# METHYL BROMIDE CRITICAL USE NOMINATION
# FOR POST HARVEST USE FOR FOOD PROCESSING PLANTS

| FOR ADMINISTRATIVE PURPOSES ONLY: | |
|---|---|
| **DATE RECEIVED BY OZONE SECRETARIAT:** | |
| ***YEAR:*** | ***CUN:*** |

| | |
|---|---|
| **NOMINATING PARTY:** | The United States of America |
| **BRIEF DESCRIPTIVE TITLE OF NOMINATION:** | Methyl Bromide Critical Use Nomination for Post Harvest Use for Food Processing Plants (Prepared in 2005) |

**NOMINATING PARTY CONTACT DETAILS**


| | |
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Following the requirements of Decision IX/6 paragraph (a)(1), the United States of America has determined that the specific use detailed in this Critical use Nomination is critical because the lack of availability of methyl bromide for this use would result in a significant market disruption.

☐ Yes ☐ No

Signature Name Date

Title:

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## LIST OF DOCUMENTS SENT TO THE OZONE SECRETARIAT IN OFFICIAL NOMINATION PACKAGE

***List all paper and electronic documents submitted by the Nominating Party to the Ozone Secretariat***

| **1. PAPER DOCUMENTS:**<br>**Title of Paper Documents and Appendices** | **Number of Pages** | **Date Sent to Ozone Secretariat** |
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| **2. ELECTRONIC COPIES OF ALL PAPER DOCUMENTS:**<br>**Title of Electronic Files** | **Size of File (kb)** | **Date Sent to Ozone Secretariat** |
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## PART A: SUMMARY

### 1. Nominating Party

The United States of America (U.S.)

### 2. Descriptive Title of Nomination

Methyl Bromide Critical Use Nomination for Post-Harvest Use in Food Processing Plants (Prepared in 2005)

### 3. Situation of Nominated Methyl Bromide Use

This sector includes rice mills, flour mills, pet food manufacturing facilities, and a few bakeries. Primarily this sector is treating only the portions of the facilities that contain electronic components and have machinery with copper and copper alloy parts. These facilities are under intense pressure from many insect pests. The flour millers and the bakeries in this sector do not target any of their commodities to be fumigated with methyl bromide; however, the rice millers and the pet food manufacturers may fumigate some products with methyl bromide.

### 4. Methyl Bromide Nominated For Food Processing Plants

**Table 4.1: Methyl Bromide Nominated For Food Processing Plants**

| Year | Nomination amount (kg) | Nomination Volume (1000 $m^3$) |
|---|---|---|
| **2007** | **401,889** | **20,689** |

### 5. Brief Summary of the Need for Methyl Bromide as a Critical Use

The U. S. nomination is only for those facilities where the use of alternatives is not suitable. In U. S. food processing plants there are several factors that make the potential alternatives to methyl bromide unsuitable. These include:

- Pest control efficacy of alternatives: the efficacy of alternatives may not be comparable to methyl bromide, making these alternatives technically and/or economically infeasible.
- Geographic distribution of the facilities: some facilities are situated in areas where key pests usually occur at lower levels, such as those located in the northern part of the U. S. In such cases, the U. S. is only nominating a CUE for facilities where the key pest pressure is moderate to high.
- Age and type of facility: older food processing facilities, especially those constructed of wood, experience more frequent and severe pest infestations that must be controlled by fumigation.
- Constraints of the alternatives: some types of commodities (e.g., those containing high levels of fats and oils) prevent the use of heat as an alternative because of its effect on the final product (e.g., rancidity). Further, the corrosive nature of phosphine on certain metals

prevents its use in mechanical and electrical areas of the facilities. Additionally, both phosphine and sulfuryl fluoride are temperature sensitive.

- Transition to newly available alternatives: Sulfuryl fluoride recently received a Federal registration for portions of this sector. California, New York and Alaska have not registered sulfuryl fluoride at the time of this analysis. Further, it will take some time for applicators to be trained in the use of this chemical and for its incorporation into a pest control program. A registration decision concerning the establishment of sulfuryl fluoride tolerances on other processed food ingredients in a treated facility is still pending.
- Delay in plant operations: e.g., the use of some methyl bromide alternatives can add a delay to production by requiring additional time to complete the fumigation process. Production delays can result in significant economic impacts to the processors.

Over the last decade, food processing facilities in the United States have reduced the number of methyl bromide fumigations by incorporating many of the alternatives identified by MBTOC. The most critical alternative implemented is IPM strategies, especially sanitation, in all areas of a facility. Plants are now being monitored for pest populations, using visual inspections, pheromone traps, light traps and electrocution traps. When insect pests are found, plants will attempt to contain the infestation with treatments of low volatility pesticides applied to both surfaces and cracks and crevices. These techniques do not disinfest a facility but are critical in monitoring and managing pests. However, when all these methods fail to control a pest problem, facilities will resort to phosphine, heat, and if all else fails, to methyl bromide.

Many facilities in the United States also are using both phosphine and heat treatments to disinfest at least portions of their plants. Phosphine, alone and in combination with carbon dioxide, is often used to treat both incoming grains and finished products. Unfortunately, phosphine is corrosive to copper, silver, gold and their alloys. These metals are critical components of both the computers that run the machines as well as some of the machines themselves. Therefore, phosphine is not feasible in all areas of food processing facilities. Additionally, phosphine requires more time to kill insect pests than does methyl bromide, so plants need to be shut down longer to achieve mortality, resulting in economic losses. There are also reports of stored product pests becoming resistant to phosphine (Taylor, 1989; Bell, 2000; Mueller, 2002).

Heat treatments have a number of problems in this industry. Not all areas of a plant can be efficiently treated with heat. Some food substances, for instance oils and butters will become rancid with heat treatments. Not all finished food products can be heated for the length of time heat is required for efficient kill of pests. In addition, geography of the United States plays a crucial role in the use of heat treatments. Food processing plants in the northern United States will experience winters with several weeks of sustaining temperatures of -32° to -35° C (-30° to -25° F). In these areas plants have heaters and the power plants have the capacity to supply excess power as needed. However, the southern and parts of the western zones of the United States are geographically quite different. Winter temperatures there seldom reach –1.2° C (30° F) and when temperatures should fall that low, it is typically for only a few hours one night. For many winters, these areas of the U. S. don’t freeze at all. Subsequently, these facilities do not have heaters, nor do the power plants have enough power to allow them to heat such large areas and sustain the temperatures necessary for an effective kill of pest populations. Still, many southern and western facilities use heat treatments as a spot treatment whereas the northern facilities can use heat treatments more extensively.

Sulfuryl fluoride was registered in the U.S. in January of 2004 for rice mills and flour mills. There are some constraints with this new fumigant: it has not been registered in California or New York; it is temperature dependent; and it requires extensive training of the applicators to proficiently use the computerized fumigation guide. Several mills used sulfuryl fluoride this summer to fumigate their facilities. The industry is trying to incorporate this new fumigant into their best management practices.

**TABLE A.1: EXECUTIVE SUMMARY***

| | RICE MILLER'S ASSOCIATION | BAKERIES | PET FOOD INSTITUTE | NORTH AMERICAN MILLER'S ASSOCIATION |
|---|---|---|---|---|
| **2007 Requested Amount (kg)** | 200,488 | 23,814 | 44,906 | 317,514 |
| **2007 Nominated Amount * (kg)** | 64,150 | 23,814 | 39,275 | 274,650 |

*See Appendix C for complete description of how the nominated amount was calculated.

## 6. METHYL BROMIDE CONSUMPTION FOR PAST 5 YEARS AND AMOUNT REQUESTED IN THE YEAR(S) NOMINATED FOR FOOD PROCESSING PLANTS :

**TABLE 6.1: METHYL BROMIDE CONSUMPTION FOR THE PAST 5 YEARS AND THE AMOUNT REQUESTED IN THE YEAR(S) NOMINATED FOR FOOD PROCESSING PLANTS**

| | HISTORICAL USE[1,2] | | | | | | REQUESTED USE |
|---|---|---|---|---|---|---|---|
| **For each year specify:** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2007** |
| **Amount of MB (kg)** | 688,441 | 676,668 | 634,234 | 561,276 | 535,596 | 565,567 | 586,721 |
| **Volume Treated (1000 m³)** | 25,518 | 25,788 | 25,880 | 25,321 | 24,553 | 26,105 | 26,040 |
| **Formulation of MB** | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| **Dosage Rate (kg/1000 m³)** | 25.43 | 25.02 | 24.32 | 23.14 | 22.75 | 20.98 | 22.86 |

[1]Best available estimate of United States Government
[2]Based on most current information.

## 7. LOCATION OF THE FACILITY OR FACILITIES WHERE THE PROPOSED CRITICAL USE OF METHYL BROMIDE WILL TAKE PLACE

This nomination package represents 275 food processing facilities across the United States. These facilities are distributed across the United States from subtropical environments of Florida to the cold northern areas of the Great Plains. The location of each facility where methyl bromide fumigations may take place was not requested by the U.S. Government in the forms filled out by the applicants. Therefore, we currently do not have a complete listing of the actual addresses for each facility. However, we have sent out an additional survey requesting this information, after receipt, compilation, analysis, and fact checking, this information will be sent to MBTOC. In addition, a full list of all processing plants that apply any registered pesticide in the U.S. is available from the U.S. Department of Labor, Occupational Safety and Health Administration website located at http://www.osha.gov/pls/imis/sicsearch.html. EPA's Facility Registry System is publicly available and is located at http://www.epa.gov/enviro/html/fii/ez.html. This information was previously submitted in August of 2004.

## PART B: SITUATION CHARACTERISTICS AND METHYL BROMIDE USE

### 8. KEY PESTS FOR WHICH METHYL BROMIDE IS REQUESTED

**TABLE 8.1: KEY PESTS FOR METHYL BROMIDE REQUEST**

| GENUS AND SPECIES OF MAJOR PESTS FOR WHICH THE USE OF METHYL BROMIDE IS CRITICAL | COMMON NAME | SPECIFIC REASON WHY METHYL BROMIDE IS NEEDED |
|---|---|---|
| *Tribolium confusum* | Confused flour beetle | Pest status is due to health hazard: allergens; plus body parts, exuviae, and excretia violate Food and Drug Administration (FDA) regulations[1]. Methyl bromide is needed because these insects can occur in areas with electronic equipment and materials that cannot tolerate high temperatures (i.e. cooking) so phosphine and heat are not completely adequate. |
| *Tribolium castaneum* | Red flour beetle | |
| *Trogoderma variable* | Warehouse beetle | Health hazard: choking and allergens; plus body parts, exuviae, and excretia violate FDA regulations[1]. Methyl bromide is needed because these insects can occur in areas with electronic equipment and materials that cannot tolerate high temperatures (i.e. cooking) so phosphine and heat are not completely adequate. |
| *Lasioderma serricorne* | Cigarette beetle | Food contamination violates FDA regulations[1]. Methyl bromide is needed because these insects can occur in areas with electronic equipment and materials that cannot tolerate high temperatures (i.e. cooking of some products; oils and butter go rancid with heat) so phosphine and heat are not completely adequate. |
| *Sitophilus oryzae* | Rice weevil | |
| *Plodia interpunctella* | Indianmeal moth | |
| *Oryzaephilus mercator* | Merchant grain beetle | |
| *Cryptolestes pusillus* | Flat grain beetle | |

[1] FDA regulations can be found at: http://www.fda.gov/opacom/laws/fdcact/fdcact4.htm and http://www.cfsan.fda.gov/~dms/dalbook.html.

**TABLE B.1: CHARACTERISTIC OF SECTOR - FOOD PROCESSING PLANTS: FLOUR MILLS, BAKERIES, AND PET FOOD FACILITIES**

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Harvest or Raw Material In** | X | X | X | X | X | X | X | X | X | X | X | X |
| **Fumigation Schedule (MB)*** | | | | | X | | | | X | | | |
| **Retail Target Market Window** | Not Applicable | | | | | | | | | | | |

* Plants in the southern United States may fumigate twice a year; plants in the northern United States may fumigate once every 3 years. However, fumigations may occur whenever a population explosion occurs.

Although fumigations occur at anytime a pest population explosion occurs, usually food-processing plants in the southern and western areas of the United States will be fumigated with methyl bromide on 3-day holiday weekends just prior to the summer and at summer's end. This maximizes efficiency since the facilities are usually closed and workers are not present; and prior to and immediately after very warm temperatures that increases insect pressure.

**TABLE B.2: CHARACTERISTICS OF SECTOR - FOOD PROCESSING PLANTS: RICE MILLS**

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Harvest or Raw Material In** | X | X | X | X | X | X | X | X | X | X | X | X |
| **Fumigation Schedule (MB)*** | | | | | | | | | | | | |
| **Retail Target Market Window** | Not Applicable | | | | | | | | | | | |

Rice Mills are fumigated, on average, about 5 times a year, whenever pests are a problem.

Most rice mills are located in the southern areas of the United States, which experience high temperatures year round. Subsequently these mills are under extreme insect pressure all year long. Therefore, the average number of fumigations exceeds the average of the other members of this sector.

## 9. SUMMARY OF THE CIRCUMSTANCES IN WHICH THE METHYL BROMIDE IS CURRENTLY BEING USED

**TABLE 9.1: (a) FOOD PROCESSING PLANTS**

| CUE | MB DOSAGE (Kg/m³) | EXPOSURE TIME (*hours*) | TEMP. (°C) | NUMBER OF FUMIGATIONS PER YEAR | PROPORTION OF FACILITY TREATED AT THIS DOSE | FIXED (F) MOBILE (M) STACK (S) |
|---|---|---|---|---|---|---|
| **Rice Miller's Association** | 32 | 24 | variable | 5 | 100% * | F |
| **Bakeries North America** | 18 | 24 | variable | 2.5 | 100% | F |
| **Pet Food Institute** | 22 | 24 | variable | < 1<br>Avg. 1application/1-2 yrs** | 80% | F |
| **North American Millers' Association** | 19 | 24 | variable | 2.5 | 100 % | F |

*Unspecified type of rice is also fumigated along with the facilities.

** Highly variable. Some facilities need fumigating 2/year, but other facilities fumigate once every 3-5 years.

**TABLE 9.1: (b) FIXED FACILITIES**

| CUE | TYPE OF CONSTRUCTION AND APPROXIMATE AGE IN YEARS | % FACILITIES AT VOLUMES (1,000*m*³) | NUMBER OF FACILITIES | GASTIGHTNESS ESTIMATE* |
|---|---|---|---|---|
| **Rice Miller's Association** | Combination of wood, stone, brick, metal, and concrete | 5% 1,416-28,317<br>90+% 28,317+ | 22 | Poor to very poor |
| **Bakeries North America** | Combination of wood, stone, brick, metal, and concrete | 28,317+ | 11 | 55% good, 27% fair, 18% poor |
| **Pet Food Institute[1]** | Combination of wood, stone, brick, metal, and concrete | 25% 1,416-28,317<br>75% 28,317+ | 75 | Good to poor areas |
| **North American Millers' Association** | Wood, stone, brick, concrete, metal; some about 100 yrs old, only a few less than 10 years old | 50% <28<br>50% >28-142 | 167 | 10% good, 10% medium, 75% poor, 5% very poor |

* Give gastightness estimates where possible according to the following scale: **good** – less than 25% gas loss within 24 hours or half loss time of pressure difference (e.g. 20 to 10 Pa ($t_{1/2}$)) greater than 1 minute; **medium** – 25-50% gas loss within 24 hours or half loss time of pressure difference greater than 10 seconds; **poor** – 50-90% gas loss within 24 hours or half loss time of pressure difference 1-10 second; **very poor** – more than 90% gas loss within 24 hours or a pressure half loss time of less than 1 second.

[1] See Appendix A for more information.

## 10. LIST ALTERNATIVE TECHNIQUES THAT ARE BEING USED TO CONTROL KEY TARGET PEST SPECIES IN THIS SECTOR

Many of the MBTOC not in kind alternatives to methyl bromide are critical to monitoring pest populations and managing those populations, but they do not disinfest food processing. The most critical of these alternatives are sanitation and IPM strategies. Sanitation is important and constantly addressed in management programs (Arthur and Phillips 2003). Cleaning and hygiene practices alone do not reduce pest populations, but reportedly improve the efficacy of insecticides or diatomaceous earth (Arthur and Phillips 2003). The principles of IPM are to utilize all available chemical, cultural, biological, and mechanical pest control practices. These include pheromone traps, electrocution traps**,** and light traps to monitor pest populations. If pests are found in traps, then contact insecticides and low volatility pesticides are applied in spot treatments for surfaces, cracks and crevices, or anywhere the pests may be hiding. These applications are intended to restrict pests from spreading throughout the facility to try to avoid a plant fumigation (Arthur and Phillips 2003). However, IPM is not designed to completely eliminate pests from any given facility or to ensure that a facility remains free from infestation. Although FDA allows minimal contamination of food products, U.S. consumers have a zero tolerance for visible insect contamination in their food products. While sanitation and IPM strategies are used to manage pest populations and extend the time between methyl bromide fumigations, neither is an acceptable alternative to methyl bromide under high pest pressure.

Many food processing facilities in the United States also use heat treatments to reduce insect populations. However, some areas (electronics and electrical portions) of facilities are sensitive to heat. Heat also causes rancidity in butters and oils and denatures proteins that may be used in the ingredients, plus, not all manufactured products can be heated to the temperature or for the time required in order to get an effective kill of insect pests. Some facilities, due to construction, are unable to use heat. There have been reports of structural damage resulting from heat treatments. Facilities in the southern and western parts of the United States do not have heat sources on the premises thereby making heat fumigations impractical without costly investments that are not economically feasible.

Phosphine, alone and in combination with carbon dioxide, is used to fumigate portions of food processing facilities.  Many facilities treat incoming raw ingredients and their storage facilities with phosphine, but the corrosive nature of phosphine limits its use throughout the entire plant, especially in areas with electronic components.  In the United States it is specifically against the label (illegal) to fumigate in areas with susceptible metals (at: http://oaspub.epa.gov/pestlabl/ppls).  Phosphine is also problematic in that some stored product pests are developing resistance to this chemical (Taylor, 1989, Bell, 2000, Mueller, 2002).

Food processing facilities in the United States have incorporated sanitation, IPM strategies, heat and phosphine and yet, on occasion, insect pest populations will still become too high and a facility will need to fumigate with methyl bromide.  However, by employing these alternatives, this sector has been able to lengthen times between methyl bromide applications, thereby reducing the total amount of methyl bromide.  However, in some areas of the country, information suggests that some processors may employ a marginal strategy without major economic dislocation if given a reasonable time frame for the transition.  The assessment of need was adjusted to account for this.

# PART C: TECHNICAL VALIDATION

## 11. Summarize the Alternative(s) Tested, Starting with the Most Promising Alternative(s)

**Table 11.1: Summary of the Alternatives Tested**

| Alternative | Pest | Study Type | Results | Citation |
|---|---|---|---|---|
| Heat | *T. castaneum* | Pilot feed and flour mills; | Insects contained in plastic boxes. Non-uniform heat. Number of hours to reach 50° C varied between the mills and within mills. 100% mortality at most locations of 50-60°C for 52 hrs. Old instars and pupae more heat tolerant | Mahroof, et al. 2003 |
| Heat | *T. castaneum* | Lab | Mortality of each life stage increased with increase in temperature and exposure time. Young larvae most heat- tolerant and required 7.2 hr at >50°C. | Mahroof, et al. 2003 |
| Heat and Diatomaceous Earth (DE) | *T. castaneum* & *T. confusum* | Lab | Mortality increased as temperature increased and decreased as humidity increased. Mortality at one week was greater than initial mortality probably due to delayed effects of DE. *T. confusum* mortality lower than *T. castaneum*. | Arthur 2000 |
| Heat and DE | *T. confusum* | 2nd & 3rd floors of a Pilot flour mill | Adult insects in open rings placed in mill. 100% mortality of beetles in 25 hr on the north end of the 3rd floor, but south end of 2nd floor had only 75% mortality with full DE and 50% mortality with partial DE after 64 hr. | Dowdy & Fields 2002 |
| DE | *Ephestia kuehniella* | Lab | Efficacy was influenced by age of the medium with DE when investigated under driest conditions (58% rh). But this is not a pest of concern in the U. S. | Nielsen 1998 |
| Low volatility insecticides | *T. castaneum* & *T. confusum* | Lab | Field collected flour beetles demonstrated varying degrees of resistance to several pesticides: malathion, chlorpyrifos, dichlorvos, phosphine, but not to resmethrin. *T. castaneum* more resistant than *T. confusum*. | Zettler 1991 |
| Mountain Sagebrush Volatiles | *Rhyzopertha dominica; P. interpunctella;* & *T. castaneum* | Lab | Initial investigation of volatiles from mountain sagebrush demonstrated some activity in against these insects in bioassays. No indication of whether this is really a potential alternative | Dunkel & Sears 1998 |
| Low volatility insecticides | *T. castaneum* & *T. confusum* | Lab | Malathion-resistant flour beetles were susceptible to cyfluthrin treated steel panels. Longer residuals on unpainted panels than on painted panels | Arthur 1992 |

| ALTERNATIVE | PEST | STUDY TYPE | RESULTS | CITATION |
|---|---|---|---|---|
| DEET (N, N-diethyl-m-toluamide) and NEEM (azadirachthin) | *T. castaneum and others* | Lab | DEET repelled *S. oryzae* by 99%, *T. castaneum* by 86%, *Cryptolestes ferrugineus* by 97% and *O. surinamensis* by 91% Neem was less effective than DEET | Hou, et al. 2004 |

**TABLE 11.2: SUMMARY OF REVIEW OR POSITION PAPERS CONCERNING ALTERNATIVES FOR STORED PRODUCT PESTS**

| SYNOPSIS OF REVIEW OR POSITION PAPERS | CITATION |
|---|---|
| Review of methyl bromide alternatives for stored product insects:<br>1) heat: gradients in buildings, insect refugia, rate can be problematic due to structures, some equipment heat sensitive, plastics warp, dust explosions, sugar, oils, butter & adhesives removed, not all food products can be heated;<br>2) phosphine: activity slow, flammability above concentrations of 1.8% by volume, corrosion of copper, silver, and gold, no data for in combination with $CO_2$ and heat;<br>3) modified atmospheres: activity slow, requires air-tight structures;<br>4) sulfuryl fluoride[1]: eggs require much higher concentrations than larvae for control | Fields & White 2002 |
| Cites studies on: the development of resistance to phosphine in stored product pests; interaction of time, temperature and concentration of performance of phosphine; sulfuryl fluoride's difficulty in killing egg stage; Tables comparing phosphine to methyl bromide (Appendix B, Table 1). | Bell 2000 |
| Theoretical paper based on a few lab studies and small field crop trials indicating that traps currently used for monitoring pest populations could be used to reduce those populations. No studies on a commercial scale or food processing/storage facility were present. | Cox 2004 |
| Mostly lab studies on assorted stored product pests indicate that IGRs, especially methoprene and diflubenzuron, may play a role in controlling these insects | Oberlander, et al. 1997 |
| A simulation model in Denmark suggests that increase temperatures inside mills drives moth outbreaks and if mills were cooled to outdoor temperatures, moth outbreaks would be less frequent. | Skovgard, et al. 1999 |
| Investigations into chemical control strategies should include a thorough examination of physical, biological and environmental factors that can affect pesticide toxicity. These include: application rate, formulation, timing, surface substrate, and target pest. WP formulation of cyfluthrin applied to concrete lasted longer than the EC formulation. *T. confusum* was more susceptible than *T. castaneum* to WP. | Zettler & Arthur 2000 |

[1]Sulfuryl fluoride was not extensively reviewed because at the time the review was written there were no tolerances for food established in either the United States or Canada. More information regarding this chemical can be found in Section 17.2.1.

## 12. Summarize Technical Reasons, if any, for each Alternative NOT being Feasible or Available for your Circumstances (*For economic constraints, see Question 15*)

**Table 12.1: Summary of Technical Reason for each Alternative NOT being Feasible or Available**

| In Kind Alternatives | Technical Feasibility | Comments |
|---|---|---|
| Carbon Dioxide (high pressure) | No | Facilities in the United States are not airtight enough for modified atmospheres or carbon dioxide to be effective primarily because most are more than 25 years old.<br><br>To implement these alternatives would require new construction of all facilities. |
| Controlled & Modified Atmospheres | No | |
| Ethyl/Methyl Formate | No | Not registered in United States (last product cancelled in Oct. 1989) |
| Hydrogen Cyanide | No | Not registered in United States (last product cancelled in Feb. 1988) |
| Phosphine, alone | No | Although does kill insects, it is corrosive to metals, especially copper and its alloys, bronze and brass. These metals are important components of the electronics that run the manufacturing equipment and some of the equipment itself (for example: motors, mixers, etc.). In addition, phosphine requires longer application time. This alternative is already being used in the areas without electronics and where temperatures are not a factor. Resistance to this fumigant has also been reported for several stored product pests.<br><br>This alternative has already been implemented in areas without sensitive metals. |
| Phosphine, in combination | No | |
| Sulfuryl fluoride | Unknown | Recently registered in United States for some uses in this sector on January 23, 2004. The use of this chemical will require training of applicators by registrant, and each state must register this product as well. Efficacy of this chemical remains to be demonstrated in the field.<br><br>May take up to 5 years before we know if it will replace methyl bromide and for industry conversion. See Section 17.2.1. |
| **Not in Kind Alternative** | **Technical Feasibility** | **Comments** |
| Heat Treatment | No | Sufficiently high temperature will kill insects given enough time; but heat sources are not readily available in all areas of United States (such as those in the south where hot weather is the norm and no heaters are available); and heat requires longer time of exposure. In areas that can use heat, it is being used. It is not feasible in remaining plants or areas of a plant.<br><br>In order to completely replace methyl bromide, some facilities would need to be relocated and others would need major reconstruction. |
| Cold Treatment | No | Does not disinfest facilities. Most of these IPM strategies are currently practiced and widely implemented with the beneficial result of lengthening time between fumigations. Facilities use sanitation and cleaning to maintain their plants. They monitor populations with pheromone traps. They try to limit incoming pests with electrocution traps by entrances/exits. When populations are discovered, they use |
| Contact Insecticides | No | |
| Cultural Practices | No | |
| Electrocution | No | |
| Inert Dust | No | |

| | | |
|---|---|---|
| Pest Exclusion/Physical Removal | No | physical removal and contact insecticides and low volatility pesticides. Facilities maintain rodenticide bait stations around their perimeter.<br><br>These IPM strategies are not a replacement for methyl bromide, but do lengthen time between fumigations. |
| Pesticides of Low Volatility | No | |
| Pheromones | No | |
| Physical Removal/Cleaning /Sanitation | No | |
| Rodenticide | No | |

**TABLE 12.2: COMPARISON OF ALTERNATIVES TO METHYL BROMIDE FUMIGATION**

| FUMIGANT | PREPARATION TIME (HR) | FUMIGATION TIME (HRS) | DISSIPATION TIME (HRS) | MINIMUM NUMBER OF APPLICATIONS TO REPLACE ONE MB APPLICATION* |
|---|---|---|---|---|
| Methyl Bromide | 24 | 24 | 24 | -- |
| Phosphine, alone | 24 | 48-72 | 24 | 2 |
| Phosphine + CO2 | 24 | 48-72 | 24 | 1-2 |
| Heat | 36 | 48-52 | 24 | 2 |

* Additional treatments with the alternatives may be required because they are less effective on the eggs and pupae than methyl bromide.

## PART D: EMISSION CONTROL

### 13. HOW HAS THIS SECTOR REDUCED THE USE AND EMISSIONS OF METHYL BROMIDE IN THE SITUATION OF THE NOMINATION?

By using sanitation and IPM the industry has been able to reduce methyl bromide use by extending the time between fumigations. According to the applicants, 10-12 years ago, plants in the southern United States used to fumigate with methyl bromide as much as 4-6 times a year. Currently, most southern facilities have reduced the number of methyl bromide fumigations to twice a year. These fumigations are typically at the beginning of the summer when pest pressure is significantly increasing and at the end of the summer.

In the northern regions of the United States, IPM strategies and sanitation methods have enabled some of these facilities to fumigate with methyl bromide once every 3 years, and a few facilities have gone without a methyl bromide fumigation for almost 5 years. The facilities in the northern United States have been able to exploit heat treatments more extensively than their southern counterparts, as well as opening up facilities during extremely cold weather for extensive cleaning coupled with low volatility pesticides (organophosphates, pyrethroids, insect growth regulators, botanicals) at the perimeters.

## PART E: ECONOMIC ASSESSMENT

### 14. COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD

**TABLE 14.1: ANNUAL COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER A 3-YEAR PERIOD**

| MB AND ALTERNATIVES | COST RATIO | COST IN CURRENT YEAR (US$) | COST ONE YEAR AGO (US$) | COST 2 YEARS AGO (US$) |
|---|---|---|---|---|
| **Rice Miller's Association** | | | | |
| Methyl Bromide | 1 | $2,596 | $2,596 | $2,596 |
| Sulfuryl Flouride** | 1.3 | $3,438 | $3,438 | $3,438 |
| Heat | 1.5 | $3,894 | $3,894 | $3,894 |
| **Bakeries** | | | | |
| Methyl Bromide | 1 | $1,277 | $1,277 | $1,277 |
| Heat | 1.5 | $1,916 | $1,916 | $1,916 |
| **Pet Foods Institute** | | | | |
| Methyl Bromide | 1 | $519 | $519 | $519 |
| Heat | 1.5 | $779 | $779 | $779 |
| **North American Miller's Association** | | | | |
| Methyl Bromide | 1 | $1,277 | $1,277 | $1,277 |
| Sulfuryl Flouride** | 1.3 | $1,719 | $1,719 | $1,719 |
| Heat | 1.5 | $1,916 | $1,916 | $1,916 |

* Costs in this table only include only the fumigation cost or heat treatment. Losses such as reductions in revenue due to lost days are included in Tables E.1 though E.4.

### 15. SUMMARIZE ECONOMIC REASONS, IF ANY, FOR EACH ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE FOR YOUR CIRCUMSTANCES

**TABLE 15.1. SUMMARY OF ECONOMIC REASONS FOR EACH ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE**

| METHYL BROMIDE ALTERNATIVE | ECONOMIC REASON (IF ANY) FOR THE ALTERNATIVE NOT BEING AVAILABLE | ESTIMATED MONTH/YEAR WHEN THE ECONOMIC CONSTRAINT COULD BE SOLVED |
|---|---|---|
| Heat Treatment | For food processing facilities which are able to convert to heat treatment, economic losses are from additional production downtimes due to longer fumigation time and from capital expenditures required to adopt an alternative. There are other food processing facilities in areas of United States where heat treatment is not feasible. | Economic losses due to downtime with heat treatment are persistent. |

Potential economic losses were estimated for the food-processing facilities that have not been converted to heat treatment. This analysis only covers cases where heat treatment may potentially be technically feasible, and does not cover situations where heat would degrade the commodity being processed (those with fats and edible oils). Economic costs in the post-harvest uses of the food-processing sector can be characterized as arising from three contributing factors. First, the direct pest control costs are increased in most cases because heat treatment is more expensive, and labor is increased because of longer treatment time and increased number of treatments. For food-processing facilities that are not already using heat, capital expenditure is also required to retrofit them suitable for heat treatment. Moreover, additional production downtimes for the use of alternatives are unavoidable. Many facilities operate at or near full production capacity and alternatives that take longer than methyl bromide or require more frequent application can result in manufacturing slowdowns, shutdowns, and shipping delays. Slowing down production would result in additional costs to the methyl bromide users. Economic cost per 1000 $m^3$ was calculated as the additional costs of methyl bromide if methyl bromide users had to replace methyl bromide with heat treatment. Implementations of heat treatment likely have substantial cost implications to the facilities that have not been converted to heat in the food-processing sector.

The four economic measures in Table E.1 through E.4 were used to quantify the economic impacts to post-harvesting uses for food-processing. The four economic measures are not independent of each other since they can be calculated from the same financial data. The measures do, however, complement each other in evaluating the CUE applicant's economic viability. These measures represent different ways to assess the economic feasibility of methyl bromide alternatives for methyl bromide users.

***Net revenue is calculated as gross revenue minus operating costs. This is a good measure as to the direct losses of income that may be suffered by the users. It should be noted that net revenue does not represent net income to the users. Net income, which indicates profitability of an operation of an enterprise, is gross revenue minus the sum of operating and fixed costs. Net income should be smaller than the net revenue measured in this analysis. We did not include fixed costs because it is often difficult to measure and verify.***

Production downtime is estimated at almost two additional days per heat treatment. Potential economic losses associated with the use of heat treatment also include the cost of capital investment. The estimated economic losses are shown in Tables E.1 through E.4. The estimated economic loss as a percentage of net revenue are over 50% for all the CUE applicants in the food-processing sector and over 100% for the rice millers resulting in negative net revenues.

The costs of using sulfuryl fluoride were also estimated in Tables 14.1, E.1, and E.4 for rice and flour millers. For purposes of this analysis, current prices of sulfuryl fluoride and equal efficacy with methyl bromide were assumed. However, if methyl bromide were not available, the price of sulfuryl fluoride could rise in the future.

The industries that use methyl bromide for commodity fumigation are, in general, subject to limited pricing power, changing market conditions, and government regulations. Companies within these industries operate in a highly competitive global marketplace characterized by high sales volume, low profit margins, and rapid turnover of inventories. The results suggest that heat treatment is not economically viable as an alternative for methyl bromide in existing facilities that still use methyl bromide.

## MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

**TABLE E.1: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR RICE MILLER'S ASSOCIATION**

| LOSS MEASURE | METHYL BROMIDE | SULFURYL FLOURIDE | HEAT TREATMENT |
|---|---|---|---|
| GROSS REVENUE (US$/1000 M³) | $29,385 | $29,385 | $27,720 |
| - OPERATING COSTS (A+B) PER 1000 M³ | $27,916 | $28,758 | $29,429 |
| A) COST OF MB OR ALTERNATIVE | $2,596 | $3,438 | $3,894 |
| B) OTHER OPERATING COSTS | $25,320 | $25,320 | $25,535 |
| NET REVENUE (US$/1000 M³) (NET OF OPERATING COSTS) | $1,469 | $627 | ($1,709) |
| LOSS MEASURES | | | |
| TIME LOST (DAYS) | 0 DAYS | 0 days | 17 days |
| LOSS PER 1000 M³ (US$/1000 M³) | $0 | $843 | $3,178 |
| LOSS PER KILOGRAM MB (US$/KG) | $0 | $8.43 | $32 |
| LOSS AS A % OF GROSS REVENUE (%) | 0% | 3% | 11% |
| LOSS AS A % OF NET REVENUE (%) | 0% | 57% | 216% |

**TABLE E.2: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR BAKERIES**

| LOSS MEASURE | METHYL BROMIDE | HEAT TREATMENT |
|---|---|---|
| GROSS REVENUE (US$/1000 M³) | $258,334 | $250,584 |
| - OPERATING COSTS (A+B) PER 1000 M³ | $245,417 | $246,271 |
| A) COST OF MB OR ALTERNATIVE | $1,277 | $1,916 |
| B) OTHER OPERATING COSTS | $244,140 | $244,355 |
| NET REVENUE (US$/1000 M³) (NET OF OPERATING COSTS) | $12,917 | $4,313 |
| LOSS MEASURES | | |
| TIME LOST (DAYS) | 0 DAYS | 9 days |
| LOSS PER 1000 M³ (US$/1000 M³) | $0 | $8,604 |
| LOSS PER KILOGRAM MB (US$/KG) | $0 | $181 |
| LOSS AS A % OF GROSS REVENUE (%) | 0% | 3% |
| LOSS AS A % OF NET REVENUE (%) | 0% | 67% |

**TABLE E.3: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR PET FOOD INSTITUTE**

| LOSS MEASURE | METHYL BROMIDE | HEAT TREATMENT |
|---|---|---|
| GROSS REVENUE (US$/1000 M³) | $175,452 | $170,773 |
| - OPERATING COSTS (A+B) PER 1000 M³ | $166,679 | $167,154 |
| A) COST OF MB OR ALTERNATIVE | $519 | $779 |
| B) OTHER OPERATING COSTS | $166,160 | $166,375 |
| NET REVENUE (US$/1000 M³) (NET OF OPERATING COSTS) | $8,773 | $3,619 |
| LOSS MEASURES | | |
| TIME LOST (DAYS) | 0 DAYS | 8 days |
| LOSS PER 1000 M³ (US$/1000 M³) | $0 | $5,153 |
| LOSS PER KILOGRAM MB (US$/KG) | $0 | $258 |
| LOSS AS A % OF GROSS REVENUE (%) | 0% | 3% |
| LOSS AS A % OF NET REVENUE (%) | 0% | 59% |

**TABLE E.4: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR NORTH AMERICAN MILLER'S ASSOCIATION**

| LOSS MEASURE | METHYL BROMIDE | SULFURYL FLOURIDE | HEAT TREATMENT |
|---|---|---|---|
| GROSS REVENUE (US$/1000 M³) | $437,472 | $437,472 | $424,348 |
| - OPERATING COSTS (A+B) PER 1000 M³ | $415,598 | $416,040 | $416,452 |
| A) COST OF MB OR ALTERNATIVE | $1,277 | $1,719 | $1,916 |
| B) OTHER OPERATING COSTS | $414,321 | $414,321 | $414,536 |
| NET REVENUE (US$/1000 M³) (NET OF OPERATING COSTS) | $21,874 | $21,432 | $7,896 |
| LOSS MEASURES | | | |
| TIME LOST (DAYS) | 0 DAYS | 9 days | 9 days |
| LOSS PER 1000 M³ (US$/1000 M³) | $0 | $442 | $13,978 |
| LOSS PER KILOGRAM MB (US$/KG) | $0 | $9.30 | $294 |
| LOSS AS A % OF GROSS REVENUE (%) | 0% | 0.1% | 3% |
| LOSS AS A % OF NET REVENUE (%) | 0% | 2% | 64% |

## PART F: FUTURE PLANS

### 16. PROVIDE A DETAILED PLAN DESCRIBING HOW THE USE AND EMISSIONS OF METHYL BROMIDE WILL BE MINIMIZED IN THE FUTURE FOR THE NOMINATED USE.

The industry is committed to studying how to improve insect control with IPM strategies and sanitation and to further reduce the number of methyl bromide fumigations. They are also continuing to pursue research of heat treatments to maximize efficiency. The United States government is supporting research in this sector (see Section 17.1) and the United States Environmental Protection Agency (U.S. EPA) has made registering methyl bromide alternatives a priority (see Section 17.2). U.S. EPA registered sulfuryl fluoride for some commodities and some mills on January 23, 2004 (see Section 17.2.1).

### 17. PROVIDE A DETAILED PLAN DESCRIBING WHAT ACTIONS WILL BE UNDERTAKEN TO RAPIDLY DEVELOP AND DEPLOY ALTERNATIVES FOR THIS USE:

#### 17.1. Research

The number of available insecticides that can be used in and around food plants, processing mills, and food warehouses in the U. S. has declined in recent years. The research and development of chemical alternatives to be used by this sector is a critical need in the U. S. The post-harvest food-processing sector has invested substantial time and funding into research and development of technically and economically feasible alternatives to methyl bromide. Past and current research focuses on the biology and ecology of the pests, primarily insect pests. To implement non-chemical controls and reduce methyl bromide use requires a thorough understanding of the pests in order to exploit their weaknesses. Some of these investigations have studied the effects of temperature and humidity on the fecundity, development, and longevity of a specific species. Other studies have been to determine the structural preferences and microhabitat requirements of a species. Studies of factors affecting population growth (interactions within and among species) have been conducted. However, there is still much research that needs to be done.

IPM and sanitation methods are also under investigation. Studies have focused on food plant design, engineering modifications for pest exclusion, and insect-resistant packaging. New research is demonstrating a potential to incorporate chemical repellents into packaging materials (Arthur and Phillips 2003). Further studies with pheromones and trapping strategies are helping to improve IPM in food processing plants.

The USDA is continuing to fund research projects for post-harvest/food processing plants. Such activities include:

> **Biology and Management of Food Pests (Oct 2002- Sep 2007)** to: examine the reproductive biology and behavior of storage weevils, Indianmeal moth, and red and confused flour beetles; determine the influence of temperature on the population growth, mating and development of storage pests, specifically storage weevils, Indianmeal moth,

and red and confused flour beetles; examine the use of $CO_2$ concentrations within a grain mass to predict storage weevils and flour beetle population growth; and examine the use of alternative fumigants on insect mortality (ozone, sagebrush, Profume®).

**Chemically Based Alternatives to Methyl Bromide for Post harvest and Quarantine Pests (Jul 2000 - Dec 2004)** to: develop quarantine/post harvest control strategies using chemicals to reduce arthropod pests in durable and perishable commodities; develop new fumigants and/or strategies to reduce methyl bromide use; develop technology and equipment to reduce methyl bromide emissions to the atmosphere; develop system approaches for control using chemicals combined with nonchemical methodologies which will yield integrated pest control management programs; and develop methods to detect insect infestations.

The rice milling industry has spent over U. S.$500,000 on research to develop alternatives since 1992, and plans to use additional pesticides, such as carbonyl sulfide, carbon dioxide, phosphine, magnesium phosphide (magtoxin), and dichlorvos (vapona) over the next few years. Non-chemical methods used by this sub-sector, to reduce methyl bromide use, include heat and cold treatments, and many individual companies are involved in further research and testing of alternatives. Industry experts have been trying to determine how best to incorporate sulfuryl fluoride into their IPM programs since its recent registration.

The bakery sector is implementing heat as an alternative at those facilities where heat is technically feasible. Currently, heat is being implemented at several facilities nationwide, but further trials are needed to determine the effects of heat on a long-term basis. However, older facilities with hardwood floors and plant electrical wiring systems are unsuitable for heat treatments. Other methods being used to reduce reliance on methyl bromide are: exclusion, cleaning, early detection, improved design of equipment, trapping, and other integrated pest management (IPM) approaches. Phosphine continues to be tested.

The flour milling industry is committed to IPM techniques in order to minimize reliance on any one tool. Many plants have reduced the amount of annual fumigations from 4-5 per year to 2-3 per year. Some of these facilities combine methyl bromide with carbon dioxide. Further, these applicants have authored three manuals on fumigation best practices, which are widely utilized throughout the industry. The industry continues to test high heat, phosphine, alone and in combination; and the combination of heat, phosphine, and carbon dioxide. In addition, industry experts have been trying to determine how best to incorporate sulfuryl fluoride into their IPM programs since its recent registration.

The Pet Food Institute has invested hundreds of thousands of dollars in research on a variety of alternatives to methyl bromide, including heat treatments. Sulfuryl fluoride was tested in an inactive pet food facility last year as well. They have made improvements in worker training, pest monitoring, and sanitation to greatly reduce the necessity for fumigations with methyl bromide, or any other fumigant.

### 17.2. Registration

Since 1997, the U.S. EPA has made the registration of alternatives to methyl bromide a high registration priority. Because the U.S. EPA currently has more applications pending in its registration review queue than the resources to evaluate them, U.S. EPA prioritizes the applications. By virtue of being a top registration priority, methyl bromide alternatives enter the science review process as soon as U.S. EPA receives the application and supporting data rather than waiting in turn for the U.S. EPA to initiate its review.

As one incentive for the pesticide industry to develop alternatives to methyl bromide, the Agency has worked to reduce the burdens on data generation, to the extent feasible while still ensuring that the Agency's registration decisions meet the Federal statutory safety standards. Where appropriate from a scientific standpoint, the Agency has refined the data requirements for a given pesticide application, allowing a shortening of the research and development process for the methyl bromide alternative. Furthermore, Agency scientists routinely meet with prospective methyl bromide alternative applicants, counseling them through the preregistration process to increase the probability that the data is done right the first time and rework delays are minimized

The U.S. EPA has also co-chaired the USDA/EPA Methyl Bromide Alternatives Work Group since 1993 to help coordinate research, development and the registration of viable alternatives. This coordination has resulted in key registration issues (such as worker and bystander exposure through volatilization, township caps and drinking water concerns) being directly addressed through USDA's Agricultural Research Service's U. S.$15 million per year research program conducted at more than 20 field evaluation facilities across the country. Also U.S. EPA's participation in the evaluation of research grant proposals each year for USDA's U. S.$2.5 million per year methyl bromide alternatives research has further ensured close coordination between the U.S. government and the research community.

Since 1997, the U.S. EPA has registered the following chemical/use combinations as part of its commitment to expedite the review of methyl bromide alternatives:

- 2000: Phosphine in combination to control stored product insect pests
- 2001: Indianmeal Moth Granulosis Virus to control Indianmeal moth in stored grains
- 2004: Sulfuryl fluoride as a post-harvest fumigant for stored commodities and some mills (see below).

#### 17.2.1. Sulfuryl Fluoride

On January 23, 2004, U.S. EPA registered sulfuryl fluoride as a post-harvest fumigant for grains and flour mills. While registration for these uses will provide opportunities to reduce methyl bromide use, it must be emphasized that such replacement, if feasible, will only occur gradually over time.

Alternatives must be tested by users and found technically and economically feasible before widespread adoption will occur. As noted by TEAP, a specific alternative, once available may take up to 5 fumigation cycles of use before efficacy can be determined in the specific circumstance of the user. The registrant is requiring that applicators be trained by them before using sulfuryl fluoride (there is a 3-tiered certification system). Several fumigation companies have teams trained by the registrant. Mills have begun testing sulfuryl fluoride in specific circumstances.

There are additional pesticide registration issues, however, that must be resolved before sulfuryl fluoride can be used in sectors for which the U. S. is nominating methyl bromide CUEs. Sulfuryl fluoride is being registered only for cereal and small grains and mills that contain and/or process these grains. Many mills also produce partial recipe products that contain such ingredients as sugar, leavening agents, hydrogenated oils, etc. The registration of sulfuryl fluoride does not include tolerances for these ingredients and therefore would not be allowed in these facilities. It is most likely that adoption of sulfuryl fluoride for some of these mills will be delayed until tolerances for these ingredients are sought by the registrant, reviewed by U.S. EPA, and granted (if they meet eligibility criteria).

States must also register sulfuryl fluoride. All states except California, New York, and Alaska have registered sulfuryl fluoride for these post harvest uses.

U.S. EPA currently has limited data on sulfuryl fluoride's performance relative to methyl bromide. We have little product performance data (direct comparisons to methyl bromide), no experience in how well it performs in different facilities and climates over multiple years, and no information on what costs might be associated with adopting sulfuryl fluoride. Based on the limited data currently available, U.S. EPA believes that within 4 years sulfuryl fluoride may be able to replace methyl bromide in up to 75% of the rice and flour mills. U.S. EPA is committed to monitoring sulfuryl fluoride use during the next few years to amend future CUE nominations.

## 18. Additional Comments

### Pheromone Traps

"One misconception about pheromone traps is that a pest population can be controlled by deploying these traps—that is not true for most situations. Traps usually attract only a small percentage of the population that is within the effective range of the trap. Also, female-produced sex pheromones attract only males; the females that lay eggs and perpetuate the infestation are not affected. Since males of the many insect species will mate with multiple females, any males that are not trapped can easily contribute to the production of a subsequent generation of pests. New methods are being researched for using pheromones in pest suppression, but current uses of pheromone traps are best used only for monitoring purposes." (Arthur and Phillips 2003)

### Sulfuryl Fluoride

There are some industry concerns regarding sulfuryl fluoride. Primarily that it is temperature dependent and that large concentrations are necessary to kill eggs. There is concern regarding mixing of bulk flour at a 10:1 ratio to meet tolerances. The post harvest industry is aware that sulfuryl fluoride, as Vikane®, is very expensive and they are very concerned that the price of sulfuryl fluoride as Profume® may be prohibitive to use at the concentrations required to control pests.

There have been a few reported problems with sulfuryl fluoride fumigations. One facility (ca 28,317 $m^3$ or1 million $ft^3$) was treated at a “less than all life stages” level, which did not control the insect infestation. Additionally, that particular mill is typically fumigated with 817 kg (1,800 lb) methyl bromide, but the May fumigation required 1,506 kg (3,321 lb) sulfuryl fluoride. This mill needed to be fumigated with methyl bromide about 8 weeks later. In this same facility, the calculated amount of sulfuryl fluoride was 2,371 kg (5,226 lb) for “complete kill”, at 30º C (86º F). A facility of similar size intended to fumigate at Thanksgiving, but the temperature would require 5,897 kg (13,000 lb) sulfuryl fluoride for “complete kill.” That facility decided to go with a methyl bromide fumigation based on volumes.

On page 6 of the sulfuryl fluoride label: “…bulk…wheat flour not removed from the fumigation area must be blended at a ratio of at least 10:1 or discarded to ensure wheat flour offered to consumers does not exceed commodity tolerances.” Many of the millers do not have the capacity to mix the fumigated bulk flour and are therefore finding this requirement to be a very difficult one to achieve.

## 19. CITATIONS


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## APPENDIX A. Supporting Data.

**APPENDIX A - TABLE 9.1(A): SUMMARY OF THE CIRCUMSTANCES OF CURRENT METHYL BROMIDE USE IN PET FOOD PROCESSING PLANTS**

| FACILITY NO. | METHYL BROMIDE DOSAGE | EXPOSURE TIME (*hours*) | EXTERIOR TEMP. (ºC) | NUMBER OF FUMIGATIONS PER YEAR | PROPORTION OF PRODUCT TREATED AT THIS DOSE | FIXED (F) MOBILE (M) STACK (S) |
|---|---|---|---|---|---|---|
| 1 Midwest | 16 g/$m^3$ | 24 | Day: 35-38 | 1 general 2 spot w/phos | 30% (1) | Fixed (2) |
| 2 Midwest | 16 g/$m^3$ | 24 | Day: 27 Night: 10 | 1 general | 40% (1) | Fixed (2) |
| 3 Southeast | 16 g/$m^3$ | 24 | 24 | 1 general | 16% (1) | Fixed (2) |
| 4 Southeast | 24 g/$m^3$ | 24 | 21 | 1 general | 15% (1) | Fixed (2) |
| 5 North | 18 g/$m^3$ | 24 | 15 – 25 (outside) | Approx. one | <10%(1) | Fixed (2) |
| 6 Midwest | 16 g/$m^3$ - 24 g/$m^3$ | 24 | 17.8 | Approx. one | 40%(1) | Fixed (2) |
| 7 West | 16 g/$m^3$ | 24 | 20.6 - 29.4 | Approx. one | 40%(1) | Fixed (2) |
| 8 Midwest | 16 g/$m^3$ | 24 | 31.7 - 36.7 | Approx. one | 50%(1) | Fixed (2) |

(1) Based on % of total volume treated
(2) Fixed = Fixed facility

**APPENDIX A - TABLE 9.1(B): SUMMARY OF THE CIRCUMSTANCES OF CURRENT METHYL BROMIDE USE IN PET FOOD PROCESSING PLANTS - FIXED FACILITIES: PET FOOD INSTITUTE**

| PEST NO. | TYPE OF CONSTRUCTION AND APPROXIMATE AGE IN YEARS | VOLUME ($m^3$) OR RANGE | NUMBER OF FACILITIES (E.G. 5 SILOS) | GAS TIGHTNESS ESTIMATE* |
|---|---|---|---|---|
| 1 Midwest | Tilt-up concrete, some corrugated metal | 184,800 $m^3$ | 1 | Medium Areas & Poor Areas |
| 2 Midwest | Tilt-up concrete | 114,800 $m^3$ | 1 | Good Areas & Medium Areas |
| 3 Southeast | Corrugated metal | 72,973 $m^3$ | 1 | Poor |
| 4 Southeast | Corrugated metal | 35,954 $m^3$ | 1 | Medium Areas & Poor Areas |
| 5 North | Corrugated Metal on slab (13 years) | 7,420 $m^3$ | < 1 (processing area only) | Good |
| 6 Midwest | Corrugated Metal on Slab | 218,400 $m^3$ | 1 | Medium |
| 7 West | Corrugated Metal on Slab | 28,759 $m^3$ | 1 | Medium to Poor |
| 8 Midwest | Poured Concrete Walls/ Slab Floor | 137,760 $m^3$ | 1 | Very Good |

* Give gastightness estimates where possible according to the following scale: **good** – less than 25% gas loss within 24 hours or half loss time of pressure difference (e.g. 20 to 10 Pa ($t_{1/2}$)) greater than 1 minute; **medium** – 25-50% gas loss within 24 hours or half loss time of pressure difference greater than 10 seconds; **poor** – 50-90% gas loss within 24 hours or half loss time of pressure difference 1-10 second; **very poor** – more than 90% gas loss within 24 hours or a pressure half loss time of less than 1 second.

## APPENDIX B. Published Performance Data.

**APPENDIX B - TABLE 1: EFFECT OF TEMPERATURE ON CONCENTRATION AND TIME THRESHOLDS FOR SOME PESTS OF STORED PRODUCTS. (FROM: BELL, C. H. 2000)**

| SPECIES | FUMIGANT | THRESHOLD (°C OR TIME) | TEMPERATURE (°C) | |
|---|---|---|---|---|
| | | | 15 | 25 |
| *Sitophilus oryzae* | Methyl Bromide | ºC (mg/l) | 0.6-0.9 | 1.3-2.0 |
| *Tribolium confusum* | Methyl Bromide | ºC (mg/l) | 1.3-2.0 | 2.5-3.0 |
| *Tribolium castaneum* | Methyl Bromide | ºC (mg/l) | 1.3-2.0 | 3.0-3.5 |
| *Tribolium castaneum* | Phosphine | ºC (mg/l) | | 0.005-0.0011 |
| *Tribolium castaneum* | Phosphine | Time (h) | | 0.5-1.5 |

For phosphine relatively long exposure times are required for kill of all stages & time threshold is more important than the concentration for efficient fumigant action.

**APPENDIX B - TABLE 2: CONCENTRATION-TIME PRODUCT RECOMMENDATIONS BY NATIONAL PEST MANAGEMENT ASSOCIATION**

| SPECIES | STAGE | TEMP (°C) | OUNCE-HOURS | | MG/L | |
|---|---|---|---|---|---|---|
| | | | PHOSPHINE 72 HR | PHOSPHINE 144 HR | METHYL BROMIDE | SULFURYL FLUORIDE |
| *Lasioderma serricorne* | eggs | 4.4 | | | 146.4 | |
| | eggs | 10 | 8.5 | 49.5 | 91.2 | |
| | eggs | 15.6 | 61.8 | 37.9 | 48 | |
| | eggs | 21.1 | 0.64 | 0.86 | 43.2 | |
| | eggs | 26.5 | | | | 711.7 |
| | larvae | 4.4 | 6.9 | 1.2 | 379.2 | |
| | larvae | 10 | 3.7 | 0.86 | 206.4 | |
| | larvae | 15.6 | 0.94 | 0.72 | 132 | |
| | larvae | 21.1 | 0.5 | 0.43 | 120 | |
| | larvae | 26.5 | | | | 55.9 |
| | pupae | 4.4 | 5.6 | 7.4 | 1046 | |
| | pupae | 10 | 5.6 | 4.6 | 324 | |
| | pupae | 15.6 | 5.2 | 1.3 | 124.8 | |
| | pupae | 21.1 | 0.58 | 0.3 | 108 | |
| | adult | 4.4 | 2.2 | 1.9 | 230.4 | |
| | adult | 10 | 1.8 | 1.1 | 105.6 | |
| | adult | 15.6 | 1 | 0.5 | 64.8 | |
| | adult | 21.1 | 0.36 | 0.3 | 57.6 | |
| | adult | 26.5 | | | | 34.9 |
| *Sitophilus oryzae* | adult | 21 | 0.36 | | 30 | |
| *Tribolium confusum* | eggs | 26.7 | | | | 1124.8 |
| | adult | 4.4 | | | 209.3 | 178.2 |
| | adult | 15.6 | | | 92.8 | 97.6 |
| | adult | 25 | 0.48 | | 64 | 55 |
| | adult | 26.7 | | | 74.2 | 76.5 |
| *Tribolium castaneum* | adult | 24 | 11.5 | | 62 | |
| *Plodia interpunctella* | eggs | 15 | | | 53 | |
| | eggs | 20 | | | 29 | |
| | eggs | 25 | | | 22 | |
| | eggs | 30 | | | 21 | |
| | larvae | 15 | | | 34 | |
| | larvae | 20 | | | 31 | |
| | larvae | 25 | | | 24 | |
| | larvae | 30 | | | 25 | |
| | pupae | 15 | | | 64 | |
| | pupae | 20 | | | 50 | |
| | pupae | 25 | | | 43 | |
| | pupae | 30 | | | 35 | |

# APPENDIX C. 2007 Methyl Bromide Usage Numerical Index (BUNI)

## Methyl Bromide Critical Use Exemption Process

## 2007 Methyl Bromide Usage Numerical Index (BUNI)

**Date:** 1/28/2005

**Sector:** STRUCTURES - FOOD FACILITIES

**Average Volume in the US:** Not Available

**% of Average Volume Requested:** Not Available

| | 2007 Amount of Request | | | 2001 & 2002 Average Use | | | Quarantine and Pre-Shipment | Regional Volume | | Research Amount (kgs) |
|---|---|---|---|---|---|---|---|---|---|---|
| FOOD FACILITY TYPE | Kilograms (kgs) | Volume (1000m$^3$) | Use Rate (kg/1000m$^3$) | Kilograms (kgs) | Volume (1000m$^3$) | Use Rate (kg/1000m$^3$) | | 2001 & 2002 Average | % of Volume | |
| RICE MILLER'S ASSOCIATION | 200,488 | 6,116 | 33 | 146,283 | 4,630 | 32 | 20% | Not Available | | 0 |
| BAKERIES | 23,814 | 1,206 | 20 | 28,354 | 1,515 | 19 | 0% | | | |
| PET FOOD INSTITUTE | 44,906 | 2,294 | 20 | 39,275 | 1,803 | 22 | 0% | | | |
| NORTH AMERICAN MILLER'S ASSOCIATION | 317,514 | 16,424 | 19 | 396,893 | 19,397 | 20 | 0% | | | |
| TOTAL OR AVERAGE | 586,721 | 26,040 | 23 | 610,805 | 27,345 | 22 | | | | |

| 2007 Nomination Options | Subtractions from Requested Amounts (kgs) | | | | | Combined Impacts Adjustment (kgs) | | Adoption / Transition Adjustment (kgs) | | MOST LIKELY IMPACT VALUE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FOOD FACILITY TYPE | 2007 Request | (-) Double Counting | (-) Growth | (-) Use Rate Adjustment | (-) QPS | HIGH | LOW | HIGH | LOW | Amount (kgs) | Volume (1000m$^3$) | Use Rate (kg/ 1000m$^3$) |
| RICE MILLER'S ASSOCIATION | 200,488 | - | 54,204 | 53,581 | 18,541 | 74,162 | 74,162 | 64,150 | 64,150 | 64,150 | 3,204 | 20 |
| BAKERIES | 23,814 | - | - | - | - | 23,814 | 23,814 | 23,814 | 23,814 | 23,814 | 1,272 | 19 |
| PET FOOD INSTITUTE | 44,906 | - | 5,630 | - | - | 39,275 | 39,275 | 39,275 | 39,275 | 39,275 | 2,006 | 20 |
| NORTH AMERICAN MILLER'S ASSOCIATION | 317,514 | - | - | - | - | 317,514 | 317,514 | 274,650 | 274,650 | 274,650 | 14,207 | 19 |
| Nomination Amount | 586,721 | 586,721 | 526,887 | 473,306 | 454,766 | 454,766 | 454,766 | 401,889 | 401,889 | 401,889 | 20,689 | 19 |
| % Reduction from Initial Request | 0% | 0% | 10% | 19% | 22% | 22% | 22% | 32% | 32% | 32% | 21% | 14% |

| Adjustments to Requested Amounts | Use Rate (kg/1000m$^3$) | | (%) Key Pest Distribution | | (%) Combined Impacts | | (%) Adopt New Fumigants | | Time, Quality, or Product Loss | Marginal Strategy |
|---|---|---|---|---|---|---|---|---|---|---|
| FOOD FACILITY TYPE | Low | EPA | High | Low | HIGH | LOW | % adopt | %per year | | |
| RICE MILLER'S ASSOCIATION | 32 | 20 | 100% | 100% | 100% | 100% | 54% | 14% | 0 days | Sulfuryl Fluoride* |
| BAKERIES | 19 | 19 | 100% | 100% | 100% | 100% | 0% | 0% | 9 days | heat |
| PET FOOD INSTITUTE | 20 | 20 | 100% | 100% | 100% | 100% | 0% | 0% | 8 days | heat |
| NORTH AMERICAN MILLER'S ASSOCIATION | 19 | 19 | 100% | 100% | 100% | 100% | 54% | 14% | 9 days | Sulfuryl Fluoride* |

| Other Considerations | Dichotomous Variables (Y/N) | | | Other Issues | | | Economic Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FOOD FACILITY TYPE | Currently Use Alternatives? | Research / Transition Plans | Pest-free Market Requirement | Change from Prior CUE Request (+/-) | Verified Historic MeBr Use / State | Frequency of Treatment /Yr | Loss per 1000 m$^3$ (US$/1000m) | Loss per Kg of MeBr (US$/kg) | Loss as a % of Gross Revenue | Loss as a % of Net Revenue |
| RICE MILLER'S ASSOCIATION | Y | Y | Y | 0 | N | 5x/1year | $ 843 | $ 8 | 3% | 57% |
| BAKERIES | Y | Y | Y | + | N | 2x/1year | $ 8,604 | $ 181 | 3% | 67% |
| PET FOOD INSTITUTE | Y | Y | Y | 0 | N | 1x/ year | $ 5,153 | $ 258 | 3% | 59% |
| NORTH AMERICAN MILLER'S ASSOCIATION | Y | Y | Y | - | N | 2.5x/1year | $ 442 | $ 9 | 0% | 2% |

Adopt new fumigants - Sulfuryl fluoride Percent of Market adoption depends on Registration Date, Cost, % of Structures that are suitable, SF not registered in CA or NY or AK

SF might also require registration on all the additives typically found in a mill or food processing plant EPA estimates are for an eventual 20 to 40% market share after complete registration.

**Conversion Units:** 1 Pound = 0.453592 Kilograms 1,000 cu ft = 0.028316847 1,000 cu m Most Likely Impact Value: High 24% Low 76%

**Footnotes for Appendix C:**

Values may not sum exactly due to rounding.

1. **Average Volume in the U.S.** – Average Volume in the U.S. is the average of 2001 and 2002 total volume fumigated with methyl bromide in the U.S. in this sector (when available).
2. **% of Average Volume Requested** - Percent (%) of Average Volume Requested is the total volume in the sector's request divided by the Average Volume in the U.S. (when available).
3. **2006 Amount of Request** – The 2006 amount of request is the actual amount requested by applicants given in total pounds active ingredient of methyl bromide, total volume of methyl bromide use, and application rate in pounds active ingredient of methyl bromide per thousand cubic feet. U.S. units of measure were used to describe the initial request and then were converted to metric units to calculate the amount of the U.S. nomination.
4. **2001 & 2002 Average Use** – The 2001 & 2002 Average Use is the average of the 2001 and 2002 historical usage figures provided by the applicants given in kilograms active ingredient of methyl bromide, total volume of methyl bromide use, and application rate in kilograms active ingredient of methyl bromide per thousand cubic meters. Adjustments are made when necessary due in part to unavailable 2002 estimates in which case only the 2001 average use figure is used.
5. **Quarantine and Pre-Shipment** – Quarantine and pre-shipment (QPS) is the percentage (%) of the applicant's requested amount subject to QPS treatments.
6. **Regional Volume, 2001 & 2002 Average Volume** – Regional Volume, 2001 & 2002 Average Volume is the 2001 and 2002 average estimate of volume of methyl bromide used within the defined region (when available).
7. **Regional Volume, Requested Volume %** - Regional Volume, Requested Volume % is the volume in the applicant's request divided by the total volume fumigated with methyl bromide in the sector in the region covered by the request.
8. **2006 Nomination Options** – 2006 Nomination Options are the options of the inclusion of various factors used to adjust the initial applicant request into the nomination figure.
9. **Subtractions from Requested Amounts** – Subtractions from Requested Amounts are the elements that were subtracted from the initial request amount.
   10. **Subtractions from Requested Amounts, 2006 Request** – Subtractions from Requested Amounts, 2006 Request is the starting point for all calculations. This is the amount of the applicant request in kilograms.
   11. **Subtractions from Requested Amounts, Double Counting** - Subtractions from Requested Amounts, Double Counting is the estimate measured in kilograms in situations where an applicant has made a request for a CUE with an individual application while a consortium has also made a request for a CUE on their behalf in the consortium application. In these cases the double counting is removed from the consortium application and the individual application takes precedence.
   12. **Subtractions from Requested Amounts, Growth or 2002 CUE Comparison** - Subtractions from Requested Amounts, Growth or 2002 CUE Comparison is the greatest reduction of the estimate measured in kilograms of either the difference in the amount of methyl bromide requested by the applicant that is greater than that historically used or treated at a higher use rate or the difference in the 2006 request from an applicant's 2002 CUE application compared with the 2006 request from the applicant's 2003 CUE application.
   13. **Subtractions from Requested Amounts, QPS** - Subtractions from Requested Amounts, QPS is the estimate measured in kilograms of the request subject to QPS treatments. This subtraction estimate is calculated as the 2006 Request minus Double Counting, minus Growth or 2002 CUE Comparison then multiplied by the percentage subject to QPS treatments. *Subtraction from Requested Amounts, QPS = (2006 Request – Double Counting – Growth)*(QPS %)*
   14. **Subtraction from Requested Amounts, Use Rate Difference** – Subtractions from requested amounts, use rate difference is the estimate measured in kilograms of the lower of the historic use rate or the requested use rate. The subtraction estimate is calculated as the 2006 Request minus Double Counting, minus Growth or 2002 CUE Comparison, minus the QPS amount, if applicable, minus the difference between the requested use rate and the lowest use rate applied to the remaining hectares.
15. **Adjustments to Requested Amounts** – Adjustments to requested amounts were factors that reduced to total amount of methyl bromide requested by factoring in the specific situations were the applicant could

use alternatives to methyl bromide. These are calculated as proportions of the total request. We have tried to make the adjustment to the requested amounts in the most appropriate category when the adjustment could fall into more than one category.

16. **Use Rate kg/ 1000 m$^3$ 2006** – Use rate in pounds per thousand cubic feet, 2006, is the use rate requested by the applicant as derived from the total volume to be fumigated divided by the total amount (in pounds) of methyl bromide requested.
17. **Use Rate kg/ 1000 m$^3$ low** – Use rate in pounds per thousand cubic feet, low, is the lowest historic use rate reported by the applicant. The use rate selected for determining the amount to nominate is the lower of this rate or the 2006 use rate (above).
18. **(%) Key Pest Impacts** - Percent (%) of the requested area with moderate to severe pest problems. Key pests are those that are not adequately controlled by MB alternatives. For structures/ food facilities and commodities, key pests are assumed to infest 100% of the volume for the specific uses requested in that 100% of the problem must be eradicated.
19. **Adopt New Fumigants (%)** – Adopt new fumigants (%) is the percent (%) of the requested volume where we expect alternatives could be adopted to replace methyl bromide during the year of the CUE request.
20. **Combined Impacts (%)** - Total combined impacts are the percent (%) of the requested area where alternatives cannot be used due to key pest, regulatory, and new fumigants. In each case the total area impacted is the conjoined area that is impacted by any individual impact. The effects were assumed to be independently distributed unless contrary evidence was available (e.g., affects are known to be mutually exclusive).
21. **Adaptation / Transition** - Estimate of the percentage of the weighted usage that can be transitioned to a marginal strategy. This estimate is for areas of the country where some processors may employ a marginal strategy without major economic dislocation if given a reasonable time frame for the transition.

22. **Qualifying Volume** - Qualifying volume (1000 cubic meters) is calculated by multiplying the adjusted volume by the combined impacts.
23. **CUE Nominated amount** - CUE nominated amount is calculated by multiplying the qualifying volume by the use rate.
24. **Percent Reduction** - Percent reduction from initial request is the percentage of the initial request that did not qualify for the CUE nomination.
25. **Sum of CUE Nominations in Sector** - Self-explanatory.
26. **Total U.S. Sector Nomination** - Total U.S. sector nomination is the most likely estimate of the amount needed in that sector.
27. **Dichotomous Variables** – dichotomous variables are those which take one of two values, for example, 0 or 1, yes or no. These variables were used to categorize the uses during the preparation of the nomination.
    28. **Currently Use Alternatives** – Currently use alternatives is 'yes' if the applicant uses alternatives for some portion of pesticide use on the crop for which an application to use methyl bromide is made.
    29. **Research/ Transition Plans** – Research/ Transition Plans is 'yes' when the applicant has indicated that there is research underway to test alternatives or if applicant has a plan to transition to alternatives.
    30. **Pest-free Market. Required** - This variable is a 'yes' when the product must be pest-free in order to be sold either because of U.S. sanitary requirements or because of consumer acceptance.
31. **Other Issues**.- Other issues is a short reminder of other elements of an application that were checked
    32. **Change from Prior CUE Request**- This variable takes a '+' if the current request is larger than the previous request, a '0' if the current request is equal to the previous request, and a '-' if the current request is smaller that the previous request. If the applicant has not previously applied the word 'new' appears in this column.
    33. **Verified Historic Use/ State**- This item indicates whether the amounts requested by administrative area have been compared to records of historic use in that area.
    34. **Frequency of Treatment** – This indicates how often methyl bromide is applied in the sector. Frequency varies from multiple times per year to once in several decades.
35. **Economic Analysis** – provides summary economic information for the applications.
    36. **Loss per 1000 m$^3$** – This measures the total loss per 1000 m$^3$ of fumigation when a specific alternative is used in place of methyl bromide. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative, such as longer time spent in the fumigation chamber. It is measured in current U.S. dollars.

37. **Loss per Kilogram of Methyl Bromide** – This measures the total loss per kilogram of methyl bromide when it is replaced with an alternative. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current U.S. dollars.
38. **Loss as a % of Gross revenue** – This measures the loss as a proportion of gross (total) revenue. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current U.S. dollars.
39. **Loss as a % of Net Operating Revenue** -This measures loss as a proportion of total revenue minus operating costs. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current U.S. dollars. This item is also called net cash returns.
40. **Quality/ Time/ Market Window/Yield Loss (%)** – When this measure is available it measures the sum of losses including quality losses, non-productive time, missed market windows and other yield losses when using the marginal strategy.
41. **Marginal Strategy** -This is the strategy that a particular methyl bromide user would use if not permitted to use methyl bromide.

## APPENDIX D. 2006 Methyl Bromide Reconsideration for Rice Mills

### Overview of the U.S. Nomination

The U.S. requested 505.982 metric tons of methyl bromide for use in mills and food processing facilities for 2006. The request was distributed as follows: 114.305 metric tons for rice mills, 14.742 metric tons for bakeries, 48.081 metric tons for pet food facilities, and 328.854 metric tons for flour mills. This is a request at the national level.

The U. S. nomination is only for those facilities where the use of alternatives is not suitable. In U. S. food processing plants there are several factors that make the potential alternatives to methyl bromide unsuitable. These include:

- Pest control efficacy of alternatives: the efficacy of alternatives may not be comparable to methyl bromide, making these alternatives technically and/or economically infeasible.
- Geographic distribution of the facilities: some facilities are situated in areas where key pests may occur at low levels, such as those located in the northern part of the U. S. In such cases, the U. S. is only nominating a CUE for facilities where the key pest pressure is moderate to high.
- Age and type of facility: older food processing facilities, especially those constructed of wood, experience more frequent and severe pest infestations that must be controlled by fumigation.
- Constraints of the alternatives: some types of commodities (e.g., those containing high levels of fats and oils) prevent the use of heat as an alternative because of its effect on the final product (e.g., rancidity). Further, the corrosive nature of phosphine on certain metals prevents its use in mechanical and electrical areas of the facilities.
- Transition to newly available alternatives: Sulfuryl fluoride recently received a Federal registration for small grains such as flour, rice, oats, etc. State registrations have not yet been issued for all states. Further, it will take some time for applicators to be trained in the use of this chemical and for its incorporation into a pest control program. A registration decision concerning the establishment of sulfuryl fluoride tolerances on other processed food ingredients in a treated facility is still pending.
- Delay in plant operations: e.g., the use of some methyl bromide alternatives can add a delay to production by requiring additional time to complete the fumigation process. Production delays can result in significant economic impacts to the processors.

MBTOC recommended a total of 394.843 metric tons of methyl bromide for this sector distributed as follows: 73.745 metric tons for rice mills, 14.742 metric tons for bakery uses, 43.273 for dry pet food premises, and 263.083 for flour mills. The total recommendation was for 394.843 metric tons of methyl for these uses in 2006.

MBTOC stated that proper sealing should allow rice mills to reduce their use rate from 31g/m 3 to 20 g/m3. Although there is no evidence that proper sealing procedures are not followed and that is the reason for the higher use rate than is common for the remainder of the sector, USG agrees that in general, a use rate of 20g/m$^3$ should allow for adequate control of pests but reserves the right to re-visit this issue should we become aware of data demonstrating that this level is not adequate to control pests in the specific circumstances of the nomination when appropriate practices (*eg* careful sealing of the building/container and other 'best practices') are followed. This reduction results in an amended U.S. request of 73.745 metric tons of methyl bromide for this portion of the sector as recommended by MBTOC.

MBTOC appears to believe that better sealing in rice facilities is necessary because they believe that facilities are treated five times per year. In this industry, the majority of the milling facilities are old and located in the southern US[1] (close to where rice is produced in Florida, Texas, Louisiana, Arkansas and California) where pest pressures are high and where insects are able to survive easily when driven outdoors by fumigation. In addition, bringing new batches of rice into the facilities can result in a re-infestation. USG does not think that there is further scope for reduction in rice mills.

MBTOC recommended that the use rate for pet food facilities be reduced from 22 to 20 $g/m^3$. USG agrees that in general, a use rate of 20$g/m^3$ should allow for adequate control of pests but reserves the right to re-visit this issue should we become aware of data demonstrating that this level is not adequate to control pests in the specific circumstances of the nomination when appropriate practices (*eg* careful sealing of the building/container and other 'best practices') are followed. This reduction results in an amended U.S. request of 44.417 metric tons of methyl bromide for this portion of the sector, an increase of 1.144 metric tons over the MBTOC recommended amount of 43.273 metric tons

MBTOC further recommended that the request for methyl bromide used in pet food facilities be reduced by 10% "to allow progressive adoption of fumigant alternatives such as sulfuryl fluoride (recently registered for flour mills (sic)[2], continuing adoption of heat technologies, improved sealing of buildings, and increased optimization of IPM techniques."

Sulfuryl fluoride is not registered for use on dry pet food. There is at present a legal question as to whether a registration is required (authorizing statute refers to "foods for human and other animals") or not required. Until this issue is clarified sulfuryl fluoride cannot be used on pet foods.

MBTOC has recommended a further reduction of 10% in the amount of methyl bromide that can be used to fumigate flour mills, citing increased adoption of sulfuryl fluoride in particular, and adoption of other alternatives more generally.

Addressing first the issue of sulfuryl fluoride; as already noted, sulfuryl fluoride is not registered in all States, nor is it registered on the additional components that transform flour into bread, cake, pancake and other mixes. It cannot, therefore, be used at all in some jurisdictions nor can it be used in many areas of 'combined' processing facilities.

[1] Location of the facilities is dictated by close proximity to the raw ingredients and to major markets. For example, the 22 rice mills are located primarily in Gulf Coast states and California.

[2] There is a Federal registration for sulfuryl fluoride use in flour mills, rice mills, and other small grain mills, however, many states have registration requirements in addition to the Federal requirements and until a pesticide has obtained a state 'label' it cannot be used. At present Sulfuryl Fluoride is registered in neither California nor New York and so cannot be use in those states.

The Montreal Protocol calls for a critical use nomination being granted when there are no alternatives that are both technically and economically feasible, There are companies that have committed themselves to using alternatives to methyl bromide regardless of the cost differences as long as they can continue to meet necessary sanitary standards. One such company shared their experience with sulfuryl fluoride with us[3]

A nine story flour mill (1.2 million cubic feet[4]) was fumigated with sulfuryl fluoride. The fumigation took place from October 1st to October 3rd. When this facility has been fumigated with methyl bromide the typical amount used has been between 1200 and 1500 lbs[5]. The fumigation with sulfuryl fluoride used 5250 lbs. at a temperature of 82[6] F over a 36 hour rather than a 24 hour period. Although fumigation with sulfuryl fluoride requires that the material be left in place for a longer period than is required for methyl bromide, this component does not add to the cost of the alternative in this instance as it is the practice of this company to conduct fumigations over a three day period to allow adequate time for preparation and for the gas to dissipate at the conclusion of the fumigation.

The cost of a methyl bromide fumigation is approximately $18,500 of which approximately 30-40% is the cost of the chemical. The remaining costs are preparing and sealing the building, monitoring, and unsealing at the conclusion of the fumigation. The cost of the sulfuryl fluoride fumigation was $48,000, nearly three times the cost of the methyl bromide fumigation. The ancillary costs (prepping, sealing, monitoring, unsealing, etc.) are the same for both treatments, the cost difference is due to the difference in the price and amount used of the sulfuryl fluoride.

At present the company that produces sulfuryl fluoride is offering sulfuryl fluoride at a price per pound that is equal to or below the price of methyl bromide. What is not known is whether this practice will continue when methyl bromide is no longer available. There is currently a sulfuryl fluoride product (Vikane®) that is registered for non-food uses[7]. The market price is $10/lb. Although we expect that the food use sulfuryl fluoride (Profume®) to be less expensive, it is currently impossible to determine the market price. This compares to a methyl bromide cost of approximately $1.5 to $3.0 per pound.

Over the last decade, food processing facilities in the United States have reduced the number of methyl bromide fumigations by incorporating many of the alternatives identified by MBTOC. The most critical alternative implemented is IPM strategies, especially sanitation, in all areas of a facility. Plants are now being monitored for pest populations, using visual inspections, pheromone traps, light traps and electrocution traps. When insect pests are found, plants will attempt to contain the infestation with treatments of low volatility pesticides applied to both surfaces and cracks and crevices. These techniques do not disinfest a facility but are critical in

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[3] The company has requested confidentiality. There is great concern within the industry that the perception that food facilities are infested with pests not become widespread. There was great fear on the part of company officials that if the company is identified with a pest management issue the public will boycott its products, feeling them (wrongly) to be unsanitary. The discussion was arranged under the auspices of the North American Millers Association and took place in Arlington Virginia in November of 2004.

[4] 1.2 million cubic feet is approximately 33,980 cubic meters.

[5] 1200 to 1500 lbs is 545 to 680 kg. The use rates have thus varied between 16 and 20 g/$m^3$.

[6] 5250 lbs is 2380 kg; 82 F is 28 C. The use rate is thus 70g/$m^3$.

[7] Vikane® is primarily used as a termiticide for wood structures and furniture.

monitoring and managing pests. However, when all these methods fail to control a pest problem, facilities will resort to phosphine, heat, and if all else fails, to methyl bromide.

Many facilities in the United States also are using both phosphine and heat treatments to disinfest at least portions of their plants. Phosphine, alone and in combination with carbon dioxide, is often used to treat both incoming grains and finished products. Unfortunately, phosphine is corrosive to copper, silver, gold and their alloys. These metals are critical components of both the computers that run the machines as well as some of the machines themselves. In the United States it is specifically against the label (illegal) to fumigate in areas with susceptible metals (at: http://oaspub.epa.gov/pestlabl/ppls). Therefore, phosphine is not feasible in all areas of food processing facilities. Additionally, phosphine requires more time to kill insect pests than does methyl bromide, so plants need to be shut down longer to achieve mortality, resulting in economic losses. There are also reports of stored product pests becoming resist to phosphine (Taylor, 1989; Bell, 2000; Mueller, 2002).

Heat treatments have a number of problems in this industry. Not all areas of a plant can be efficiently treated with heat. Some food substances, for instance oils and butters will become rancid with heat treatments. Not all finished food products can be heated for the length of time heat is required for efficient kill of pests. In addition, geography of the United States plays a crucial role in the use of heat treatments. Food processing plants in the northern United States will experience winters with several weeks of sustaining temperatures of -32° to -35° C (-30° to -25° F). In these areas plants have heaters and the power plants have the capacity to supply excess power as needed. However, the southern and parts of the western zones of the United States are geographically quite different. Winter temperatures there seldom reach –1.2° C (30° F) and when temperatures should fall that low, it is typically for only a few hours one night. For many winters, these areas of the U. S. don’t freeze at all. Subsequently, these facilities do not have heaters, nor do the power plants have enough power to allow them to heat such large areas and sustain the temperatures necessary for an effective kill of pest populations. Additionally, escaping insects can survive these outdoor temperatures and re-enter the facility after treatment, even when low volatility pesticides are used to treat the surfaces exiting the plant. Still, many southern and western facilities use heat treatments as a spot treatment whereas the northern facilities can use heat treatments more extensively.

Potential economic losses were estimated for the food-processing facilities that have not been converted to heat treatment. This analysis only covers cases where heat treatment may potentially be technically feasible, and does not cover situations where heat would degrade the commodity being processed (those with fats and edible oils). Economic costs in the post-harvest uses of the food-processing sector can be characterized as arising from three contributing factors. First, the direct pest control costs are increased in most cases because heat treatment is more expensive, and labor is increased because of longer treatment time and increased number of treatments. For food-processing facilities that are not already using heat, capital expenditure is also required to retrofit them suitable for heat treatment. Moreover, additional production downtimes for the use of alternatives are unavoidable. Many facilities operate at or near full production capacity and alternatives that take longer than methyl bromide or require more frequent application can result in manufacturing slowdowns, shutdowns, and shipping delays. Slowing down production would result in additional costs to the methyl bromide users.

Economic cost per 1000 $m^3$ was calculated as the additional costs of methyl bromide if methyl bromide users had to replace methyl bromide with heat treatment.  Implementations of heat treatment likely have substantial cost implications to the facilities that have not been converted to heat in the food-processing sector.

Production downtime was estimated at two more days per fumigation with heat and total capital expenditures for heat treatment was assumed to be $1,076 per 1000 $m^3$ with 10-years lifespan with 10% interest rate from the data provided by the CUE applicants for post-harvesting uses. The potential economic losses associated with the use of heat treatment mainly originate from the cost of capital investment.  The estimated economic loss per 1000 $m^3$ ranges from $2,023 for rice milling to $12,439 for flour/grain milling.  The estimated economic losses as a percentage of gross revenue ranges from 3% to 18% and the estimated economic loss as a percentage of net revenue are over 45% for all the CUE applicants in the food-processing sector.  The industries that use methyl bromide for commodity fumigation are, in general, subject to limited pricing power, changing market conditions, and government regulations.  Companies within these industries operate in a highly competitive global marketplace characterized by high sales volume, low profit margins, and rapid turnover of inventories.  The results suggest that heat treatment is not economically viable as an alternative for methyl bromide in existing facilities that still use methyl bromide.

For these reasons, both technical and economic, USG does not believe it is appropriate to assume that alternatives that are both technically and economically feasible will be available to substitute for currently used methyl bromide in flour mills and is requesting that the full request of 328.854 metric tons of methyl bromide, which is an additional 65.771 metric tons of methyl bromide over the MBTOC recommended amount of 263.083 metric tons.

**Technical and Economic Assessment of MBTOC/TEAP Report.**

We have not been provided by MBTOC with information on the technical assessment of the performance of alternatives, or the economic assessment on the impact of converting to alternatives.  To support the MBTOC's recommended change in the U.S. request citations of the research references and economic assessments that led to the MBTOC conclusions are needed so we can understand the justification.  The technical references should describe the species tested, pest numbers, concentrations, times, and commodity volumes.  Economic references should describe the costs of converting from methyl bromide to alternatives, and the economic feasibility of sulfuryl fluoride if it must be used at a higher rate than methyl bromide.

**U.S. 2006 nomination**

The USG is requesting an additional 66.915 metric tons of methyl bromide for 2006 over the MBTOC recommended amount of 394.843 metric tons for use in flour mills.  This represents an amended request of 461.758 metric tons rather than the 505.982 metric tons of methyl bromide originally requested.

| **Citations** |
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