

Danger of resistance building: As outlined above resistance building can be fostered by misapplication on the one hand, on the other hand the small number of active ingredients available presents a problem in itself. Since no possibility of a change of active ingredient exists a preventive resistance management cannot be effected.

Contamination of foodstuffs: Due to the lack of effective control possibilities heavier moth infiltration often results in excessive contamination of the grain with insects and their residues (bodies, cocoons, excreta etc.). And as mentioned above these misapplications of stored product protection preparations carry the risk of substantial residues in the grain.

When considering these facts the question arises whether the reduction in the number of active ingredients for plant protection preparations does not achieve the opposite of what is intended. It should be considered whether the current problem does not stand in contrast with the ever stricter foodstuff regulations on the European level.

What possibilities remain for successful stored product protection in the future? Preventive measures like prophylactic hygiene, monitoring or biological pest control are instruments at whose research and promotion should be worked with full force. But despite all efforts in these areas an effective stored product protection as we demand it can hardly become possible without efficient preparations.

A further problem must be pointed out which may possibly contribute to the decrease of the amount of preparations for stored product protection. In Germany stored product protection will in future be placed somewhere between plant protection and biocidal legislation as regards approval and registration. Although originally entirely falling under plant protection, the control of pests in stored unprocessed agricultural commodities but also goods following simple processing (e.g. flour in a mill) will then be under plant protection legislation while the control of the same organisms in foodstuffs and animal feeds will be handled under biocidal law. Small wonder that some border areas arise here causing a lot of ambiguity. For instance, will grain used as animal feed be handled according to biocidal legislation and has to be treated with a biocide or is it an unprocessed agricultural commodity to be treated with a plant protection preparation? When is a rat a storage pest (plant protection), when is it a hygiene problem (biocide)? Is flour in the mill a basically processed agricultural commodity falling under plant protection legislation or is it a foodstuff and has to be treated with biocides in the case of infestation? Is muesli with oats, nuts and raisins still an agricultural commodity (plant protection) or is it a processed food (biocide)?

These examples demonstrate what kind of difficulties may arise. To ensure that the application of a preparation is legally safe registrations for both plant protection preparations and biocide products must be available for the same product in the same commodity. Below the example of the application of hydrogen phosphide in grain: the substance must be registered as a plant protection product for stored product protection as well as a biocide in the product groups "insecticide" and "protection for foodstuffs and animal feeds". Because of the high costs of such double registration many companies will have to consider whether it will be economically reasonable to pursue the defense of active ingredients and further product registrations in all areas respectively.

Conclusively a proposition which may be worthy of some discussion: Would it not make sense to implement a clear division and to integrate stored product protection entirely into biocidal law? Harvest time may be the right moment to draw the separation line. In simple words: "before harvest is plant protection and after harvest the goods are protected under biocidal law".

04 - Adoption of sulfuryl fluoride for the control of stored product insects in Europe and future development

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Abstract

The strong commitment to protect the ozone layer by European governments has resulted in the complete phase out of methyl bromide (MB) use in the flour mills and food processing plants. Following the phase out the industry has successfully adapted, maintained its production capacity, hygiene standards and economic viability. This has been achieved through increased focus on sanitation and utilizing alternatives control procedures such as fumigation with sulfuryl fluoride (SF) with the tradename ProFume containing 99.8%. The fumigation is frequently accompanied by additional heating. Recent research on stored product pest insects in treated flour mills confirmed long lasting control effects 8 to 12 weeks after the fumigation. ProFume gas fumigant is now established as an alternative fumigant to MB. It has been granted registration for the control of SPIs in structures in ten European countries. Since its first approval in 2003, the number of ProFume fumigations has increased each year. In 2008, over 200 fumigations were completed in Europe and due to performance satisfaction, the growth trend is expected to

continue. A range of structures have been fumigated, some exceeding 60,000 m³ for flour mills and 100,000 m³ for food processing plants. Dow AgroSciences is continuing to invest in supporting SF to meet future regulatory requirements. In addition, label extensions are being developed on dried fruits and tree nuts, cocoa beans and quarantine pests. The original use of SF on wood boring insects is also supported and is now listed in Annex I of Biocide Directive 98/8 EC for product type 8.

Introduction

Control of stored product insects (SPIs) is a key element to keep the high level of hygiene standards required in the milling and food processing industries. Fumigation with Methyl bromide (MB) was widely used historically in Europe for disinfestation, but over the past five years, major changes in pest management practices have occurred. This paper provides an update on the evolution of practices in insect control, current status of the replacement fumigant ProFume® (99.8% sulfuryl fluoride) in terms of its market adoption, registration, practical performance and environmental fate.

Evolution of insect control in milling and food industry with the phase out of Methyl bromide in Europe: Following Montreal Protocol implementation, MB volumes used in the milling and food industry have declined in Europe from an estimate of 640,000 tons in 1991 to zero in 2008. Despite this dramatic reduction in MB, the European industry has been able to maintain its hygiene standard and economical viability by implementing several alternative control methods. Increased sanitation has been implemented through more effective practices, reducing access of insects in plants and increased control of raw materials. In addition, use of targeted curative methods has been implemented like heat treatment, application of contact insecticide in fogging and fumigation with ProFume. Since ProFume was approved in the countries that requested Critical Use Exemptions (CUEs) for their milling industry in 2005 (UK, Italy, Belgium, France, Germany, Ireland, Greece), it has contributed to the decrease and final end of CUE's and helped EU governments reach their Montreal protocol goals. This fumigant does not contribute to ozone depletion and its contribution as an alternative to MB was recognized in 2007 with the United Nation's Montreal Protocol Innovators award presented to Dow AgroSciences LLC.

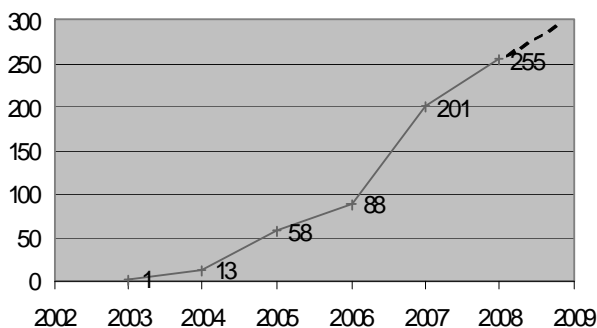


Fig. 1 number of structures fumigated in Europe with ProFume since 2002 (Source ProFume distributors)

The first European registration of ProFume and commercial mill fumigation took place in Switzerland in 2003. Additional registrations followed, from 2004 through 2008, in Germany, Italy, UK, France, Belgium, Austria, Ireland, Spain and Greece. The number of mills and food processing structures annually fumigated with ProFume in Europe has grown as new registrations have been achieved and in 2008, 255 structures were treated (Figure 1). Fumigated structures varied in age, construction material and size, from village mills to large industrial mills of 100,000 m³, and pasta plants of up to 140,000 m³. A high level of satisfaction was reported by millers and food processing managers following fumigation with ProFume of structures of all types.

Studies on SPIs populations following ProFume fumigation and heat: Monitoring stored product insects (SPIs) populations within flour mills or food processing establishments is a valuable procedure for determining the location of infestations and population dynamics. Regular monitoring, record keeping and correct species identification can determine if a population is increasing or decreasing and is of economic significance. In addition monitoring SPIs improves the precision of the timing of treatments and the evaluation of their effectiveness.

ProFume fumigation and heat treatment are in commercial use for the disinfestation of SPIs in structures in the food industry. Each method has been considered as a valuable SPI management 'tool' for inclusion in integrated pest management (IPM) strategies to replace MB (Drinkall, 2007). The impact of ProFume compared with heat treatment on SPI populations has been compared in commercial flour mills in Germany (Mück and Böye, 2007) and

in the UK (Small, 2008) by trapping insects before and after treatment. In both countries one mill was treated with ProFume and one with heat treatment (Table 1). The target insect species for capture in the studies were the stored product beetles *Tribolium castaneum* (Herbst) and *T. confusum* (Jacquelin du Val) [Germany and UK] and moths *Plodia interpunctella* (Hübner), *Ephestia elutella* (Hübner) [Germany] and *E. kuehniella* [UK].

Tab. 1 Building and treatment details of studies comparing ProFume and Heat

Mill	Treat- ment	Construction material	Volume (m ³)	Date of treatment	Dosage (CTP in g-h/m ³)	Temp. (°C)	Exposure time (h)
Mill A (Germany)	ProFume	Brick and ferroconcrete	23000	31/08/07-02/09/07	1013	21	50
Mill B (Germany)	heat	Brick /concrete+wood	40000	2-4/11-07	-	>50	24
Mill A (UK)	ProFume	Brick	15455	27-28/05/06	271-755	35-40	48
Mill B (UK)	heat	Brick-Timber	10947	9-11/06/06	-	>50	24

The German study concluded that both ProFume and the heat treatment were effective at controlling SPIs under commercial conditions and that they were valid replacements for MB but the rebound of insect population to pre-treatment was faster with heat (Table 2). These results were achieved in mill buildings which were of 25-150 years old and provided a vigorous test for both technologies.

These results were in contrast to those reported in the UK. In this study based on insect trapping data ProFume achieved good efficacy of SPIs but control with heat was very variable. The explanation for reduced efficacy was considered as being due to uneven temperature distribution within and among floors during the heating process leading to some insect survival.

Tab.2: date of monitoring and insect population in Mill A and B in Germany (in bold: monitoring immediately following the treatment, in grey: post-treatment insect population significantly below prefumigation level)

Mill A (ProFume)		Mill B (Heat)	
Date of monitoring	Total number of <i>Tribolium</i> sp	Date of monitoring	Total number of <i>Tribolium</i> sp.
23.08.07	155	16.08.07	28
31.08.07	42	17.09.07	58
02.09.07	0	17.10.07	59
04.10.07	2	02.11.07	22
08.11.07	0	04.11.07	0
21.12.07	1	09.11.07	2
12.02.08	31	18.12.07	18
11.03.08	38	22.01.08	16
08.04.08	81	26.02.08	43
05.05.08	83	26.03.08	43
16.06.08	148	29.04.08	67
11.08.08	204		

Regulatory status and future developments: ProFume is currently approved on emptied flour mills and emptied silos in the following European countries: Austria, Belgium, Germany, France, Greece, Italy, Ireland, Switzerland and UK, and on dried fruits and tree nuts in Germany and Greece. Label extensions on dried fruits and tree nuts have been submitted in all countries using ProFume on emptied mills, and in Turkey.

It has been identified that there was a need of an alternative fumigant on cocoa beans and development work is carried out currently in Germany and the Netherlands.

A new potential use for ProFume is to eradicate quarantine pests transported in wood packaging in shipping containers used in international trade. Some of these wood destroying pests are highly damaging to forestry and amenity trees.

Sulfuryl fluoride is also marketed under the trade name Vikane® in France, Finland, Germany, the Netherlands, Norway, and Sweden to control wood destroying insects in historical buildings and artifacts. Sulfuryl fluoride has been submitted under EU Directives (91/414/ EEC)Plant Protection and (98/8/EC biocide). It has been listed in Annex I of the Biocide Directive for Product Type 8 (wood preservative). 91/414/EECAnnex I listing and the listing in product type 18 (insecticide) under the Biocidal Products Directive are still pending.

Conclusion

The strong commitment to protect the ozone layer by European governments has resulted in the complete phase out of methyl bromide (MB) use in flour mills and food processing plants. Following the phase out, the industry has successfully adapted and maintained its production capacity, hygiene standards and economic viability. This has been achieved through increased focus on sanitation and utilizing alternatives control procedures such as fumigation with ProFume and heat. ProFume has been adopted by the industry with 255 fumigations of flour mills or food processing plants in 2008 in Europe. Product performance has been shown to be effective through monitoring studies of insects and commercial user satisfaction.

Dow AgroSciences is committed to secure and maintain the legal right to sell and where possible to extend registrations in areas of use whilst ensuring the high Stewardship standards are maintained. This will able this valuable fumigant to continually be available for years to come for control of SPIs in the food industry and to eradicate wood destroying pests.

Questions and answers during presentation: Q Could the decrease in insect population in the studies presented be explained by natural decline of population ?

A: When we consider the dates of application: except the mill in Germany that was treated with heat in November, (but it reached the pre-treatment level in February) all other application shown took place in summer (July, August), in the peak of insect reproduction, so the very low level of insect catches following application can only be explained by effectiveness of the treatment. ® Trademark of Dow AgroSciences LLC

Literature

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05 - Rodents – health risk and control measures

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Abstract

Rodents beside damages they make to stored products and any food also cause health risk to humans and domestic animals. Hazard can be direct or indirect.

Direct hazards to humans are rodent attacks, revulsion, shock or fear due to rodent presence, rodents' parts found in food, damaged wires gnawed by rodents that can be cause of fire or hurt one.

Indirect hazards include transmission of parasites or pathogens like *Salmonella enteritidis* and *S. typhimurium* or fleas transmit plague or murine typhus from infected rodents on humans. Unstable damaged bags and scattered grains may be hazardous to workers in storages.

Different methods might be used to prevent damages or health risk caused by rodents. Beside sanitation measures and rodent proofing important role has application of rodenticides especially at present high populations of rodents. Anticoagulants chlorophacinone, coumatetralyl, warfarin called first-generation compounds, brodifacoum, bromadiolone, difenacoum, difethialone and flocoumafen placed in the second-generation of rodenticides are used for rodent control in most European countries. In some cases carbon dioxide, phosphine and hydrogen cyanide are used for rodent control.

Introduction

Rodents, *Rattus norvegicus*, *Rattus rattus* and *Mus musculus* due to their life beside people often are called commensal rodents. They make damage in and outside of buildings, living under bushes in gardens or inside everywhere where there is any kind of food.

The damage they cause is dangerous to humans living or working in buildings. To prevent damages and to protect people it is necessary to provide rodent control.