

Cooling phase: Towards the end of the maintaining phase doors and windows are opened, the heaters are switched off but the axial fans are left running. The effect is a "reversed" heat transmission supporting the cooling of building and installations.

Advantages of ThermoNox treatments:

- Absolutely non-toxic pest control in sensitive areas
- No residue, odourless
- Effective against adults, larvae and even eggs
- No resistance in insects possible against heat
- Deep penetration of cracks and crevices and otherwise inaccessible areas
- A secure procedure because of the slow-rising temperature and the maintenance of steady 55 – 60 °C
- Discreet treatment, independent from outside temperatures (year-round method)

Limitations:

- As all treatment methods, the ThermoNox-System has certain limitations and drawbacks. Some of these are:
- Not applicable in locations without a sufficient electrical power source
- Temperature sensitive raw material or products
- Filled containers, silos and plants inside the treated area (heat does not reach infestation > insects survive > recalls)
- Special floor constructions (materials with very different thermal coefficient of extension)
- Big, empty concrete silos, high concrete staircases, humid ground-floors
- Outer walls with outlying isolation
- Insects escaping to an area not heated and survive (barriers!)
- ThermoNox requires trained and experienced application technicians (just like modern precision fumigations)
- Thermal treatments "as such" do not have a lasting effect, therefore they have to be carefully planned and executed – the aim is eradication (no survivors).

The ThermoNox System is not a panacea but very close

Literature

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12 - Residues of Biocides and Pesticides in Stored Product Protection (SPP) Available active substances, specific problems

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Abstract

To meet the high quality criteria for food, very effective methods are needed to control insects and other pests during storage. Chemical SPP products are widely used for this purpose. However, the number of active substances which may legally be used in storage protection is very limited. High efficacy of the substances is often linked with high toxicity also towards humans. This gives rise to concerns for the safety of workers and/or consumers. A large variety of food and food products comes in contact with SPP products and consumers may be exposed to these chemicals via residues in food. Storage protection is an area that falls both under the biocide and the pesticide legislation. An overview is given on available active substances (biocides and pesticides) and some specific residue problems including the current state of discussion in the EU.

Introduction

To meet the high quality criteria for food, very effective methods are needed to control insects and other pests during storage. Storage protection is an area falling both under the biocide and the pesticide legislation. Chemical SPP products are widely used for this purpose. A large variety of food and food products gets in contact with SPP products and consumers may be exposed to these chemicals via residues in food.

The number of active substances which is available for storage protection is very limited. High efficiency of the substances is often linked to a high toxicity for humans that could give rise to concerns for workers and/or consumers. This contribution is focused on consumer protection issues and highlights specific SPP chemicals and their problems from the residues point of view.

Legal Background: The EU Pesticide legislation is mainly based on Regulation (EC) No 396/2005 on maximum residue levels (MRLs) of pesticides in or on food and feed of plant and animal origin and on Council Directive 91/414/EC concerning the placing of plant protection products on the market. The Directive provides data requirements and criteria for including substances in Annex I of 91/414 ("positive list").

A similar regulatory framework has been established for biocides. Council Directive 98/8/EC lays down rules concerning the placing of biocidal products on the market. It contains data requirements and criteria for including substances in Annexes I and Ia ("positive lists"). No MRL legislation is in place for biocides yet. However, it is currently discussed to include MRLs for biocidal substances which lead to the presence of residues in foodstuffs of plant origin in Regulation 396/2005. MRLs for products of animal origin might be regulated elsewhere (e.g. in Regulation (EC) 2377/90 for the establishment of maximum residue limits of veterinary medicinal products in foodstuffs of animal origin). This discussion is ongoing.

Currently Available Chemical Substances in SPP (Pesticides and Biocides)

Pesticides: The following active substances are contained in pesticide products which are currently (25.05.2009) authorized for SPP uses in Germany:

Area of use	Active Substance	Consumer relevance
Products against mites and insects	Phosphides (Al, Mg), phosphane	residues in stored products have to be considered
	Kieselgur (diatomaceous earth)	
	Carbon dioxide	
	Pirimiphos-methyl	
	Pyrethrins	
Products against rats and house mouse	Sulfuryl fluoride	usually bait application, "no-residue" situation for consumers
	Brodifacoum	
	Bromadiolon	
	Difenacoum	
	Zinc phosphide	

In addition, lambda-cyhalothrin may be used for the treatment of wooden containers against insect pests.

In order to reach all parts of a storage facility, most of the insecticides and acaricides used in SPP are applied as a gas or a fumigant. One exception is diatomaceous earth which is applied as a dust. Another one is pirimiphos-methyl which is either sprayed in empty rooms or directly mixed into the grain during loading (admixture). All these applications might leave residues in treated food and feed and require a detailed assessment of the residue situation and the potential risk for consumers.

Rodenticides are usually applied as a bait. Most of the rodenticides listed in the table belong to the group of anticoagulants. When following the directions of use, normally no residues occur on food and feed and no consumer exposure has to be considered.

Biocides: Under the biocide legislation, no national authorizations have been granted yet, because the active substances have to pass the EU assessment first and have to be included in Annex I or Ia of Directive 98/8/EC. The review process proceeds product type by product type and up to now, only substances belonging to the wood preservatives (product type 8) and to the rodenticides (product type 14) have been included in Annex I. These are:

Wood preservatives: Clothianidin, dichlofluanid, etofenprox, IPBC (3-iodo-2-propynyl-butylcarbamate), K-HDO (cyclohexylhydroxydiazene 1-oxide, potassium salt), propiconazole, sulfuryl fluoride, tebuconazole, thiabendazole, thiamethoxam Rodenticides (which includes uses in storage protection):

- Carbon dioxide, difenacoum, difethialone.

Wood preservatives not necessarily get in contact with stored food items. Therefore they are not further discussed in this context.

Rodenticides are usually applied as baits thus giving rise to a "no-residue" situation for consumers. As already mentioned for the pesticides, consumers are not considered to be at risk if the products are used according to the directions of use.

The evaluation of active substances belonging to product type 4 ("Food and feed area disinfectants") is still ongoing. From this group, benzoic acid is intended to be used for disinfection of storage facilities. Residues in stored products can not be excluded and therefore a consumer risk assessment is required.

Also under evaluation are active substances belonging to product type 18 ("Insecticides, acaricides and products to control other arthropods"). A couple of active substances from this group is intended to be used in storage protection, e.g. aluminium phosphide, magnesium phosphide, sulfuranyl fluoride, dichlorvos, flufenoxuron and imidacloprid. Most of these applications might leave residues in treated food and feed and – as already mentioned for the pesticides - require a detailed assessment of the residue situation and the potential risk for consumers.

Borderline pesticide/biocide: It is not always easy to decide if a storage protection use falls under the pesticide or the biocide legislation. The following examples are supposed to illustrate the borderline.

Area of Use	Pesticide	Biocide
Rodenticide	Use to protect plants from rodents in plant growing areas (agricultural field, greenhouse, forest)	Use to control rodents for reasons of human hygiene (in farms, cities, industrial premises or in plant growing areas if the aim is not plant protection)
Insecticide in storage protection	Target organism is detrimental to plants or plant products Storage goods are plant products in unprocessed state or having undergone only simple preparation (milling, drying, pressing)	Use as a hygiene disinfectant (general biocidal purpose) Storage goods having undergone more advanced food processing

The treatment of empty rooms may fall under both regulatory frameworks depending on the kind of storage goods which is stored in the rooms after treatment.

Discussion of specific chemicals: To make some of the latest decisions and discussions on EU level more transparent, some important SPP chemicals will be highlighted in the following with respect to residues in food, MRL setting and consumer risk assessment.

Sulfuryl fluoride

Biocide Use: Sulfuryl fluoride has been included in Annex I of 98/8/EC as a wood preservative, but not yet as an insecticide, national authorisations for biocidal products with sulfuranyl fluoride have not been granted yet.

Pesticide Use: Under the pesticide legislation, inclusion of sulfuranyl fluoride in Annex I of 91/414/EC is still pending. From the residues perspective, there are no problems expected, because the only use supported for Annex I inclusion is the use in empty rooms leading to a "no-residue" situation in food and feed. The national authorisation of the sulfuranyl fluoride containing product ProFume has been prolonged recently. The registered uses comprise applications in empty rooms as well as in the presence of selected storage goods (dried fruit, tree nuts). The former use in the presence of cereals is no longer supported.

As from 01.09.2008, Regulation (EC) No 396/2005 entered into force. Harmonized European MRLs have been set for the active substance sulfuranyl fluoride and also for its main metabolite fluoride. Fluoride is a common nutritional component. Fluoride intake via food adds to the intake from other sources (e.g. tooth paste, fluorinated salt, drinking water). The ingestion of fluoride is recommended on a low level, but the intake of higher amounts of fluoride may pose a risk to consumers. To restrict the fluoride level in food to an acceptable level, MRLs were set for fluoride. Relatively high LOQs were applied to distinguish between natural background level and residues from pesticide application.

- With regard to the registered or formerly registered uses, the following MRLs are relevant:
- Dried fruit: commodity not covered by Regulation (EC) No 396/2005, no MRLs set
- Tree nuts: sulfuranyl fluoride: 10 mg/kg, fluoride: 25 mg/kg. Residues resulting from the registered uses in Germany comply with these MRLs.

Cereals: sulfuryl fluoride: 0.05 mg/kg, fluoride: 2 mg/kg. The formerly intended cereal use would have resulted in a much higher fluoride residue than 2 mg/kg and would have given rise to an MRL of 15 mg/kg. Any MRL lower than this would most likely have been violated following the sulfuryl fluoride treatment of storage rooms in the presence of cereals.

A fluoride MRL of 15 mg/kg for cereals was not considered safe for consumers. Taking into account the cereal consumption data from European and relevant WHO diets (as compiled in the EFSA model PRIMOI), a fluoride residue of 15 mg/kg led to a calculated intake of fluoride corresponding to more than 200 % of the ADI value (ADI 0.12 mg/kg bw/d, WHO 2003). To this point, the calculation has not taken into account the additional fluoride intake from other sources (tooth paste, fluorinated salt, drinking water etc.). Since cereals form a big part of the overall food consumption, an MRL of 15 mg fluoride/kg was not tolerable and it was lowered to the LOQ of 2 mg/kg. With this low MRL in place, currently no sulfuryl fluoride treatments of storage rooms in the presence of cereals (according to typical application conditions) are possible, because the residues in treated cereals would most likely violate the MRL and the cereals would not be marketable. Thus, no respective authorisation is granted.

Dichlorvos

Biocide Use: Under the biocide legislation, dichlorvos has not yet been included in Annex I of 98/8/EC, the peer review is currently ongoing. National authorisations have not yet been granted. The representative use in the context of Annex I inclusion is the control of insects in storage protection or animal housings by means of a strip application.

Pesticide Use: Under the pesticide legislation, the non-inclusion in Annex I of 91/414/EC has been decided two years ago (2007/387/EC, 07.06.2007ii), because no safe use could be established. The last remaining use in the context of Annex I inclusion was the control of insects in storage facilities in the presence of flower bulbs by using fogging vaporising equipment. This use has no relevance for consumers. Since all other formerly supported uses in presence of consumable stored products have been withdrawn by the applicant, there was no need to complete the consumer risk assessment on EU level. Main reason for non-inclusion was the incomplete data package in the toxicology section. Due to uncertainties concerning genotoxic and carcinogenic properties of dichlorvos, very low toxicological reference values were established tentatively: an ADI of 0.00008 mg/kg bw/day and an AOEL of 0.0005 mg/kg bw/day. Based on these values, no safe use could be established for operators, workers and bystanders. As a consequence of non-inclusion in Annex I, the MRLs for dichlorvos were lowered to the respective LOQ in all plant matrices (which was 0.01 mg/kg in most matrices) and all national authorisations for pesticide products containing dichlorvos had to be withdrawn.

Phosphides (Al, Mg), phosphane

Biocide Use: Under the biocide legislation, aluminium and magnesium phosphide have not yet been included in Annex I of 98/8/EC, the work is ongoing. National authorisations therefore have not yet been granted. Some of the representative uses of the phosphides listed in the EU biocide dossiers are comparable to those listed in the pesticide dossiers, apart from lower application rates for the latter.

In preparation of national product applications for phosphide containing biocidal products, the uses will have to be defined accurately and should refer only to those stored products which are not under the scope of pesticide legislation (e.g. chocolate products, milk powder, natural fibres, packing materials). These phosphide applications might leave residues in stored products and the residue situation has to be addressed appropriately. It is not yet clear how to describe and group potential "biocide" storage goods (i.e. storage goods in the presence of which the use would be considered a biocidal use) and which data requirements for residue trials will apply.

Data requirements have to be developed on EU level. A new biocide working group with members from several EU member states, EFSA, EMEA and COM has been established in May 2009. It is called DRAWG (Dietary Risk Assessment Working Group) and it is chaired by Germany. The mission of this group is:

- to develop appropriate, use-specific exposure scenarios for biocides which allow for an estimation of biocide residues in/on animals (and in a later work stage of the group also in/on plants),
- the definition of data requirements for the refinement of exposure estimations and
- the establishment of detailed procedures and the definition of potential further data requirements for dietary risk assessment.

Pesticide Use: Under the pesticide legislation, aluminium and magnesium phosphide have been included in Annex I of 91/414/EC, the inclusion of phosphane is still pending.

MRLs for aluminium and magnesium phosphide are currently re-evaluated and waiting periods the user would have to adhere to are re-considered (waiting period: shortest allowed time interval between end of treatment+ventilation and marketing of the stored product). It can be foreseen that further re-evaluations will be required once phosphane

has been included in Annex I of 91/414/EC. Depending on the decision on how biocide MRLs will be regulated in future, further amendments might be needed to reflect also the biocide uses of phosphides.

Pirimiphos-Methyl

Biocide Use: Under the biocide legislation, no use of pirimiphos-methyl has been assessed yet.

Pesticide Use: Under the pesticide legislation pirimiphos-methyl has been included in Annex I of 91/414/EC based on the use in empty cereal storehouses. On national level, in addition to this use the post-harvest treatment of cereals by directly mixing the pirimiphos-methyl into the grain during loading is authorized (admixture use). The maximum application rate for the admixture use is 4 g as/t. Currently an EU MRL of 5 mg/kg is in place for pirimiphos-methyl in cereals, but this MRL is under discussion. Any MRL lower than this would most likely be violated following the admixture use in cereals. Depending on the EU decision on the MRL for pirimiphos-methyl in cereals, the national authorization of the admixture use might be withdrawn.

The ADI value of pirimiphos-methyl has been lowered to 0.004 mg/kg bw/day on the occasion of Annex I inclusion with the consequence that the cereal MRL of 5 mg/kg exceeds this ADI. In a first opinion, EFSA recommended the lowering of this MRL but also highlighted that the existing MRL for cereals could be maintained if a more refined intake calculation proves that this MRL does not pose a consumer health risk. The refinement is still ongoing on EU level.

First step of refinement was not to use the MRL in chronic risk assessment but the median residue from supervised residue trials. In addition to that, some readily available processing factor were applied for wheat flour, whole meal flour and oat flakes.

With this refinement, five diets from those compiled in the EFSA PRIMO model still resulted in an exceedance of the ADI value considering cereal consumption only (see Fig. 1). These were three WHO cluster diets, the Irish adult diet and the Italian children diet. Because the WHO cluster diets are based on food balance sheets rather than on real food intake information, there is not much room for refinement. However, they tend to overestimate the intake considerably and are therefore not fully relevant for consumer risk assessment.

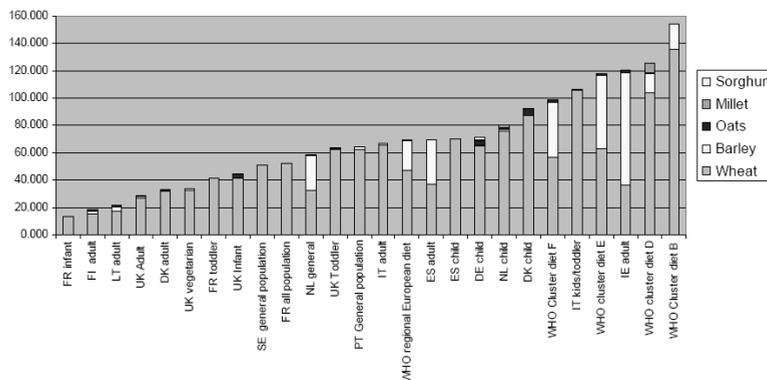


Fig. 1 Refined dietary intake assessment for cereals, using the STMR-p values for wheat and oats and the STMR for barley, sorghum and millet. The exposure is expressed as % of ADI.

Looking into the Irish adult diet in more detail reveals that the main contributor to the overall intake was barley. Further data submitted by Ireland confirm, that the barley intake mainly traces back to beer consumption and that it would be reasonable to use an appropriate processing factor (barley -> beer). With this factor, the chronic risk for Irish consumers based on the intake of pirimiphos-methyl residues via food was acceptable.

Main contributor to the diet of Italian children was wheat, most likely consumed as bread or pasta. More detailed consumption data would be needed for refinement.

Other options for refinement are currently discussed on EU level. One option would be to use a 'percentage of crop treated' factor. This factor could be 0.5 in case of pirimiphos-methyl, based on information according to which 0-44 % of wheat and barley are treated with pirimiphos-methyl in EU member states. However, the European Commission seems to disapprove of this approach. Also the second option, the use of monitoring data in the assessment instead of data from supervised residue trials, will most likely not be followed by the Commission.

Instead or that, EFSA was asked again for a revised risk assessment which was provided recently). EFSA collected more detailed cereal consumption data and re-calculated processing factors for cereal based products. Still supported uses are barley, millet, oats, sorghum and wheat. With all the new data available, it is now two UK diets (infants and toddlers) which exceed the ADI value. According to all other diets the risk for consumers is now acceptable. Main contributors to the UK diets are wheat bran and wholemeal bread. Concerning wheat bran, it is currently not clear from the data and has to be confirmed by UK, if bran is consumed as such or in the form of bran-based breakfast cereals. In the latter case, a different processing factor would apply and the risk would also be acceptable.

EFSA proposes to maintain the MRL of 5 mg/kg for pirimiphos-methyl in barley, millet, oats and sorghum. If the bran intake in UK turns out to be acceptable, the MRL of 5 mg/kg will also be proposed for wheat. If not, EFSA proposes to lower the wheat MRL to the LOQ.

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13 - Grain and seed storage in France: State of practice and perspectives

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Abstract

ARVALIS – Institut du végétal is a French research and development institute working for farmers on different topics: in the field as well as after harvest with storage and quality preservation of grain. This work is carried out with various partners: public and private research institutes and professional organisations. In France, storage of cereals between harvest and use takes place in elevators and on farms. A survey carried out by the French National Office for Cereal (ONIGC/France Agrimer) showed that elevators use various ways to fight against insects, for example with preventive or remedial use of insecticides.

In this frame and given the current regulatory reduction of chemical products on the market, ARVALIS– Institut du végétal recommends the application of preventive practices through vocational scientific and practical training, articles in specialized papers, and meetings. The approach is first to store clean grain free from insects in cleaned premises. Additionally, the most important parameters to control and manage quality of stored products during storage are grain humidity and temperature. Thanks to this procedure, insects might not infest grain. But in case of insect development in the grain, elevator workers can use one of the three authorized liquid insecticides or control treatment. At the same time, ARVALIS is involved in research. The topics are close to the current preoccupations of elevator operators: sampling (how to get a representative sample of grain for insects search), early detection of insects in stored grain, use of aeration to cool grain temperature to avoid attracting insects to the grain and use of physical processes to kill insects (heat...).

Introduction

ARVALIS is a French institute involved in applied agricultural research. This paper introduces some of ARVALIS activities in the field of grain storage and preservation, and gives some pointers into the understanding of grain storage in France.

ARVALIS – Institut du végétal is an agricultural research and development institute composed of 400 people working in close relation to the food and cereal channel operators.

Principal topics range from the production of different cereal species to the different qualities of cereals required by users. In the field, there are trials of seed assessments, better crop management practice, cropping practices.

ARVALIS works on cereals, maize, pulses, potatoes and forage crops. After harvest, the institute is involved in research on the reception and evaluation of grain quality, grain cleaning and cooling ventilation during storage.

ARVALIS board of directors includes food and cereal channel operators, cultivators also participate in the financial support of the institute.

This is why ARVALIS is so close to the cultivator's direct preoccupations, to improve competitiveness whilst preserving the environment.