Environment

Ozone-protection treaty strengthened

Representatives of more than half the world's nations met in Copenhagen last month to revise the Montreal Protocol, an international ozone-protection treaty. The compromise recommendations they agreed to on Nov. 25 would accelerate the phaseout of previously targeted ozone-destroying pollutants, such as chlorofluorocarbons (CFCs), and initiate the treaty's regulation of three additional chemicals.

A progressive erosion of Earth's ozone layer by several major classes of industrial pollutants seriously threatens the ability of Earth's upper atmosphere to filter out the sun's biologically harmful ultraviolet radiation. But "nature and man can cooperate, because the ozone layer will repair itself when we halt the destruction of it," said Denmark's environment minister, Per Stig Møller, who hosted the conference.

Provisions agreed to in Copenhagen would seek to help preserve the ozone layer by:

- Phasing out production of CFCs and carbon tetrachloride by Jan. 1, 1996 – four years earlier than now required.
- Banning halons, fire retardants used in many fire extinguishers, by 1994, six years early.
- Ending production of methyl chloroform, a dry-cleaning agent, by 1996, nine years early.
- Initiating controls on hydrochlorofluorocarbons (HCFCs). In 1996, the treaty would freeze consumption of these CFC substitutes at 1991 levels, with a promise to eliminate them by 2030.
- Drafting initial controls on hydrobromofluorocarbons (HBFCs). Both production and use of these fire retardants would be eliminated by the end of 1995.
- Beginning a review of the risks posed by methyl bromide, a widely used fumigant pesticide, to be completed by 1995. A freeze—at 1991 production levels—would begin that same year. Though this chemical poses a potentially serious threat to ozone, its relatively short life makes its atmospheric levels fairly responsive to altered patterns of use.
- Agreeing to maintain a multilateral fund beyond 1993. Opened with money from industrial nations last year, this bank account has taken in at least $73 million for the financing of ozone-friendly industrial development in Third World countries. Last month, delegates agreed to increase the fund's capitalization to between $340 million and $500 million by 1996.

Earlier this year, in response to data forecasting a possible Arctic ozone hole similar to the one that now forms annually over the Antarctic, the United States volunteered to accelerate its phaseout of chemicals regulated under the Montreal Protocol (SN: 2/15/92, p.102). However, it left open a big loophole: Companies could produce the banned chemicals indefinitely for "essential uses and for servicing certain existing equipment." Delegates in Copenhagen agreed to the same exceptional-use provisions, says Dan Strub of Friends of the Earth in Washington, D.C.

To date, 92 nations have ratified the Montreal Protocol. Together, these countries produce and consume virtually all the pollutants being regulated under the treaty.

Recycling refrigerants

On Dec. 1, the Environmental Protection Agency proposed new rules prohibiting atmospheric release of chlorofluorocarbons and other ozone-destroying compounds during the servicing or disposal of air conditioning and other refrigeration equipment. Under the new scheme, "the final person in the disposal chain would be responsible for ensuring that [the] refrigerant had been recovered from the equipment" – presumably for recycling, EPA said. Currently, U.S. operations vent some 111,000 metric tons of ozone-depleting refrigerants annually. The proposed rule would cut that level by more than half.

Materials Science

Elizabeth Pennisi reports from Boston at the fall meeting of the Materials Research Society

Rocking ions improve lithium battery

Though often considered the next generation of portable power, lithium-based batteries have so far failed to live up to their potential. Over time, lithium electrodes become unstable and can cause reactions that make the battery unsafe.

Now solid-state chemists think they have gotten around those shortcomings by developing a rechargeable, "rocking-chair" battery. To charge and discharge the battery, lithium ions "rock" back and forth between the battery's two electrodes, says Dominique Guyomard of the University of Nantes, France.

He and Jean-Marie Tarascon at Bellcore in Red Bank, N.J., use lithium manganese oxide as the positive electrode and coke or graphite as the negative electrode.

When first developing the battery for Bellcore, they discovered that when they initially charged the battery, it lost 25 percent of its capacity because some lithium ions got stuck at the carbon and didn't cycle back and forth. So they added enough excess lithium ions to the system to compensate for those that got stuck and learned how to add this lithium in such a way that the electrodes remained stable, Guyomard says.

In addition, they came up with a new electrolyte composition that does not oxidize at higher temperatures, so the battery lasts longer, says Guyomard.

When fashioned into prototype AA batteries, this new technology performs better than current nickel-cadmium rechargeable batteries. The rocking-chair battery has the same capacity, but it packs three times the output voltage, asserts Guyomard. It averages 3.7 volts compared to the nickel-cadmium's 1.2 volts. Lithium, manganese, and carbon are cheap and easier to recycle and dispose of than cadmium-based batteries. In addition, unlike the nickel-cadmium battery, the rocking-chair battery can be short-circuited and totally discharged without being destroyed, he notes.

At Bellcore, other scientists are seeking to modify this technology to make a thin-film rocking-chair battery that would be part of a computer chip. This rechargeable battery would kick in during power failures to keep the chip from losing its data, says Frough K. Shokoohi of Bellcore.

Stretch peptide shows promise for many uses

A piece of a protein that keeps the aorta elastic even after decades of pumping blood may one day have a variety of biomedical and other applications. This protein contains many copies of a five-amino-acid peptide. That short peptide makes the molecule curl up tight at body temperature and unfold at room temperature, says Dan W. Urry, a molecular biophysicist with the University of Alabama at Birmingham. He and his colleagues discovered that chemical energy and light also have that effect on the peptide.

They produced a transparent film of polymers made from this peptide. By slightly modifying the film's chemical makeup, scientists can alter the bioelastic's properties for a variety of uses, Urry adds.

The film has passed the standard tests for assessing biocompatibility – how well the body accepts it when implanted. In animals, the film effectively prevented development of adhesive scar tissue, which can bind intestines to the abdominal cavity as they heal after surgery or a wound, says Urry. He and his colleagues have also fashioned prototype blood vessels. They think the material, slightly modified, could deliver drugs to the body at a controlled rate or work as biodegradable filler for disposable diapers.

A different film, made from a biopolymer found in the fluid bathing joints, also shows promise for preventing potentially dangerous adhesions after surgery, says Keith Greenawalt of Genzyme Corp. in Cambridge, Mass. That film, made from hyaluronic acid, is now being tested in humans, he says.