

**THE PRESENT USE OF METHYL BROMIDE AS A FUMIGANT
FOR STORED PRODUCTS IN DEVELOPING COUNTRIES:
RESULTS OF A RECENT SURVEY**

R.W.D. TAYLOR

*Natural Resources Institute, Central Avenue,
Chatham Maritime, Chatham, Kent ME4 4TB, UK*

ABSTRACT

In 1992, under the terms of the Montreal Protocol Agreement, methyl bromide (MB) was listed as an ozone-depleting substance. It was expected that a programme to control its use would be decided in 1995. Some developing countries have expressed concern that any controls on MB may adversely affect trade, although uncertainties regarding the effect of future restrictions were, in part, considered likely to be due to the lack of detailed information about the continued importance of the chemical. To overcome some of these uncertainties a survey of both MB use and potential alternatives was organised by the United Nations Development Programme in three regions. The results obtained in the surveys and the implications for Latin America and Southeast Asia and the Pacific, as well as for English-speaking Africa, are described.

INTRODUCTION

Fumigation continues to play a major role in the protection of stored products against damage by insect pests. By the beginning of the 1990's only two fumigants were in regular world-wide use, phosphine (PH_3) and methyl bromide (MB); principally because of hazards to human health, almost all of the other 14 fumigants listed by Bond (1984) had been discarded. PH_3 is an extremely popular fumigant, particularly in developing countries where it may be the only fumigant used. One of its main strengths is the relative ease with which it can be applied in comparison to MB. However, a distinct disadvantage of PH_3 is the long period of exposure required; a minimum of 5 d is now being recommended. Where swift disinfestation is necessary, such as with cargoes awaiting transportation, PH_3 is often not appropriate. In such cases MB is employed because MB treatments can be completed in 24 h, reducing waiting time and minimising demurrage charges.

There is at present no ready alternative fumigant to MB for short-period treatments, and this is a significant factor in its continued importance for disinfesting stored products.

There are other continuing uses for MB in stored-products protection, and these have been dealt with comprehensively in the report of the Methyl Bromide Technical Options Committee (MBTOC, 1995). In 1992, MB was identified as an ozone-depleting substance and formally listed under the terms of the Montreal Protocol on Substances that Deplete the Ozone Layer. Of major international concern was the increase in global use of MB and this trend is illustrated in Table 1 (Watson *et al.*, 1992). Following an investigation organised through the United Nations Environment Programme into the current uses and possible alternatives to MB (MBTOC, 1995), agreement was reached that in January 1995 developed countries would introduce a freeze on consumption of the chemical at 1991 levels. The Parties to the Protocol agreed in late 1995 on a further, more detailed control programme for MB. The programme for developed countries consists of a phase-out in 2010 with stepped reductions starting in 2001. The only controls yet agreed for developing countries, consist of a freeze, starting in 2002, in use of the chemical, based upon an average of the quantities used in the period 1995 to 1998. The position with regard to developing countries will, however, be reviewed again in 1997. Under present agreements, there are exemptions from controls on MB for all countries when the fumigant is used for quarantine and pre-shipment fumigations as well as for some critical agricultural uses yet to be defined.

Although many potential alternatives to MB exist (MBTOC, 1995), some of them require considerable development and field-evaluation programmes before they can be introduced into routine disinfestation systems. These programmes are likely to be costly, and many developing countries are not well placed to carry out such evaluations without assistance. The Multilateral Fund was established to assist developing countries in phasing out ozone-depleting substances, and the Executive Committee of the Fund decided in mid-1995 that, in determining the magnitude of assistance necessary to phase out MB, a comprehensive survey of current uses for the chemical was necessary.

TABLE 1
MB sales (1990) by use ($\times 1000$ t) (Watson *et al.*, 1992)

| Year | Soil | Commodity/ Quarantine | Structural ¹ | Chemical intermediates ² | Total |
|------|------|--------------------------|-------------------------|----------------------------------------|-------|
| 1984 | 30.4 | 9.0 | 2.2 | 4.0 | 45.6 |
| 1985 | 34.0 | 7.5 | 2.3 | 4.5 | 48.3 |
| 1986 | 36.1 | 8.3 | 2.0 | 4.0 | 50.4 |
| 1987 | 41.3 | 8.7 | 2.9 | 2.7 | 55.6 |
| 1988 | 45.1 | 8.0 | 3.6 | 3.8 | 60.5 |
| 1989 | 47.5 | 8.9 | 3.6 | 2.5 | 62.5 |
| 1990 | 51.3 | 8.4 | 3.2 | 3.7 | 66.6 |

Source: MB Industry Panel/Chemical Manufacturers Association (1992).

¹Included residential, commercial and industrial. ²Not released into the atmosphere.

THE SURVEY PROGRAMME

The survey, organised by the UNDP Montreal Protocol Unit, New York, was conducted over a 3-month period and completed by early November 1995 for presentation in draft form to the Seventh Meeting of the Parties to the Montreal Protocol. It was co-ordinated regionally by international specialists recruited for the purpose and, in individual countries, primary responsibility for organising surveys was delegated to national ozone units. Locally-employed national survey teams undertook the tasks of gathering information in each country.

The survey was directed at three regions. English-speaking Africa comprises 19 countries (Botswana, Egypt, Ethiopia, Gambia, Ghana, Kenya, Lesoto, Malawi, Mauritius, Mozambique, Namibia, Nigeria, Seychelles, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe). Southeast Asia and the Pacific comprise 8 countries (Brunei, Fiji, Indonesia, Malaysia, Myanmar, Philippines, Thailand and Vietnam). Latin South America comprises 10 countries (Argentina, Bolivia, Brazil, Chile, Columbia, Ecuador, Paraguay, Peru, Uruguay and Venezuela).

The main purpose of the survey, conducted with the aid of a comprehensive questionnaire, was to determine both the consumption of MB in targeted countries and the status of potential alternatives to this fumigant. Some countries, particularly the major users, were visited by international staff to verify that data-gathering was proceeding effectively. However, the exercise was somewhat constrained by the limited time available. The survey covered the uses of MB for both post-harvest protection and soil disinfestation, the latter being a particularly important use for the chemical in some developing countries.

SURVEY RESULTS — CURRENT USES OF METHYL BROMIDE

Much of the following data quoted, with sources acknowledged, is taken from the Draft Interim Report of the survey, produced by the United Nations Development Programme (UNDP, 1995).

English-speaking Africa

This region contained the largest number of countries but, partly because of both the limited survey time available and the poor communication facilities, it produced the least amount of data. Several countries failed to respond at all to repeated requests to provide information, and it was concluded that these countries used little, if any, MB for any purpose.

Although MB is widely used in Africa, there is a very wide variation in the extent of use which is often closely related to the climate and the cropping regimes of individual countries. Countries with good rainfall patterns and extensive arable farming systems usually have marketable surpluses of such staple food crops as maize. These surpluses are purchased by parastatal marketing organisations. Fumigation of this grain is an essential element of stock management and continues to be effected in several countries by means

of MB, although alternative disinfestation techniques have begun to be adopted. These countries include Kenya and Zimbabwe, and it is notable that, in both countries, there has also been a considerable increase in the use of MB for soil fumigation in recent years, due to expanding horticultural industries, increasing the consumption of this chemical. Countries where rainfall patterns make farming practices pastoral rather than arable tend to use either considerably smaller quantities of MB or none at all. The only use of the fumigant in these countries may be in connection with imports of grain or grain products where a short disinfestation period is desirable.

In Egypt, MB is used to fumigate imported foodgrains, chiefly wheat. Of the six million t of grain annually imported, it was reported that approximately 30% is disinfested on arrival. The survey indicated that for post-harvest applications, Egypt is the largest consumer of MB in Africa. Zimbabwe uses a similar quantity of the chemical annually, but there the major use is for soil disinfestation. Information gained from the survey on the quantities of MB imported by individual countries in Africa allows them to be conveniently placed in one of three groups: countries with little or no use of MB, those with moderate use and major users. These groups are shown in Tables 2, 3 and 4.

Southeast Asia and Pacific

Comprehensive data on the uses of MB were obtained from all countries surveyed except Myanmar. Of the other seven countries surveyed, only Brunei reported no regular use of the fumigant. In this region, excepting the Philippines, the major use reported for MB was commodity fumigation. The quantity imported in 1994 and the proportion used for commodity disinfestation are both shown in Table 5.

The major use for the fumigant in this region is treatment of commodities, chiefly rice, prior to export. Thailand consumes 62% of the regional MB total. This is due to Thailand's very large annual export programme.

TABLE 2
African countries with little or nil use of MB

| Country | Quantity of MB used in 1994 (t) |
|------------|---------------------------------|
| Botswana | 0.1 |
| Gambia | ? |
| Ghana | 0 |
| Lesoto | ? |
| Mauritius | 0.8? |
| Namibia | 0 |
| Nigeria | 0.3 |
| Seychelles | 0 |
| Swaziland | 1.4 |
| Uganda | 0 |

? = indicates no information available.

TABLE 3
African countries with moderate use of MB

| Country | Quantity of MB used in 1994 (t) |
|------------|---------------------------------|
| Ethiopia | 21 |
| Mozambique | 8.3 |
| Sudan | 78.4 |
| Tanzania | 3.0 |
| Zambia | 40 |

TABLE 4
African countries that are major users of MB

| Country | Quantity of MB used in 1994 (t) |
|----------|---------------------------------|
| Egypt | 572 (69) |
| Kenya | 440 (10) |
| Malawi | 200 (10) |
| Zimbabwe | 604 (14) |

Quantities in parenthesis represent percent post-harvest/quarantine usage.

TABLE 5
MB imports and usage in 1994, in SE Asia and the Pacific

| Country | Import in 1994 (t) | Use on commodities (%) |
|-------------|--------------------|------------------------|
| Fiji | 4 | 98 |
| Indonesia | 255 | 82 |
| Malaysia | 89 | 90 |
| Philippines | 63 | 46 |
| Thailand | 590 | 96 |
| Vietnam | 108 | 99 |

Latin America, South

Data were obtained from all the countries included in the survey, except Ecuador, although only limited data were provided by Bolivia and Venezuela. Table 6 gives details of MB use in the region during 1994.

Except for Peru, there is only minor use of MB for fumigating durable commodities in the countries surveyed. In Peru 86% of total fumigant usage (29 t) is for quarantine treatment of imported grain. The major use of the chemical in the region is for soil fumigation and, in some countries, particularly Chile, there is considerable use of MB for fumigating perishable commodities, such as grapes, prior to export.

TABLE 6
Quantities and percent use of MB for post-harvest applications in South American countries

| Country | Quarantine (t) | Post-harvest excl. quarantine (t) | % Post-harvest use | Total use (t) |
|-----------|----------------|--------------------------------------|--------------------|---------------|
| Argentina | 30 | 10 | 2.2 | 462 |
| Brazil | 0 | 17 | 2.0 | 850 |
| Chile | 45 | 0 | 0 | 201 |
| Colombia | N/A | 2.0 | 5.5 | 36 |
| Peru | 24.32 | 1.22 | 4.2 | 29.1 |
| Uruguay | 1.24 | 0.7 | 5.4 | 13.45 |
| Venezuela | 0 | 0 | 0 | 3.4 |
| Total | 100.56 | 30.92 | | 1,595 |

TRENDS IN THE USE OF METHYL BROMIDE FOR DURABLE COMMODITY FUMIGATION

Table 1 indicates that, although there was a general increase in the consumption of MB between 1984 and 1990, this was principally because of increases in soil fumigation. There was little change in usage for commodity disinfestation during that period. In many grain-producing countries in Africa, MB was the principal fumigant used until the mid-1980s, and it has continued to be used for that purpose in several countries, probably due to both familiarity with the chemical and because it can provide prompt treatment over a short period when this is necessary. The short fumigation period that MB can provide continues to have particular implications for large-scale marketing organisations. For example, in Kenya grain requiring fumigation in relatively remote locations is treated by pest control teams that travel from established bases. However, in some countries, such as Malawi, where MB was previously regularly used to treat grain in central storage, the trend in recent years has been to use less MB and increase the amount of PH_3 fumigation. In the past, cocoa exported from Ghana was regularly fumigated with MB but, in the 1990s, disinfestation practices have changed entirely and PH_3 is being used instead. Exported tobacco was usually fumigated with MB in earlier years, but in both Zimbabwe and Malawi almost all tobacco is now disinfested with PH_3 . This trend of gradual change from MB to PH_3 as a commodity fumigant was reported from many African countries.

Liberalisation of grain markets in Africa has affected pest control operations in several countries. In Tanzania, for example, the National Milling Corporation lost its monopoly in grain marketing under the World Bank/IMF reconstruction programme, and a steady decline in the use of MB has occurred. Where grain stocks are now fumigated by private contractors, they almost invariably use PH_3 . A major need for MB arose, however, in 1992–93, in Southern Africa, in connection with the drought-relief programme. Very large quantities of grain had to be imported and, in order to ensure that grain movements

were not unduly delayed, fumigation, deemed essential to prevent movement of the larger grain borer across national borders, was primarily with MB. Grain deficits due to drought are an increasingly common occurrence, and fumigation of imported relief supplies using MB ensures that delays in transit are minimised.

In Southeast Asia, there has been little change in the consumption of MB in recent years and, because the major use is for the fumigation of commodities for export, the opportunities to use alternatives, such as PH_3 , are limited. It seems likely, therefore, that little change in MB use can be expected in this region in the immediate future, and major users such as Thailand will continue to rely on the chemical for pre-shipment treatments. In Latin America, there is no obvious trend in use of MB for the treatment of durable commodities because the fumigant is used relatively little in the region for this purpose. Its only significant use on commodities was reported from Peru, where it is used for quarantine fumigation, and this use will probably continue for the foreseeable future under the current exemption agreed for this type of treatment.

CONCLUSIONS FROM THE SURVEY

MB continues to be an important fumigant for post-harvest pest control in some developing countries. Use patterns vary considerably, not only among the regions surveyed but also within regions, particularly in Africa. Of the 19 countries in Africa included in the survey, only four could be considered major users of MB, for various purposes, and only one, Egypt, employs the chemical in substantial quantities for commodity disinfestation. In Southeast Asia, of the total of 1,109 t of MB used in 1994, more than 90% was used for commodity fumigation. In contrast, in the Latin American countries surveyed, the major use for MB is for soil treatment. There is very little usage with durable commodities, although some perishable commodities are disinfested with MB prior to export.

Although there continues to be some use of MB in developing countries for routine grain disinfestation, in the last decade there has been a change to PH_3 in many countries whenever the time period available for treatment is not a constraining factor. There may still be some situations, particularly in Africa, where the use of alternatives such as PH_3 could be further extended, although this might require changes in stock management operations and also the provision of additional equipment. Where rapid disinfestation is necessary there is, at present, no ready alternative to MB, and this has been recognised in exempting fumigations conducted for pre-shipment and quarantine purposes from the agreed control programme for the chemical. With these exemptions in place, it appears unlikely that the introduction of additional controls on MB, in the future, would have significant impact on commodity disinfestation programmes in most developing countries. There are, however, exceptions to this generalisation, and further controls on MB would, for example, undoubtedly cause serious disruption to the routine use of the chemical for commodity fumigation in Egypt.

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