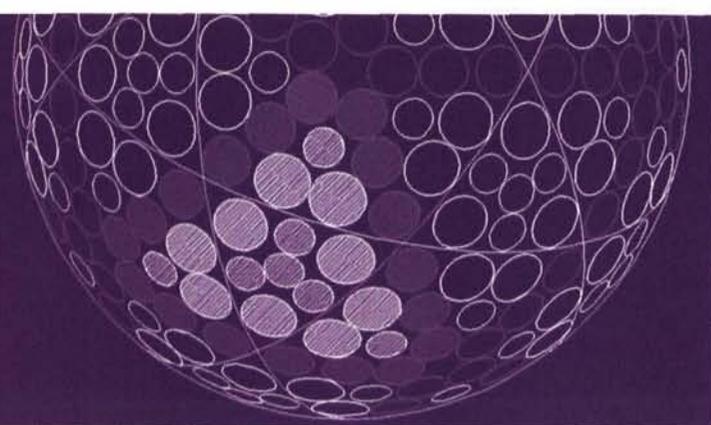


A Space Shuttle-derived system for purifying water highlights a selection of spinoff for consumer, home and recreational use



The World Health Organization estimates that more than one billion of Earth's people do not have daily access to clean, safe drinking water and millions of deaths each year are directly related to contaminated water. That under-

lines a long-standing humanitarian need for an effective yet inexpensive system of water purification that can be scaled up to municipal water treatment capacity for developing nations and can additionally serve as a backup emergency system in developed nations.

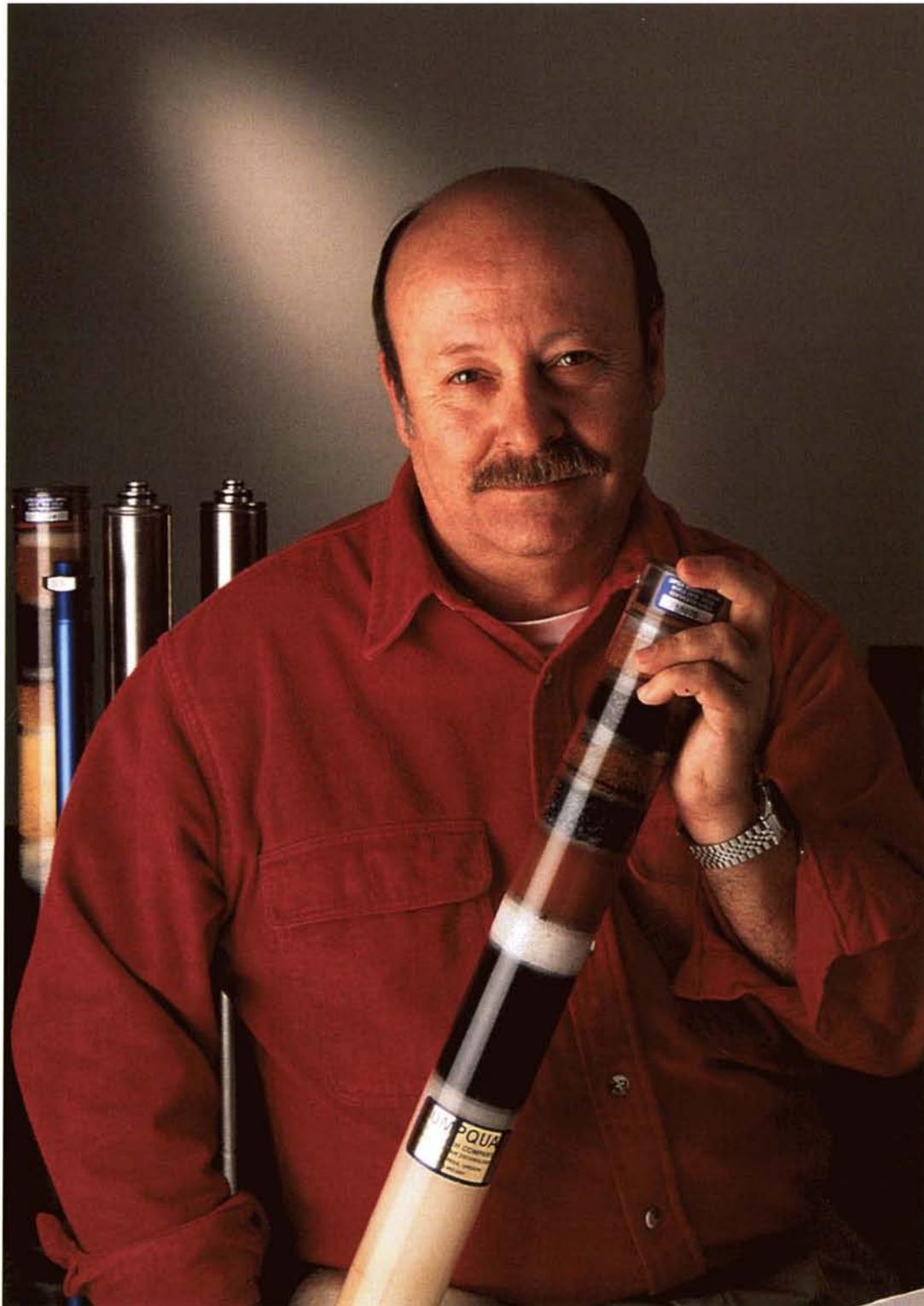
Such a system, a spinoff from Space Shuttle technology, is now commercially available and is, in fact, being installed in growing numbers in developing nations. Called the Regenerable Biocide Delivery Unit, it is a prime example of a dual-use technology, one developed for space application but also adaptable to a pressing Earth-use requirement. Its worldwide importance led to its selection as the 1993 NASA Government Invention of the Year and NASA Commercial Invention of the Year. The recipients of the awards were Richard L. Sauer, Water Quality Manager at Johnson Space Center; Gerald V. Columbo, vice president of Umpqua Research Company, Myrtle Creek, Oregon; and Clifford D. Jolly, also of Umpqua.

The Regenerable Biocide Delivery Unit uses iodine, rather than chlorine, to kill bacteria. Though new to the commercial market, the system represents an advanced phase of a technology that has been around for a considerable time. The effectiveness of iodine as a biocide has long been known, but its commercial application has lagged for want of an efficient long-term delivery system. The new invention solves that problem and thus opens up possibilities for a new line of iodination systems for portable, emergency, industrial and community use.

In operation, the unit disinfects water by passing it through a bed of iodinated resin known as MCV[®] resin; it gets its name from the cartridge that contains the iodine resin, the Microbial Check Valve. The MCV cartridge is not new; it was developed by Umpqua Research in the mid-1970s to purify the Space Shuttle Orbiter's supply of drinking water, and it has been used on every Shuttle flight since.

What is new is the ability to regenerate the iodinated resin bed. The original MCV cartridge was a limited life device that had to be replaced periodically with a new cartridge. The Regenerable Biocide Delivery Unit eliminates the frequent replacement requirement; it regenerates cartridges in place without removing them from the unit. Tests have shown that the cartridge can be regenerated more than 100 times.

It is this regenerable capability that makes the invention a significant advancement in water purification. Use of a regenerable resin bed answers the need for a practicable iodine delivery system. Use of iodine provides a most effective disinfectant and eliminates the hazards associated with chlorine. Regenerability also enables a sharp reduction in cost — ultimately perhaps less than one cent a gallon, compared with \$1 - 2 per gallon for bottled water. That,



Gerald V. Columbo of Umpqua Research Company displays a Shuttle-derived Umpqua filter. The basic filter is filled with iodine resin, dispensed in a water supply for killing bacteria. The filter employs other purifying materials; the colored banding identifies the different materials used to remove different contaminants.

coupled with the Shuttle-derived characteristics of high reliability and low maintenance, and the inherently long shelf life of the system, make it attractive as an emergency backup system for use in developed nations during power outages, floods and other natural disasters, and as a water treatment system for whole communities in developing nations. The first large-scale application of the technology is already under way in Vietnam.

(Continued)

*MCV is a registered trademark of Umpqua Research Company.

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CLEAN WATER**

Continued

The development of the Regenerable Biocide Delivery Unit evolved over a number of years, beginning in the mid-1970s when NASA was looking for an advanced method of purifying drinking water for the Space Shuttle Orbiter. A NASA contract to Umpqua Research, a small business specializing in air and water support equipment, resulted in development of the MCV (Microbial Check Valve) iodine-dispensing system. Introduced to Shuttle service in 1979 and still in use, the system proved reliable and effective for the relatively short-duration missions flown by the Shuttle Orbiter.

In 1989, looking to the International Space Station and future long-duration spacecraft, NASA awarded Umpqua a new contract for development of a system that would overcome the limitations of the original MCV system and allow continuous, controlled release of iodine over

a lengthy period. That contract produced the Regenerable Biocide Delivery Unit, demonstrated in 1993 and being considered as the baseline water purification system for the International Space Station.

Umpqua Research was granted an exclusive worldwide license for commercial marketing of the technology. Umpqua, oriented to R&D and analysis work rather than manufacturing, is offering sublicensing opportunities to manufacturers of water filtration equipment. The principal sublicensee — the Vector Group of Companies — has embarked on a large-scale program to make clean water more widely available in developing nations.

A number of sublicensees are using the NASA/Umpqua iodinated resin technology for a variety of home-use and commercial products. In the photo is a sampling of home-use systems, a countertop model (left), an under-the-counter unit (center), and a faucet attachment unit (right). In the foreground is the original Shuttle Orbiter cylinder.



Represented in the U.S. by Vector Environmental Technologies, Sparks, Nevada, Vector is an international organization that focuses on technology for correction of such global problems as water contamination, marine oil spills, debris removal from waterways, and hazardous material storage.

Vector's manufacturing arm produces the DIAMOND RAIN Water Purification System, a modular system sized for any requirement from a single household

to small community. The DIAMOND RAIN unit first passes raw water through a filtration stage to capture suspended particles, then through a granular activated carbon filter to absorb organic molecules — such as herbicides and petroleum contaminants — and to help remove unpleasant odors and taste.

The heart of the DIAMOND RAIN system is the Microbial Destruction Unit, an adaptation of the NASA/Umpqua technology that destroys pathogenic microbial organisms. In the final stage, the water passes through a series of post-filters, then is routed to a storage tank.

In July 1993, Vector signed an agreement with the Government of Vietnam for a water purification project of enormous scope: installation of 10,000 DIAMOND RAIN units over a five to six year period. The program focuses initially on making systems available to rural communities, hospitals, clinics, schools, hotels and households. The first units were shipped in 1994. Eventually, facilities for manufacturing DIAMOND RAIN systems will be established in Vietnam under an agreement among Vector, the Vietnamese government, and a state-owned company that oversees the country's water infrastructure.

Vector is also engaged in a joint venture with a Saudi Arabian firm for marketing DIAMOND RAIN systems in Saudi Arabia, Kuwait, Oman, Bahrain, Qatar and the United Arab Emirates. Additionally, Vector is introducing the water purification technology in the Philippines, Sri Lanka, Mexico, Egypt and Angola. Ongoing discussions with a number of countries suggest that DIAMOND RAIN systems will find extremely broad applications in Asia, Africa and Latin America.



This eight-foot-long model is a representative DIAMOND RAIN water purification system, produced under Umpqua license by Vector Manufacturing Corporation in sizes ranging up to a unit that can cleanse drinking water for 35,000 people.

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