European Crop Protection Association
member of CropLife International

# Container Management Guidelines

## Building effective and integrated strategies for packaging reduction, design, rinsing and recovery

# Contents

# 1 Introduction: Evolving container management strategies (CMS) in Europe today

Photo courtesy of Pamira

## Working together: companies, associations and authorities

**This document outlines ECPA's policy on CMS and provides guidelines based on that policy. The guidelines are intended to help national crop protection associations and companies establish their own effective and integrated CMS.**

The guidelines are offered on the understanding that where local laws and regulations are already in place, these must take priority. The guidelines can and should, however, be used in dialogue with the relevant authorities to help shape new laws and regulations and revise existing ones.

Two levels of information are provided in the guidelines. The guidelines are provided at a glance in a concise form at the beginning of each section, for those seeking basic information on the rationale behind each container management theme. The guidelines are also provided in depth, for those seeking more detailed and technical information on the themes.

### Contributing to environmental sustainability

Crop protection products play a vital role in securing the quantity and quality of the food, feed and fibres required by a growing global population.

Notwithstanding these benefits, the crop protection industry is increasingly expected to provide the scientific research that demonstrates the safety of its products to operators, consumers and particularly the environment.

Packaging plays a central role in safely delivering crop protection products to the intended targets, thereby minimising risk of leakage in the supply chain and exposure to operators.

Packaging also needs to be managed to meet other environmental goals, which have become increasingly important in the context of prevailing societal concerns about environmental sustainability. It follows that the container management strategy presents the industry with an opportunity to show that it strives to be an environmentally responsible partner in agriculture and society.

Consequently, the guidelines are based on the following guiding principles:

- Safe packaging;
- Safe use;
- Waste reduction at source by design;
- Safe and sustainable recovery.

There are many instances where the industry has been highly effective in demonstrating its commitment to Responsible Care by managing its packaging waste in response to escalating public awareness and pending local legislation. However, these schemes have not always resulted in cohesive regional strategies. The purpose of these guidelines is to provide foundations for the development of such strategies.

Legislation on packaging and packaging waste, at both the Member State and European Community (EC Directive 94/62/EC) levels, sets targets for the recovery and recycling of packaging.

The development of comprehensive CMS at the national level by the associations and companies, based on a coherent policy developed at the Brussels level by ECPA, has never been more important than it is today.

### Looking to the future

Container management is a dynamic and innovative process. The strategies outlined in this document will address short to mid-term issues relating to the safety of container management. Regular reviews will be necessary to link the present strategies to future technology innovation, which will further enhance the standards of farm chemical operations.

# 2 ECPA Policy: The fundamentals of a pan-European container management strategy

Photo courtesy of Pamira

## Preamble

**The crop protection industry recognises the need to extend best practice to the management of packaging waste. It does so through various industry processes and educational initiatives designed to minimise risk to people and the environment associated with waste product containers.**

Container management strategies (CMS) can only be successful if all stakeholders are fully committed to their development and actively participate in their implementation. The industry therefore strongly encourages co-operation in this field.

ECPA's policy on CMS consists, essentially, of a fundamental series of commitments to action at the Brussels level and recommendations for action at the national level.

These commitments and recommendations are outlined on this page.

### Commitments to action at the Brussels level

**1.** ECPA will maintain both a policy on CMS and guidelines based on that policy.

**2.** ECPA's Packaging and Transport Expert Group (PTEG) will manage the issues affecting the policy and guidelines, with a view to encouraging a pan-European industry approach that is harmonious, coherent and workable.
Specifically, this will involve:
- Ensuring local country and company requirements are taken into account;
- Annually reviewing performance against objectives.

**3.** At the national level, ECPA promotes its policy on CMS to the industry and the guidelines provided for the purpose.

**4.** The ECPA PTEG will work to meet customers' packaging needs and promote the highest priority to operator and environmental safety.

**5.** ECPA will ensure that national crop protection associations and companies are aware of the need to extend best practice to all packaging activities.
Specifically, this will involve:
- Defining best practice and setting standards for design, registration and use;
- Establishing and maintaining effective communication with country staff involved in packaging so that they can influence European decisions and take local action;
- Publishing clear and concise information via all relevant media;
- Aiming to continuously improve all aspects of the packs the industry offers;
- Developing the practical structure to ensure that the national associations can implement ECPA's policy on container management strategy;
- Participating in packaging committees, teams and conferences to ensure that the industry's views are disseminated;
- Initiate training of staff and customers to ensure that they can safely use and recover or dispose of product packaging.

## Recommendations for action at the national level

1. Compliance with the law is paramount. Specifically, for the crop protection industry, this involves:
   - Complying with European directives and local laws on packaging waste and waste disposal;
   - Actively collaborating with regulators to help shape new laws and regulations and revise existing ones.

2. The reduction of packaging is an important starting point. Specifically, for the crop protection industry, this involves:
   - Reducing packaging at source by design, wherever possible;
   - Ensuring that pack weight is consistent with fitness for use, in line with the Essential Requirements. (EC 94/62 Articles 9 and 11 require minimisation of packaging weight and volume consistent with safety, hygiene and environmental considerations).

3. Formulations have an important role to play in container management. For the crop protection industry, this involves providing increasingly innovative formulations that facilitate emptying, rinsing and draining.

4. Designing increasingly innovative packs that facilitate emptying, rinsing and draining is fundamentally important. Specifically, for the crop protection industry, this involves:
   - Ensuring that packaging is designed to be safe to use;
   - Ensuring that packaging and the ultimate disposal of packaging waste are given a high priority during and after product development.

5. Appropriate cleaning of packs at the time of application will be promoted so that packs can be recovered or disposed of safely. This is important and specifically, for the crop protection industry, involves:
   - Advocating the importance of container rinsing as one of the cornerstones of all effective and integrated container management;
   - Actively encouraging farmers to empty, rinse and drain their packs during the application process.

6. Disposal routes that are safe to the operator, the public and the environment need to be encouraged. Specifically, for the crop protection industry, this involves:
   - Seeking agreement from local country regulators that cleaned packaging can be disposed of as non-hazardous waste;
   - Seeking to ensure (based on local country laws and farm practice) safe and closed disposal routes for the industry's packaging waste, including recycling routes, as alternatives to the accepted energy-from-waste option.

Compliance with the law is paramount.

7. Resource conservation goals can be met by respecting a step-wise hierarchy for the management of packaging waste. Specifically, for the crop protection industry, this involves:
   - Respecting a hierarchy of (1) reducing, (2) reusing and (3) recovery and recycling packaging waste;
   - Selecting the best option in the hierarchy on a case-by-case basis, taking into account the technical and economic feasibility of the options in specific circumstances.

8. The key objective of any container management strategy is to establish a set of practices and a defined route for recovery of cleaned, empty packaging waste. Specifically, this set of practices needs to:
   - Be appropriate to specific local circumstances;
   - Evolve in line with improvements in technology, legislation and infrastructure;
   - Be socially, environmentally and economically acceptable.

# 3 ECPA Guidelines: A strategy-building tool for the European crop protection industry

Photo courtesy of Pamira

## Getting started

**The European crop protection industry is committed to managing its packaging in an environmentally sound way, encouraging resource conservation wherever possible. The guidelines in this document provide a comprehensive management approach for the industry's packaging waste. They include reducing the amount of packaging, developing increasingly intelligent packaging design, and promoting the on-farm rinsing of packaging with a view to ultimate recovery. All of these are essential building blocks of an effective and integrated container management strategy.**

### 3.1 A basic principle: reducing the amount of packaging

A reduction in the amount of packaging placed on the market can be achieved by:

- Product presentation;
- Formulation innovation;
- Reusable packaging.

A reduction in the amount of single-trip packaging requires:

- Optimum pack sizes to meet the farmer's needs better;
- Further advances in pack process technology;
- An optimal choice of materials.

Innovation in new active substances and/or new formulations has already contributed to, and will continue to reduce, the amount of packaging waste.

### 3.2 Minimising risks: intelligent packaging design

#### 3.2.1 Design at a glance

**An integrated approach to packaging design**

When designing packaging for crop protection products, it is important to consider the pack, the formulation and application technology as a single entity. The design should ensure that the container/formulation combination can be easily rinsed. The industry has an agreed test method to assess the rinsing characteristics of containers, which facilitates the design of effective container/formulation combinations.

**Continuous improvement of packaging design**

Most of the currently available pack designs are easy to handle on farms and allow for more complete emptying by avoiding blind corners and other design features that can trap product residues. This should be maintained and further improved by regular company reviews and audits on packaging. In addition to the design features, an appropriate choice of container materials can also help minimise the product residues remaining in the container after rinsing.

For more detailed guidelines on packaging design, see section 3.2.2 (Design in depth).

#### 3.2.2 Design in depth

**How to use these guidelines**

These guidelines provide standard design criteria for one-trip packs of crop protection products in solid and liquid formulations.

They are intended to help ensure that crop protection products are packed to present a minimum risk to people and the environment. They have been prepared by an ECPA working group of specialists with extensive experience in the field of packaging to help those involved in the various stages of pack procurement (such as design, selection, testing, approval and purchasing).

They will also be of help to national authorities and international organisations.

In these guidelines the word "must" is used to indicate the minimum industry standard acceptable and the word "should" to indicate proven good practice.

These guidelines provide standard design criteria for one-trip packs of crop protection products in solid and liquid formulations.

## Basic requirements

- Must comply with all legal requirements where these exist;
- Must comply with transport regulations and pass UN* performance tests where required;
- Must be identified as packaging for crop protection products (for example, by the appropriate labelling);
- Must minimise the possibility of operator contamination in opening, transferring, re-closing and rinsing;
- For a primary pack, or in the case of a combination pack, the packaging system should not exceed 25 kg/20 litres for manual lifting by one person;
- The packaging concept should use a chemical-specific standardised pallet (for example, 1000 x 1200mm, CP1);
- Should drain well and facilitate easy and effective rinsing to maximise product residue removal;
- Opportunities should be taken to develop product packaging that avoids confusion with food or drink packaging;
- Should be capable of passing UN performance tests where these standards are not required by local legislation;
- Should provide appropriate measures to prevent counterfeiting;
- Should offer a simple method of quality control;
- Should facilitate simple and environmentally sound management of packaging waste;
- Consideration should be given to the need for a separate or integral measure facility or graduated scale.

* UN - United Nations Recommendations on the Transport of Dangerous Goods (Model Regulations)

## Containers

In general:

- Must be physically adequate to withstand the required filling, transport, storage and use mode;
- Must be product-tight;
- Should have no sharp edges or projections;
- External rims or recesses should not trap product during or after pouring (otherwise ancillary dispensing devices may be needed);
- Should stand up without falling over (in the case of rigid packs);
- The ratio of pack material to product volume should be minimised in line with essential requirements legislation;
- Should be usable for as many different products as possible with standardised and modular formats;
- Empty packaging material should occupy minimum storage space;
- The container should be designed to permit glug-free pouring with minimal dripping or splashing;
- Where a 63mm closure system is used, it should be consistent with agreed ECPA industry standards.

Handles (and/or suitable recesses in the base for large containers):

- Should be provided for rigid packs of more than 5 kg/ litres;
- Should be isolated from the contents (vapour/ liquid phase);
- Should be large enough for a gloved hand;
- Should allow for easy gripping when wet.

Closure:

- Must be leak-proof;
- When intended, re-closure must be safe and liquid-tight;
- Closure must be removable with gloved hands, preferably without tools;
- Should be tamper-evident;
- Must meet the requirements of EC99/45 Article 9 in terms of tightness, compatibility, strength and re-application and resist the normal stresses and strains of handling.

Packaging materials:

- Must be inert to contents;
- Must be an effective barrier against diffusion and migration (water-soluble packs must be packed in waterproof packaging);
- Should be selected with recyclability and/or disposability in mind;
- Should be identified by a coding system;
- Should not be fragile or potentially hazardous.

Labels and printing:

- Material and printing inks must be resistant to the elements, the product and physical damage throughout the storage period;
- Must be firmly attached to the containers;
- Must comply with legal requirements (for example, hazard labelling);
- Should allow adequate space for safety instructions that can be referred to before opening the pack;
- Must survive immersion in sea water where the product category demands it.

## 3.3 The route to recovery: rinsing on the farm

### 3.3.1 Rinsing at a glance

**Recovery depends on rinsing**
Rinsing is a fundamental part of application. Empty chemical containers that have not been properly rinsed and cleaned can pollute the environment and pose a potential threat to public health, animals, and wildlife. Effective on-farm rinsing is therefore an integral building block of all the routes to recovery supported in these guidelines. ECPA is satisfied that properly rinsed containers present no practical hazard within the recovery logistics.

Crop protection associations are therefore advised to actively work towards a non-hazardous waste classification for rinsed containers. This is supported by a number of countries that do classify rinsed containers as non-hazardous waste.

**The farm is the best place for rinsing**
It is extremely important that the effective rinsing of containers takes place on the farm itself. No matter how an empty container is recovered, it must be properly rinsed. This underpins all subsequent activities. The correct practice for rinsing requires the farmer or spray operator to:

- Rinse the containers immediately after emptying them;
- Add the rinsate to the spray tank.

This allows for effective removal of product residues and, in addition to being good agricultural practice, makes good economic sense by ensuring that users get full value from their purchase.

For more detailed guidelines on rinsing, see section 3.3.2 (Rinsing in depth), below.

### 3.3.2 Rinsing in depth

**How to use these guidelines**
These guidelines cover containers for liquid or solid products that are normally diluted with water. All other containers should be disposed of according to the instructions on the product label or through agencies licensed for the purpose.

These guidelines provide three different options for rinsing:

- Triple rinsing;
- Pressure rinsing;
- Integrated rinsing.

Whichever option is selected, responsible rinsing is in the interests of everyone concerned with the handling of crop protection products. Rinsing ensures that excessive product residues are not left in the product containers after use - an essential prerequisite for recovery and for good economic control. Moreover, clean containers minimise the risk of exposure to people, animals, wildlife and the environment.

**Triple rinsing**
To triple rinse, the operator should allow the contents of the container to drain for an extra 30 seconds when emptying.

Then, 25 to 30 percent of the container's capacity should be filled with clean water. The cap should then be securely re-closed, after which the container should be shaken, rotated, rolled or inverted so that the water reaches all the inside surfaces.

The rinsate should then be drained into the spray tank (the recommended draining time being 30 seconds). This process should be repeated at least twice or until the container is visually clean.




Photographs on this page are courtesy of AdiValor.

Responsible rinsing is in the interests of everyone concerned with the handling of crop protection products.

### Pressure rinsing

Pressure rinsing equipment uses water under pressure (typically 3 bar) in the form of a static or rotating spray jet and valve. Some pressure rinsing equipment includes a sharp device that penetrates the container walls for rinsing purposes, thereby offering the additional advantage of preventing the container from being re-used. These devices should be used in accordance with manufacturers' instructions to avoid injury to the operator.

### Integrated rinsing

Wherever possible, integrated rinsing equipment should be used. Integrated rinsing is the most efficient method of rinsing containers and provides a high level of operator safety. It is also quicker than both triple rinsing and pressure rinsing.

Integrated rinsing devices rinse by using water under pressure (of typically three to five bar). A static nozzle with a valve is normally built into the induction hopper of the sprayer. The water pressure cleans the container until no residues are visible (typically requiring up to 30 seconds and 15 litres of water). The rinsate is then automatically added to the spray liquid.

Integrated rinsing devices can be built into a closed chemical transfer system and can therefore provide both efficient rinsing and even greater operator safety. This avoids spillage, which may expose the operator to unnecessary risk.

NB: Whatever the selected method of rinsing, the rinsate must always be added to the spray solution. Closures can be rinsed by placing them in the induction hopper. With triple rinsing they are cleaned by the shaking process. In addition, the manufacturer's instructions should be followed when using any rinsing equipment.

Photographs on this page are courtesy of Bayer Crop Scuience.

## A comparative assessment of rinsing methods

### Advantages

**Triple rinsing**
- No extra equipment is required
- Can be used in all situations
- No cost

**Pressure rinsing**
- Residues of less than 0.01%
- Prevents containers from being reused
- Low cost

**Integrated rinsing**
- Residues of less than 0.01%
- Used for both rigid and flexible packaging
- Simple operation
- With correct use of equipment, negligible risk to the operator
- Rinsate is automatically added to spray mix

### Disadvantages

**Triple rinsing**
- Residues are influenced by operator technique
- Additional operating time is required
- Some risks of endangering the operator
- Is difficult with non-rigid packaging
- The rinsate is not automatically added to the spray mix

**Pressure rinsing**
- Additional operations required
- Some risks of endangering the operator
- Can only be used with rigid packaging
- The rinsate is not automatically added to the spray mix

Recommendations to industry and associations

- Fill crop protection products into modern packages and continue to standardise on packaging materials that comply with the design criteria in terms of handling, opening, pouring, rinsing and recovery;
- Encourage the spray equipment industry to offer sprayer systems with integrated rinsing devices and to make available a device for retro fitting to older equipment;
- Advise and consult with end users;
- Include rinsing and recovery recommendations on the label;
- Devise promotional programmes to support rinsing initiatives;
- Initiate a certification scheme to identify product pack combinations that are capable of being efficiently rinsed.

## 3.4 Packaging recovery: considering the options

### 3.4.1 Recovery at a glance

Focusing on recovery schemes

The crop protection industry strongly supports recovery schemes for packaging waste. They must be feasible in terms of logistics, economics and their environmental impact. Recovery is given prominence in these guidelines because it is a developed option and the communication of best practice in this field is particularly important.

Planning for recovery schemes

Common success criteria

After many years of development, there are several mature and successful container collection and recovery schemes throughout Europe. Experience gained in this field shows us that the most successful schemes share a number of characteristics. Typically, successful recovery schemes feature the following:

- They are economically viable and environmentally safe;
- There is a clearly defined and controlled end-use for the recovered plastic and other packaging materials;
- Containers are rinsed and cleaned before entering the recovery route;
- There is a shared responsibility between all the stakeholders (including the crop protection industry, distributors, retailers, farmers, farmers' unions, custom applicators, local authorities, government environmental agencies and professional waste collection companies);
- There are controlled and supervised collection sites (and waste streams) to avoid dumping of unwanted crop protection product packaging.

Testing the scheme

In order for national crop protection associations to assess the viability of a collection and recovery scheme, the first step is a feasibility study. This will involve both waste management professionals and key stakeholders. If viable, before proceeding to a wider programme, the next step is to organise a limited pilot scheme to test farmer response, container cleanliness, logistics and the costs of recycling and/or energy recovery.

Funding the scheme

Container collection schemes require funding which should reflect the environmental burden. An example is the German PAMIRA scheme, which is based on the amount of packaging each company puts into the market. Costs are borne by all stakeholders involved in the process in ratio to the burden. More information on collection schemes can be obtained from ECPA.

Energy recovery

The preferred approach for final treatment of the packaging waste is energy recovery.

Energy recovery is preferred because:

- It is the best option environmentally, particularly in terms of resource conservation (for plastic and paper-based materials, energy recovery is effectively a form of recycling);
- It assures the highest stewardship, environmental and safety standards (the energy content of the packaging is effectively recycled);
- It is highly versatile across a range of packaging materials;
- It is legally and economically viable, as well as generally available across the EU (entailing only a small development effort).

### Material recycling

Material recycling can also be a suitable approach. In Canada, the US and Brazil, for example, specific end-uses have been identified. For this approach, proposed end-uses should receive specific approval by a suitable body of industry experts after an appropriate risk analysis has been completed.

### On-farm disposal

Approved recovery schemes are a good approach for managing both empty, rinsed containers and secondary packaging materials. Where suitable schemes are not established, on-farm disposal may be carried out if legally permitted. Extending best practice for on-farm disposal is the most effective way to raise overall standards. On-farm disposal must therefore be carried out according to local regulations and guidance.

### Looking at all the options

While the crop protection industry strongly supports recovery schemes, it is recognised that this may not always be the most practical or suitable option.

Consequently, there are three waste management options that should be considered (after local assessments of legislation, social and environmental impacts, economics and logistics):

1. Recovery schemes, where they are legal, practicable and economically viable.

2. Inclusion in municipal waste streams, preferably with energy recovery, and provided the necessary safeguards are in place (particular care must be taken to avoid the possibility of crop protection containers being selected for inclusion in unapproved material recycling streams).

3. On-farm disposal, where legally permitted and there is no feasible alternative, observing guidelines for best practice.

All three are sound approaches but need to be carefully implemented. This will require that national crop protection associations collaborate with official bodies to promote best practice and thereby avoid unacceptable practices such as:

- Indefinite accumulation of waste packaging on farms;
- Entry of used packaging material into waste streams lacking the necessary safeguards;
- Non-approved reuse of containers.

The municipal waste stream option does not usually require particular involvement by crop protection associations and companies. These guidelines therefore focus on recovery schemes and on-farm disposal options.

For more detailed guidelines on recovery and other waste management options, see section 3.4.2 (Recovery in depth) and the decision-making flow chart, on next page.

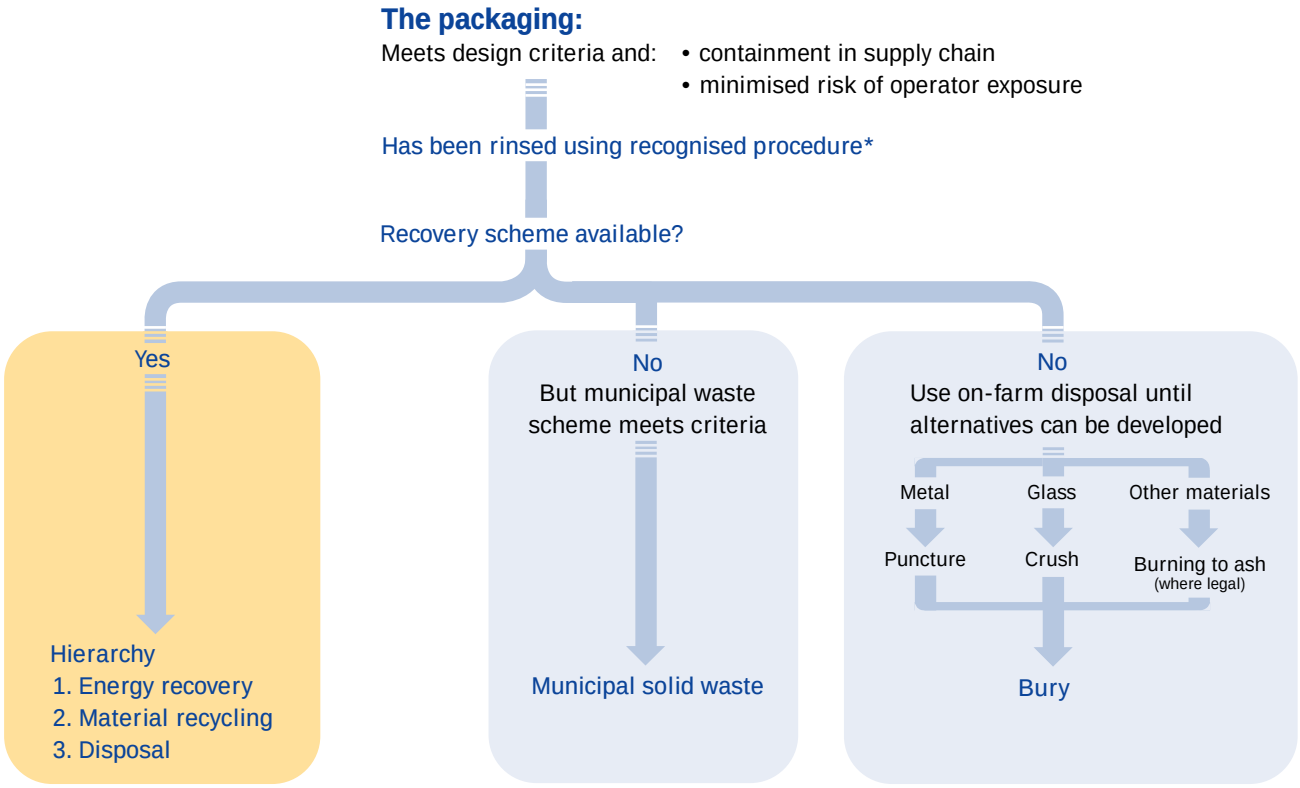
## 3.4.2 Recovery in depth

### Showing the way

Modern society considers waste as a valuable resource that has inherent value as energy. By treatment in a suitable plant, this value can be recovered directly saving consumption of virgin fossil fuels.

The crop protection industry believes that energy recovery is one valid strategy for managing used agrochemical packaging. The industry proposes that, where collection schemes are economically viable and environmentally reasonable (by local assessments of regulatory, social, environmental and economical conditions), energy recovery should be considered the waste management option of choice. Energy recovery from waste effectively means that fossil fuels are exploited not once, but twice. The focus of conservation should be on optimising the use of oil reserves rather than on plastics in isolation.

## Decision-making flowchart




This flow-chart is intended to facilitate decision making in the selection of waste management options (for packaging that has satisfied primary design requirements and has been rinsed after use).

* Manual triple rinsing or integrated rinsing preferred.

Energy recovery

The preferred option

In situations where it makes sense to recover empty, rinsed containers of crop protection products, energy recovery is typically the best waste management option. Energy recovery offers all stakeholders in agriculture the most viable solution. It is:

- The environmental option to best utilise resources and minimise pollution;
- Well-regulated and safe;
- Economically viable;
- High-tech but nevertheless available in developing countries.

For resource conservation, the energy-recovery approach is the optimum. As a fuel, the plastic containers that remain when crop protection products have been used are on a par with fossil fuels - and can even replace them in existing facilities with only minor modifications.

For stewardship assurance purposes, energy recovery also affords many benefits. State-of-the-art facilities have to meet very tight regulatory standards and are rigorously monitored.

For versatility, energy recovery stands above all other options. It can incorporate not only plastic containers but all the other materials (such as the outer paper-based packaging and labels). Where energy-recovery options exist, they need only minimal development effort to become operational.

Municipal Solid Waste (MSW)

Municipal Solid Waste (MSW) is necessarily mixed in composition, but within MSW plastics are a particularly rich source of energy - despite the fact they make up a minor proportion of the weight. In the mix, plastics can provide the fuel-power to drive the overall process of energy recovery for MSW.

A rich source of energy, packaging (and particularly plastics) waste can also be used in plants that are already established as generators of heat or electricity. After conversion to a suitable physical form, such as Plastic Derived Fuel (PDF), it can be blended into the process to partially replace virgin fossil fuels. This is called co-combustion. PDF is highly efficient as a substitute fuel (1 kg of PDF replaces at least 1 kg of oil. The energy value (KJ/kg) of plastic being approximately twice that of coal).

Cement kilns

Cement kilns deserve special consideration because:

- Their operating conditions permit waste classified as hazardous to be used as fuel, meaning that very large safety margins exist for rinsed agrochemical packaging;
- They have stringent controls on their emissions, equivalent to those prevailing for toxic waste;
- Energy costs dominate the overall production costs, creating a significant incentive to develop low-cost, alternative fuels (indeed, cement kiln operators often have considerable experience in developing alternative fuels from, for example, car tyres and waste solvent);
- The PDF needs to be in an appropriate physical form;
- Particulates are captured within the process and are built into the final cement product;
- Like agriculture, they are located in rural rather than urban areas;
- They are widely available in both developed and developing countries.

US Environmental Protection Agency (EPA) has looked at the suitability of cement kilns for processing hazardous waste and concluded that replacing coal with solvent-derived fuel "should present no negative effect on the environment or health care in the community, if EPA standards are met". In the US, test burns have been conducted with rinsed agrochemical packaging waste. These confirmed no change from the control emission levels that were within the limits set by federal and local regulations.

The environmental profile of cement kilns is largely positive. One tonne of PDF substitutes more than an equivalent amount of conventional fuels (coal dust, oil or gas). There are no induced additional energy losses in the system - and the energy of plastics can even be used to produce high temperature heat (not only low temperature heat). Moreover, it has been clearly established that combustion of plastics in the high temperature zone does not adversely alter the emissions of the cement kiln.

Cement kilns in practice

After visual control, the rinsed containers are shredded to a preferred particle size of less than 20mm (for relatively flat particles). The location of the shredding facilities is usually based on logistical and cost criteria.

Agrochemical packaging waste is introduced, in shredded form into the main firing (or sinter zone) of the kiln.

Cement kilns produce cement clinker, which involves a final burning step (called sintering) at 1450°C material temperature. Very high flame temperatures of 1800 - 2000°C enable the safe destruction of organic compounds. Traces of residual agrochemicals are efficiently destroyed at very high temperatures and long residence time (at least 5 seconds at a temperature above 1100°C).

## Recommended quantities per kiln

- Assumed kiln capacity: 1000 t/d clinker
- Assumed total fuel consumption of kiln: 3.5 - 5 GJ/t clinker
- Recommended fuel substitution rate: 5 - 25% substitution
- Quantity of shredded packaging: 3,8 - 27,8 t/d
- Calorific value recovered: 170 - 1250 GJ/d

NB: The running time of a cement kiln depends on market conditions and the kiln stoppages for maintenance and repairs (usually one month per year). At a running time of 300 d/a, such a 1000 t/d kiln could use about 1100 - 8000 t/a of (agrochemical) packaging. Smaller quantities should be avoided for economic reasons (unless the cement kiln is already equipped with the necessary installation to feed such material into the sinter zone).

To conclude, cement kilns are suitable for the recovery of agrochemical packaging waste because:

- They offer an environmentally acceptable alternative when no dedicated Energy-From-Waste (EFW) facility is available;
- Recovery in cement kilns offers an advantageous recovery value (one-to-one substitution of actually required fuels) - consequently, as a substitution of fossil fuels, it has no adverse effect on carbon dioxide emissions;
- Cement kilns are widely available and the highest demand for cement is in developing countries.

### Material recycling

Steel smelting

In the blast furnace method of steel production, hydrocarbons have been used successfully for more than 200 years as reducing agents in the transformation of iron ore into pig iron.

Tests in 1994 concluded that plastics waste can substitute heavy oil. More than 80 per cent of its energy content is used as chemical energy. This method is recognised by the German Environmental Protection Agency as raw materials recycling.

In a comprehensive analytical programme focusing on dioxin and furan contents, no significant increase in waste gas emissions linked to the use of plastics was observed.

The plastics are blown into the blast furnace after shredding the agglomerate to less than 5mm.

Chemical feedstock recovery

It is also possible to convert plastic back into its monomers - the chemical building blocks from which new materials can be made. The process includes effective chemical separation and has an important technical advantage over mechanical recycling in that it can even cope with contaminated or dirty packaging waste where necessary.

However, the technique has relatively high running costs and, because it is highly specialised, requires considerable capital investment. From the technical and economic viewpoints, there are no advantages over energy recovery.

Mechanical recycling

Converting plastics waste into useful new plastic items is generally seen as sensible, where:

- The collected material is clean;
- The collected material does not contain different polymers/laminates;
- There is a market for the product;
- The economics are sound.

The establishment and implementation of container management strategies (CMS) require specific actions at the association and company levels.

## 3.5 Implementing strategies: a pan-European effort

### 3.5.1 Crop protection associations

Implementation

The establishment and implementation of container management strategies (CMS) require specific actions at the association and company levels.

Crop protection associations

To begin, associations should:

- Set up a container management task force to establish the strategy and to promote rinsing and recovery campaigns;
- Review the local strategy for agrochemical packaging waste and identifying the local significance (if any) of the pack collection strategy versus the other strategies supported by ECPA.

Then, if significant, associations should set up a task force to:

- Make a broad survey of all possible energy recovery options available within national boundaries, using contacts with the local plastics trade association and official pollution regulators;
- Identify industries with common issues and consider the potential of joint projects.

Associations should also develop a formal project proposal addressing:

- Scope for collaboration with other industries;
- Logistics and economics for the total waste management chain;
- Facilitation of mandatory rinsing prior to recovery;
- Plans for pilot testing;
- Management and funding.

Other key actions at the association level include:

- Auditing current packaging against design criteria (see section 3.2 in these guidelines);
- Discussing campaign principles with authorities to gain their approval and support;
- Gaining specific agreement for a non-hazardous classification;
- Ensuring agrochemical packaging waste is positioned as “valuable PDF” not “problem waste” - ensuring that any discussions on disposal of waste concentrates or active ingredients are kept separate;
- Implementing communications campaigns on rinsing at the farm and dealer levels;
- Defining a communication plan that minimises any unwelcome, negative attention directed at crop protection products;
- Incorporating the recovery of post-consumer packaging waste into education campaigns;
- Conducting surveys to assess attitudes to, and the degree of compliance with, rinsing and recovery scheme requirements;
- Agreeing a budget and funding mechanism;
- Actively networking with other national associations to share information and experience.

Agrochemical companies

Key actions at the company level include:

- Implementing quality container designs;
- Implementing newer technologies that contribute to minimising packaging waste;
- Reducing the amount of packaging placed on the market;
- Promoting best practices for container rinsing and recovery through education programmes, including training of field sales and technical staff;
- Ensuring information on rinsing appears on product labels and instructions for use;
- Preparing to provide appropriate technical information to national associations on rinsing and recovery procedures.

European Crop Protection Association
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