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Stratospheric Ozone Depletion and Regulation of Methyl Bromide

Wayne A. Morrissey
Science and Technology Information Analyst
Resources, Science, and Industry Division

Summary

In the mid-1980s, some scientists became concerned that emissions of methyl bromide (MBr), a pesticide widely used in agriculture, could become a major source of bromine that could contribute to depletion of the Earth's stratospheric ozone layer. The ozone layer shields the Earth's surface from harmful forms of ultraviolet radiation. MBr plays an important economic role in U.S. agricultural commerce because of its effectiveness in killing insects and plant pathogens. It is used extensively for pre-planting, post-harvest, quarantine, and pre-shipping treatments. Global production, consumption, and trade of MBr is regulated under the 1987 Montreal Protocol (on Substances That Deplete the Ozone Layer), amended in 1992 and adjusted in 1997. Domestically, those are regulated under Title VI of the U.S. Clean Air Act (CAA), amended in 1993 and in 1998. This report discusses regulation of MBr as an ozone-depleting substance and addresses possible concerns for Congress such as 1) the timing of a production phaseout, 2) "critical use" allowances, and 3) the search for alternatives, and will be updated as warranted.

About 76,000 metric tons of MBr are manufactured globally each year primarily for agricultural uses. MBr is effective at killing molds, other fungi, insects, and worm (nematode) infestations of crops. About 80% of that tonnage is used as a fumigant to treat soils prior to planting. Another 20% is used to treat post-harvested commodities such as fruits, vegetables, dried foodstuffs, stored grains, cut flowers, and timber. Quarantine and pre-shipment (QPS) treatments with MBr for import/export account for about 1% of total tonnage produced. The profile of emissions is different. About 50% of MBr used is emitted into the atmosphere during pre-planting applications, while 80% is emitted during post-harvest and QPS applications, unless treatment occurs in a contained environment.

Many domestic users of methyl bromide have petitioned Congress to amend the Clean Air Act and to extend the phaseout of U.S. production from Jan. 1, 2005 to Jan. 1, 2015. Users foresee higher costs, diminishing supplies, lack of viable alternatives, and possible future restrictions on trade of U.S. agricultural products if such products cannot be treated with MBr. Congress extended the phaseout date once before.

On Dec. 10, 1993, the U.S. Environmental Protection Agency (EPA), acting under the authority of §604 of the CAA, issued a final rule to freeze U.S. production and consumption of MBr at 1991 levels, and to cease domestic production of it by Jan. 1, 2001. However, in 1999, Congress amended §604 of the CAA, with §764(a) of P.L. 105-277, which extended allowances for U.S. production of MBr until Jan. 1, 2005, but with interim reductions. The CAA currently comports with international regulation of MBr under the 1987 Montreal Protocol, as amended and adjusted.

In the 106th Congress, H.R. 4125 and S. 2504 were introduced to amend the CAA again to extend U.S. phaseout of MBr production to Jan. 1, 2015, the deadline for ending *consumption* of it by Article 5(1) parties under the Montreal Protocol.[1] These similar bills proposed that production, importation, and consumption of MBr for "fumigating agricultural commodities, articles, or process and storage facilities" would be permanently exempted if approved as "critical uses" under the Montreal Protocol. In anticipation of enactment of this legislation, EPA issued a notice of proposed rule making to ban all domestic *uses* of MBr, other than those deemed "critical uses," by Jan. 1, 2015.[2] MBr's manufacture would be banned Jan. 1, 2005, except for small quantities for export to Article 5 countries. The legislation was not enacted, however. Recent negotiations at the 15th Meeting of Montreal Protocol Parties have pitted the European Community against many other industrialized countries, including the United States, that call for an increase of tonnage of MBr produced for "critical uses." As proposed, production would exceed a 100% reduction for domestic uses beyond the 2005 phaseout presently called for under the Montreal Protocol and Clean Air Act.

Current concerns about U.S. regulation of MBr as an ozone-depleting substance include whether there is a need for stronger *or* less stringent controls of MBr emissions, whether production cutbacks scheduled under P.L. 105-277 will be met, and whether effective alternatives can be developed economically for all agricultural uses. Common questions have included:

- Do the economic benefits of MBr for U.S. produce growers outweigh its potential danger to the stratospheric ozone layer and the health of humans and the environment?
- Is the scientific evidence about MBr and stratospheric ozone depletion conclusive enough to justify stronger regulation, or any regulation at all?
- Are current phaseout schedules realistic given the time it might take to develop, approve, and market feasible alternatives?
- Might it be necessary to stockpile more MBr for "critical uses," if alternatives aren't available by the production phaseout deadline?
- Can suitable chemical substitutes or alternative treatments be found for *all* of MBr's current applications?
- Are there policy actions that can be taken now to reduce MBr emissions, so that their potential effects on the ozone layer might be reduced?

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[1] Article 5(1) refers to developing countries that consume less than 0.3 kg of ozone-depleting substances per capita; Non-Article 5(1) countries are industrialized or developed countries. Consumption equals tonnage for domestic uses plus imports of MBr, minus exports of it.

[2] See: Ozone Secretariat, UN Environmental Programme, Draft Decision IX/1: "Further adjustments and amendments to the Montreal Protocol" and Decision IX/2: "Critical-use exemptions for methyl bromide." (UNEP/OzL.Pro.9/6 10 June 1997.)

Questions such as these imply the need for in-depth analysis of the costs and benefits of MBr use, for U.S. producers and consumers alike. The U.N. Environmental Program (UNEP) and U.N. World Meteorological Organization (WMO) have co-sponsored several scientific, technical, and economic studies related to the costs and benefits of international MBr use over the past two decades. Such studies, requested by Montreal Protocol parties, have included input from international government science and agricultural agencies and representatives of private sector chemical industries and agricultural producers.

Scientific Research. Many scientists believe that diminishing ozone in the stratosphere that traps UV-B radiation could increase incidences of skin cancer in humans and animals, produce genetic damage in terrestrial plants, and destroy phytoplankton, possibly disrupting the natural marine food chain.[3] Laboratory experiments conducted in the 1980s showed that chlorine and bromine molecules released from chlorofluorocarbons (CFCs), and fire extinguishing agents containing bromine (halons), were extremely effective at breaking down ozone molecules. In 1994 atmospheric scientists declared MBr to be a potent ozone-depleting substance (ODS), which over time could become as significant an environmental threat as CFCs and halons. The manufacture and trade of these ODSs, with limited exemptions, were banned globally Jan. 1, 1996. Atmospheric scientists are assessing MBr's potential contribution to future ozone depletion, attempting quantify the sources and sinks of both its man-made and natural emissions.

Methyl bromide's suspected high ozone-depleting potential (ODP) was first reported outside the scientific literature in the U.N. WMO/UNEP, *1991 Assessment of Ozone Depletion*. Montreal Protocol parties and the EPA accepted UNEP scientists' estimates that it had an ODP of 0.7.[4] Consequently, the Natural Resources Defense Council, Environmental Defense Fund, and Friends of the Earth jointly petitioned EPA to regulate MBr as a "Class-I ozone-depleting substance" under the CAA.[5] In March 1993, the EPA issued a notice of proposed rule making to add MBr to the CAA's list of Class-I ozone-depleting substances that would regulate its future production and use.[6] Accordingly, the EPA capped domestic production of MBr at 1991 levels Jan. 1, 1994, and proposed to cease its manufacture Dec. 31, 2000.[7]

The WMO/UNEP *1994 Scientific Assessment of Ozone Depletion* urged more stringent control of MBr emissions, because scientists had since discovered MBr had a

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[3] "Surface UV Radiation," *Global Ozone Research and Monitoring Project—Report No. 37, Scientific Assessment of Ozone Depletion: 1994*, UN WMO: Geneva, Feb. 1995, p. 9.1.

[4] Susan Solomon, A.R. Ravishankara, et al., "Atmospheric lifetimes and ozone depletion potentials of methyl bromide (CH3Br) and Dibromoethane (CH2Br2)." *Geophysical Research Letters*, (19), October 23, 1992: 2059-2062.

[5] According to the Montreal Protocol's "Schedule A," Class-I ozone-depleting substances have an ODP greater than 0.2, *vis-a-vis* CFC-11, which has an ODP of 1.0.

[6] "Protection of Stratospheric Ozone: Notice of Proposed Rule Making (Environmental Protection Agency, 40 CFR Part 82)", in *Federal Register*, v. 48, March 1993: 15014-15038.

[7] "Protection of Stratospheric Ozone, Final Rule Making (Environmental Protection Agency, 40 CFR Part 82)," in *Federal Register*, v. 58, December 30, 1993: 69235-69238.

potent short-term ODP, which was estimated to fall within a range of 0.3-0.6.[8] However, because its ODP still exceeded 0.2, it would continue to be regulated as a Class-I ozone-depleting substance.[9] Four years later, the WMO/UNEP *1998 Assessment of Ozone Depletion* reported possible environmental benefits (e.g., quicker recovery of pre-ozone hole condition and lesser long-term exposure to UV-B radiation) that might be attained, if concentrations of ozone-depleting substances in the stratosphere could be stabilized in the near-term. Reaping those benefits, the report stated, would require Montreal Protocol parties to implement the 1997 treaty adjustments and schedule to phase out MBr.

Under previous international agreements, atmospheric scientists estimated maximum ozone loss from *all* manmade ozone-depleting substances emitted into the atmosphere would peak around 2030, and then slowly decline.[10] However, the WMO/UNEP 1998 assessment reported that scientists had observed concentrations of ozone in the upper stratosphere begin to increase, which many had attributed to the 1996 production ban of CFCs and halons. As such UNEP projected that peak concentrations of ozone-depleting substances might occur as early as 2010 and pre-ozone hole conditions return by 2050. They also suggested that, if manmade MBr emissions were to cease, full recovery might possibly occur ten years sooner. Those findings inspired many Montreal Protocol parties to pursue even more stringent controls of MBr production. That notwithstanding, *consumption* of small quantities of MBr by Article (5) countries would be allowed until 2015. The possibility of an earlier peak of maximum ozone depletion and evidence of recovery of the stratospheric ozone layer were viewed in some circles as evidence that the Montreal Protocol (and U.S. Clean Air Act) was working.

In its latest, 2002 assessment, WMO/UNEP scientists reported difficulties in fully accounting for all manmade and natural sources and natural sinks of MBr emissions. They concluded that actual quantities and apportionment of MBr in the environment were difficult to estimate, because long-term measurements at probable sources were limited, or non-existent. However, many atmospheric scientists continued to accept estimates reported in the 1994 assessment that its use in agriculture accounts for nearly a third of *all* MBr emissions. The 2002 assessment reconfirmed that, in addition to agricultural emissions, there were other major sources of MBr, including natural and human burning of biomass, automobile exhaust, and to a lesser extent ocean out-gassing. In addition, UNEP scientists projected that by 2010, when atmospheric concentrations of all manmade ozone-depleting substances were anticipated to peak, bromine predominantly from MBr would constitute 30%-60% of that mixture. Further, they projected that as stratospheric concentrations of chlorine began to decline, bromine released from MBr would continue to increase by about 3% annually, even if emissions ground to a halt at 1999 levels.

Economics and MBr Alternatives Studies. In 1994, the Montreal Protocol's Methyl Bromide Technical Options Committee released its first report (MBTOC-1) which

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[8] Short-term ODP refers to MBr's capacity to deplete stratospheric ozone in two years, or less.

[9] "ODPs, GWPs and Cl-Br Loading,"UNEP/WMO Scientific Assessment of Ozone Depletion: 1994, p. 13.17.

[10] CFCs are no longer produced in most industrialized countries; however, CFC emissions are believed to remain in the atmosphere for 70-150 years, accounting for a high cumulative ODP.

examined alternatives for MBr in different uses.[11] This study focused primarily on agricultural applications, and would be used to guide international negotiations to regulate emissions of manufactured MBr. Many international policy makers found the study useful, because it laid out possible options they might take for complying with the new regulations for MBr under the Montreal Protocol, as amended in 1992. MBTOC-1 explored chemical substitutes and alternative practices used for different MBr applications to be prepared in the event of a *rapid* production phaseout, and actions that might need to be taken to secure exemptions for "critical uses." MBTOC-1 concluded that its use for QPS treatments should be exempted from regulation, pending a longer-term study of potential alternatives. MBTOC-2, released in 1988, focused on the need for Montreal Protocol parties to: 1) identify future critical uses of MBr; 2) inventory the quantities produced and consumed globally; and 3) survey efforts to develop potential alternative treatments that might replace MBr as a "soil fumigant, a fumigant of durable commodities and structures, and a fumigant of perishable commodities." Also, the report contained a developing country perspective on the phaseout of MBr; it addressed the issue of non-uniform responses to alternative treatments; and, suggested actions policy makers might take to reduce MBr emissions immediately, including conservation and control measures, taxes to dissuade its use, and increased research funding for alternatives.[12]

MBr Regulations

In Dec. 1995, scientific findings about the suspected potent ODP of MBr led parties to the 1985 U.N. Vienna Convention on Protection of the Stratospheric Ozone Layer, the progenitor of the 1987 Montreal Protocol, to convene. Over the following two years, parties negotiated treaty text to amend and adjust international regulations of MBr to expedite a global phaseout of its production and use. In September 1997, at the "9th Meeting of the Montreal Protocol Parties," the *final* treaty text negotiated under the Vienna Convention was adopted. Industrialized countries would phase out MBr production by Jan 1, 2005, except for possible "critical uses" that were still under study by MBTOC. According to the treaty "adjustment," MBr production would be cut back in the interim, 25% by 1999, 50% by 2001, and 70% by 2003. In addition, Article 5(1) countries would be required to reduce consumption of MBr 20% by 2005, based on average consumption between 1995 and 1998, and discontinue its use by 2015.

Many U.S. produce growers and some U.S. lawmakers soon became concerned about different requirements and schedules for phaseout of MBr in industrialized countries under the Montreal Protocol and the CAA. Of particular concern were use allowances granted to developing countries, some of which are competitors of U.S. produce growers, while domestic supplies of MBr declined. To address the first concern, in 1998, Congress amended the CAA and extended the deadline for U.S. production of MBr from Jan. 1, 2001 to Jan. 1, 2005, thereby securing parity with other industrialized Montreal Protocol parties. To address the second, it granted allowances to U.S. manufacturers to produce

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[11] U.S. interests are represented through such agencies as EPA, the National Oceanic and Atmospheric Administration, other Department of Commerce agencies, the National Aeronautics and Space Administration, and the USDA Agricultural Research Service (ARS).

[12] The EPA currently lists a range of substitutes for a variety of uses of MBr at [http://www.epa.gov/ozone/mbr/mbrqa.html].) The Agricultural Research Service has its research results on alternatives on its website at [http://www.ars.usda.gov/mb/mebrweb.htm].

in excess of its annual allowance 15% for export to Article 5(1) countries until 2015, as provided for in the Montreal Protocol. That decision discouraged many environmental interests who wanted an expedient ban on global use of MBr.

In July 2001, under authority of the CAA, EPA exempted quantities of MBr produced for QPS treatment of agricultural commodities from regulation until Dec. 30, 2002. Then, on Jan. 3, 2003, it extended those exemptions through Jan. 1, 2005.[13] Also, EPA announced it would solicit comments on a proposed rule to establish exemptions for certain "critical uses" beyond Jan. 1, 2005, for the 2005-2006 growing season.[14] The process of determining what EPA might consider "critical uses"under the CAA began May 2002, when petitions were solicited from domestic users who foresaw no economically feasible replacements for different uses of MBr after Jan. 1, 2005. EPA received 57 petitions which it either approved, required additional information for, or rejected.[15] EPA estimated at least 23 million pounds of MBr would be needed for "critical uses" approved for that growing season alone. It proposed a production increase of 39% and 36% (greater than a 100% reduction), for those two years, respectively. In the 108th Congress, on June 3. 2003, the House Energy and Air Quality Subcommittee convened a hearing to solicit the perspectives of a number of U.S. agricultural producers and Bush Administration officials about phaseout and possible "critical use" exemptions for MBr.[16]

At the 15th Meeting of Montreal Protocol Parties (MOP), which convened in Nairobi, Kenya, Nov. 10-14, 2003, critical use nominations (CUNs) were considered for approval under the international treaty. Facing uncertainty about whether U.S. nominations would be approved, H.R. 3403 was introduced in Congress to amend Title VI of the CAA and allow uses and production of quantities of MBr at levels that were approved by EPA to take effect after 2004, and annually thereafter. Some in Congress have threatened a possible U.S. withdrawal from the treaty. If that were to occur, the United States could lose privileges afforded parties to the Montreal Protocol, including allowances for exportation of MBr to Article 5(1) parties after 2004.[17,18] Some have challenged whether phaseout MBr is necessary, citing recent scientific findings that, "the ozone layer is already healing."[19] According to UNEP, a decision to grant exemptions for critical uses of MBr has been deferred until a special followup session in Montreal in March 2004.

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[13] "Process for Exempting Quarantine and Pre-Shipment Applications of Methyl Bromide: Interim Final Rule." *Federal Register*, 66 (139), July 19, 2001: 37752-37769; *Federal Register*, 68 (1), Jan. 2, 2003: 237-254.

[14] "Process for Exempting Critical Uses of Methyl Bromide," *Federal Register*, 67(91), May 10, 2002: 31798-31801.

[15] "U.S. Government Nominates Critical Use Exemptions for Methyl Bromide. EPA, *Environmental News*, Feb. 7, 2003 [http://www.epa.gov/spdpublic/index.html#methyl].

[16] Testimony may be found at [http://energycommerce.house.gov].

[17] "Methyl Bromide Production for Export Can Continue Until 2005 under EPA Rule," (BNA, Inc.) *Daily Environmental Report* (82), Apr. 29,2002: A-6.

[18] The Senate Committee on Foreign Relations had considered Treaty Doc. 106-32, the "Beijing Amendment," which restricts international trade of MBr among Montreal Protocol parties by requiring a license for exporting and importing. The Senate approved that provision Oct. 2, 2002.

[19] "U.S. to Seek Support for Broad Ozone Exemptions." *NYTimes.com*, Nov.10, 2003.