Ozone Depletion: Double the Trouble

Against the shadow of a raging conflict over whether to halt the use of halocarbon propellents in aerosol-spray cans, the National Research Council (a research arm of the National Academies of Sciences and Engineering) issued a cautiously worded report on the halocarbon-ozone picture in 1976 (SN: 9/18/76, p. 180). Ridden with caveats and qualifications, it cited calculations suggesting a probable depletion of the earth's biologically protective atmospheric ozone that could total 7 percent over the next 50 to 100 years. Although the report carefully ducked the sensitive issue of whether there was scientific justification for a ban on halocarbon sprays, the Environmental Protection Agency nevertheless has since effected such a ban. The report had suggested that regulators postpone action for a few years until better data became available.

Well, the wait is over and the results of the NRC's latest look at halocarbon-ozone interactions is anything but encouraging. Improved measurements and updated computer modeling of complicated atmospheric chemistry indicate that stratospheric ozone is being depleted at more than twice the rate estimated in the 1976 report.

The new study estimates ozone depletion could total 16.5 percent over the next 100 years if halocarbon releases continue at the 1977 rate.

Scientists are concerned about accurately measuring and minimizing its depletion because ozone shields biologically harmful ultraviolet radiation from the earth's surface. Its loss can generate temperature-related climate changes.

Although several sources — such as high-flying aircraft, nuclear weapons and nitrogen fertilizers — are known to disturb the atmosphere's careful ozone balance, the new NRC study confirms halocarbons as the greatest and most immediate apparent threat to stratospheric ozone. Like the earlier report, the current one focuses its attention on a pair of widely used chlorofluoromethanes — F-11 ($CFCl_3$) and F-12 (CF_2Cl_2).

But while the use of these two chemicals has been slowed by the ban on halocarbon sprays, two other halocarbons are now climbing to industrial-use levels that could threaten atmospheric ozone also. Use of F-22 ($CHClF_2$), for example — principally in refrigeration — has increased by 25 percent in only two years. And methylchloroform (CH_3CCl_3) production, used in a variety of devices, is doubling every five years. New measurements indicate methyl chloroform pumps a quarter to half as many chlorine atoms into the stratosphere as either F-11 or F-12, and could well become the stratosphere's leading chlorine source.

Unlike F-11 and F-12, stratospheric uptake of F-22 and methyl chloroform is dependent on hydroxyl (HO) concentrations in the troposphere, something poorly understood at best. It is known, however, that tropospheric removal of halocarbons by reactions with HO is not complete. Thus the rapidly accelerating production of these chemicals, particularly methyl chloroform, gives the authors of the new NRC report "grounds for concern." They say that over time effects of these chemicals on ozone could increase overall depletion values by an additional several percent.

In the short span since publication of the 1976 NRC report, understanding of stratospheric chemistry has advanced. For example, better measurements support earlier theories that as halocarbons reach the stratosphere, they photodissociate into fragments that serve as catalysts for the destruction of ozone, and the fragments themselves react with ozone. But as the number of chemical reactions involved — at least 125 — is large, it may take many years before reliable quantifications of the rates and relationships between reaction products are possible.

For instance, two reactions that may affect stratospheric ozone levels were identified too late for incorporation in the new NRC study. One, the reaction of chlorine atoms with formaldehyde (CH_2O), can *decrease* ozone depletion by 7 percent. The other, a reaction between ClO and BrO, *increases* ozone depletion by about the same factor.

Among the report's major findings:

- If halocarbon emissions continue at the 1977 rate, predictions estimate a loss of stratospheric ozone totaling 16.5 percent (plus or minus 11.5 percent). If emissions continue at three-quarters of the 1977 rate, the expected ozone loss falls to 13.3 percent (± 9.3 percent). At half the 1977 rate, the loss would be 9.4 percent (± 6.8 percent).
- Ozone loss will vary, tending to be greatest in the upper stratosphere, in winter hemispheres and in upper latitudes.
- Even after emissions stop, ozone changes will continue for several decades, the result of the halocarbons' long atmospheric lifetimes. □

Deadline halts species protection studies

More than 1,700 plants and 30 animals (all but one invertebrates) were dropped from consideration for endangered-species protection by the Interior Department Monday when the deadline passed for studying the creatures' status. Most were dropped not so much because they were unendangered as because researchers could not find time to investigate whether they were in serious jeopardy.

A 1978 amendment to the Endangered Species Act stipulates that the Interior Department must rule on whether to list a species as endangered within two years of proposing to do so, or drop work on the species altogether. Congress gave Interior an additional year's grace period to finish its analyses of any species that had been under consideration for at least two years at the time of the amendment's passage.

In fact, Interior had developed quite a backlog, largely due to a massive proposal involving 1,760 plants and 61 animals that it proposed for listing as endangered in June 1976. From a Smithsonian Institution review of the status of more than 3,000 plant species worldwide, Interior's fish and wildlife service proposed its 1,821-member list, including only species for which sufficient data *already* existed to make possible a review of their protection needs. Based on those data, only 36 plants and 29 foreign animals qualified.

Presumably others would have, as well, had Interior scientists been able to investigate their status fully. But the 1978 amendment restricted scientists to use mostly — and in many cases, only — existing data. According to Interior's Inez Connor, data on many of the species, particularly the foreign ones, were scanty at best. But any dropped species can be resubmitted for listing when new data become available, Connor adds.

"It's the manpower to acquire data that has been lacking," she sums up. She said it requires an average of 300 person-days per species to complete the entire process of proposing to list a species for protection, holding hearings and public meetings on it, soliciting and answering comments regarding the listing, and writing final regulations. Interior's endangered-species office had only one botanist — until it hired two more last year.

Complicating the situation, Connor says, is another new rule requiring that the critical habitat for a species be named when it is considered for listing and that the habitat study include an economic analysis — such as what impact habitat protection will have on jobs. "We have biologists, you know, but not too many economists," says Connor, "and it's hard to rate the economic benefit of plants and [invertebrates]." □