A clearer look for glass optical fibers

Glass fibers that carry telephone transmissions in the form of light pulses already link cities like New York and Washington, D.C. (SN: 2/19/83, p. 119). Now, cables made from a new class of glasses, called halide glasses, promise to carry signals up to 10 times farther than the best glass fibers in use.

Halide glasses, accidentally discovered about nine years ago, form from combinations of halogens such as fluorine, with metals such as zirconiun and hafnium. Their potential transparency, ability to transmit infrared light and other unique properties have attracted much recent research interest, particularly in France, Japan and the United States, where the Department of Defense is providing most of the funding. Last week, about 125 researchers met at the Second International Symposium on Halide Glasses, held at the Rensselaer Polytechnic Institute (RPI) in Troy, N.Y., to discuss progress in studying the characteristics of these glasses and finding potential applications.

RPI's Cornelius T. Moynihan, meeting chairman, says that the application most people have in mind for halide glasses is in fiber optics. "These glasses have the theoretical potential to carry light at least 10 times farther (before you need an amplifier or repeater) than is currently possible with the best silica fibers," he says. Silica optical fibers, made from silicon dioxide-based glass, must have repeaters every 10 to 50 kilometers (SN: 5/21/83, p. 330).

Equally exciting, says Martin G. Drexhage of the Rome Air Development Center at Hanscom Air Force Base in Massachusetts, is that, unlike silica glasses, halide glasses transmit infrared light. "Until the advent of these [halide glasses], there really was no good infrared-transmitting fiber material," he says. In addition, halide glasses, in bulk form, potentially can be used as infrared optical components such as lenses and prisms.

Halide glasses are also "somewhat more resistant to nuclear radiation effects than conventional glasses," says Drexhage. Radiation tends to darken glasses, but this visible darkening has little effect on a fiber's ability to transmit infrared light. Thus, optical communications systems based on halide glasses would be more likely to survive a nuclear attack.

So far, the best halide fibers (with the lowest light losses during transmission) have been made in Japan by Nippon Telegraph and Telephone. However, these fibers still do not match the capabilities of silica fibers now in use. Moynihan says that the biggest difficulty in producing low-loss fibers is reducing impurities in the glasses to a sufficiently low level. These impurities tend to absorb light at the wavelengths at which most transmissions occur.

Drexhage says, "Up until now, all of the glasses have been made by conventional melting,...taking a bunch of commercially available powders, throwing them into a pot, melting them down and then extracting a fiber by some method. That's a very dirty process." One solution is to obtain purer starting materials. The Air Force is also funding a study, at Corning Glass Works in Corning, N.Y., of chemical vapor deposition techniques for preparing these glasses.

A second problem is the formation of microscopic crystals within the glasses. A single crystal scatters enough light to ruin a fiber's transmission quality. Robert Doremus of RPI, with help from the Jet Propulsion Laboratory in Pasadena, Calif., is preparing an experiment for a spring 1984 space shuttle mission to try to make a crystal-free halide glass. He plans to use a zirconium, barium, lanthanum fluoride mixture in a furnace in which sound waves keep the samples suspended away from the furnace walls.

Researchers are also unsure how the properties of halide glasses change with time, especially over decades of use. The glasses are weaker than silica glasses, and their strength further degrades because of reactions on the glass surface with atmospheric water. Halide fibers must have a coating that's impervious to water.

"There are still very large improvements to be made," says Moynihan. "However, improvements in transparency [of halide fibers] are occurring at a faster rate than occurred in silica fibers in the early 1970s." Drexhage sees military applications for halide fibers within 10 years. Some commercial applications, for remote sensing (for example, temperature monitoring in areas inaccessible to other instruments), for thermal imaging in medicine and as laser-power guides, may appear sooner. *— I. Peterson*

Calcium, chlorine and heart disease linked

There's more reason to drink milk than merely to build strong bones and teeth. Preliminary animal research now strongly suggests that a diet somewhat low in calcium may be a risk factor in heart disease for that half of the U.S. population whose drinking water is disinfected with chlorine. The findings, which come out of studies involving pigeons (a good laboratory model for the development of atherosclerosis in humans), were presented Aug. 11 in Philadelphia at the annual meeting of the American Society for Pharmacology and Experimental Therapeutics.

"There's an old, much repeated observation in epidemiology that hard water protects against cardiovascular disease and mortality," says Richard Bull, who heads the Environmental Protection Agency's (EPA) toxicology and microbiology division in Cincinnati. It was to explore the potential hazards and benefits of calcium — a mineral usually abundant in hard water — that Bull and colleagues began their studies.

In one of Bull's studies, 12 pigeons were fed a diet that was normal except for its calcium content; it contained only 80 percent of the recommended daily allowance (RDA) of that mineral. Half these birds drank unchlorinated water, the rest drank water containing 10 milligrams of chlorine per liter. After only three months, serum chlolesterol levels of the birds that drank chlorinated water were 50 percent higher — or 300 mg per deciliter of blood — than those of the birds that drank unchlorinated water. A similar test conducted with pigeons that ate a normal diet showed no statistically significant difference in cholesterol levels between birds with and without chlorine in their water; all had roughly 200 mg/dl.

The difference in drinking-water effects was magnified dramatically when 10 percent lard was added to the calcium-deficient diet. Though birds that drank unchlorinated water had only slightly modified cholesterol levels — 230 mg/dl — pigeons that drank chlorinated water had 600 mg/dl. What's more, Bull told SCIENCE NEWS, autopsies of the high-cholesterol birds also suggest they had developed more atherosclerotic plaque — lipid deposits which can eventually block arterial passages (and which have been implicated with strokes, heart attacks and other forms of heart disease).

Bull's tests, part of an ongoing series, have recently been revised to include rabbits. Though final results are not yet in, Bull said preliminary data suggest that the rabbit tests are confirming the effects seen in pigeon tests.

This research is far from an academic exercise. Though the chlorine levels Bull chose are high, they are not high by much: Residential water chlorine levels average 1 mg/l, but range as high as 3 mg/l in some areas, EPA surveys show.

More important, most adults in this country are consuming diets that do not meet the RDA for calcium, according to the most recent national Health and Nutrition Examination Survey (HANES), conducted by the National Center for Health Statistics (NCHS). The 1980 revised RDA for adults 18 and older is 800 mg of calcium. Yet HANES' data show, "All women 18 through 65 are below the 800 mg RDA," says Sidney Abraham of the NCHS. Calcium levels range from a high of 96 percent of the RDA, for ages 18-24, to a low of 68 percent of the RDA for ages 65-74. Men 18 and older exceed the RDA easily, Abraham notes, until age 65, when their calcium intake drops to about 87 percent of the RDA.

—J. Raloff