 gal/h;
2. virus filter — 500 gal/h;
3. reverse osmosis membrane — 50 gal/h.

Contaminants removable by inorganic membrane purification

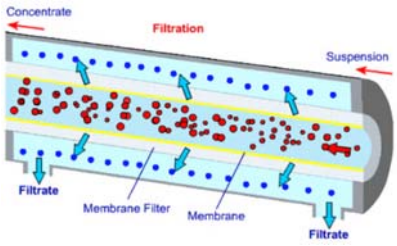
Biological	Inorganic
Anthrax	Arsenic
Cryptosporidium	Copper
E. coli bacteria	Cyanide
Giardia	Iron
Oocysts	Manganese
Protozoa	Nitrate/nitrite
Viruses	Particles
Salmonella	Sediments

Capturing particles near the surface makes the tubes easier to clean. In the final stage (reverse osmosis), membranes operate on a vapor-gap principle, preventing the passage of any particles or nonvolatile chemicals.

The membrane filters are fabricated using porous stainless steel or other rugged metal (see figures). These filters can be inside the water vessel and extend the length of the vessel (tank or canteen) with closure fittings on each end. The vessel is then filled through the fittings. Alternatively, the filter can be a separate module. A canteen can be filled in about 3.5 minutes and a 500-gal tank in about 30 minutes using a 2- to 3-foot water head. Faster filling occurs with higher water heads (i.e., greater pressure).

Filtration tubes are closely bundled to increase the membrane area, allowing greater throughputs.

Filtration is performed by the membrane that lines the inside surfaces of all tubes.



Development Approach

Additional research and development are needed to design and test membranes to meet military performance criteria and that can be manufactured in quantity. All research is performed at ORNL's Inorganic Membrane Technology Laboratory (IMTL), which has unique equipment items for development and testing of these membranes. The IMTL staff has considerable experience in developing specific purpose inorganic filters/membranes. Although a great deal of experience is resident at IMTL in all three types of filters/membranes of interest, water treatment applications have not been emphasized to date due to a lack of stated requirements. However, the fabrication process is proven and a theoretical basis for the properties and operation of these porous membranes has been established. Sixteen products have been approved for commercialization and Pall Corporation has a license to manufacture and sell those products. Further, components and principles that apply to water purification have been demonstrated.

Oak Ridge Facilities

Oak Ridge researchers at IMTL are taking advantage of 40 years' experience developing filters for the uranium enrichment process. For the past 15 years, they have focused on developing innovative inorganic membranes for commercial use. This world-class membrane fabrication and evaluation laboratory has about 40,000 ft^2 of space and is equipped to support performance modeling, rapid prototyping, and a wide range of testing.

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