

RECYCLING POST-CONSUMER AEROSOLS

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Introduction

Aerosols provide a convenient means of storing and dispensing a wide range of goods for personal, household, medical, technical and industrial use. Around 600 million are consumed annually in the UK, giving a consumption rate of nearly one per person per month, or 27 per household per year. In 1999, Aerosols accounted for about 4% of metal packaging systems marketed in the UK, with approximately 65% of aerosols made from tin plated steel and the rest from aluminium. BAMA estimate that this equates to about 25,000 tonnes of tinplated steel and 4,500 tonnes of high grade aluminium available for recycling.

Recovered aerosols can therefore make a valuable contribution to metal recycling and do so in many countries. Seventy-five percent (75%) of all USA cities now include empty post-consumer aerosols in their recycling programmes, covering 138 million people. There are also major schemes in Canada, Germany, France, and The Netherlands which recover significant numbers of empty post-consumer aerosols for recycling.

In 1999 PPS Recovery Systems Ltd completed a study¹ for BAMA which coupled a review of the health and safety literature for aerosol recycling with a practical experience by an independent health and safety expert. The study considered the recycling of aerosols in the context of a general Health and Safety Code of Practice for a Materials Reclamation Facility (MRF). As for any other manufacturing process or work activity, health and safety issues in the operation of a MRF should be managed as a key aspect of the operation. The advice in this guide is given against the background of a MRF where a written safety policy which sets the standards² to be achieved is implemented, monitored and reviewed over time to ensure that the operating standards and other control over the risks identified are maintained. Within this context the study established that by taking some basic precaution to control risks, empty aerosols could be included in the household waste recycling stream.

This document is extracted from the review and sets out 'Best Practice' for the recycling of empty post-consumer aerosols recovered through material reclamation facilities (MRFs). A copy of the report of this study is available from BAMA.

¹ The Recovery of Post Consumer Aerosol Containers Through Material Reclamation Facilities - PPS Recovery Systems Ltd. 1999.

² General advice on operating a MRF is produced by the Institute of Wastes Management in their Guide 'Material Recycling Facilities' obtainable from IWM tel: 01604 620426

A Risk Assessment Of The Likelihood Of Accidents

Since 1992 a number of studies have considered the potential hazards of the handling, sorting and baling of empty post-consumer aerosols in MRFs. These studies included a wide range of sampling to identify, define and quantify the potential risks of the hazards occurring. The general conclusion is that although flammable or harmful residual contents are potential hazards, taking some basic precaution to control risks to an acceptable level means that empty aerosols may be included in the household waste recycling stream.

The studies found that since there is a theoretical risk of fire or explosion arising from the release of aerosol propellant or contents, the generation of flammable atmospheres cannot be completely eliminated. However, it is unlikely that an accumulation of flammable mixtures that could result in explosions or significant fires will occur during collection or sorting because releases are small and/or in an open atmosphere. The risk of fire or explosion is highest during baling, but in practice, provided suitable precautions are taken, the actual risk of a serious incident or accident is low because:

- The amount of flammable gas propellant or flammable vapours from residual contents of empty post-consumer aerosols³, in the normal proportions in which they are found in the domestic waste stream, make a fire or explosion unlikely.
- The design and operating conditions of the type of balers used⁴ is not conducive to generate hot spots or sparks through mechanical means - i.e. friction or impact - due to the relatively low speed of compaction.
- Even if an ignition source is available, the energy during baling is unlikely to be sufficient to initiate an ignition.
- Not all mixtures of gases and atmospheric air are combustible, the air/vapour mixture may be too lean or too rich to support combustion. For ignition to occur the composition must be within the lower and upper limits.
- Flame propagation may be prevented within the bale matrix as inter-distances are not continuous or are less than the quenching distance.⁵

³ After normal use, aerosols may still have small quantities of residual contents. Various studies from around the world including the UK have shown that an aerosol may contain 1-2.5wt% of propellant and 1-2.5wt% of product (e.g. hairspray, deodorant etc.). In the USA, an aerosol with less than 3% of its original contents is defined as 'empty' by Environmental Protection Agency. In the UK, BSEN 13430:2000 a standard dealing with the recycling of waste packaging defines packaging as 'empty if - under normal and foreseeable circumstances - all product residues that can be removed by the emptier have been removed by using practices commonly employed for that type of packaging'.

⁴ A wide variety of baling equipment is used for compacting recovered metal packaging (i.e. used beverage and food cans) in UK MRFs. Balers such as the Mills UBC and McIntyre Alpack 5000 M10 or M20 producing bales of about 0.02m³ are common. Larger balers such as the Mills T40 producing bales of 0.77m³ are less common

⁵ Bales comprising steel cans form a compressed matrix of metal surfaces and may not have any continuous paths of sufficient width and length for the spread of fire. Ignited flammable material is not sustained in such metal matrices, due to quenching effects. This phenomenon is employed in miners' safety lamps.

Best Practice Guidelines For Post-Consumer Aerosol Recycling

The health and safety issues associated with the recovery of empty post-consumer aerosols are generally the same as those associated with other recyclables and as such are covered by general guidance to good practice for operating MRFs⁶. Operating procedures specific to the recycling of empty post-consumer aerosols within the context of a general Health and Safety Code of Practice are set out below:

- 1) Only aerosols derived from the domestic waste stream should be handled by the MRF. It is recommended that aerosols from the commercial waste stream be directed to specialist recycling facilities.
- 2) As far as possible only empty aerosols should be handled by the MRF. This should be emphasised at the point of collection and through advice given to householders. Additional advice on appropriate disposal routes for unused or faulty aerosols should also be provided. Consumers should be advised not to pierce or crush aerosols themselves.
- 3) Aerosols should not be segregated from the steel and aluminium recycle streams.
- 4) A no-smoking policy should be enforced during collection, transport and material handling at the MRF, with training given to operators to explain why the policy is required.
- 5) Good ventilation is required at the MRF in areas where aerosols are handled or may accumulate e.g. the transit and sort conveyors, automated separators, baler/shredder feed hopper, baling press and immediate storage area for completed bales. The baler should be installed in an area where good ventilation can be maintained to prevent accumulation of flammable gases or vapours (e.g. not in a pit).
- 6) A 'Zone 2' area should be maintained within one metre horizontally and vertically of the press and the last two bales produced.
- 7) The baler and other equipment used in the Zone 2 Area should comply with the requirements of BSEN 60079.
- 8) The baler and other equipment in this area should be maintained so that there are no loose parts which could become detached in the event of a deflagration e.g. lids, gratings, panels, etc.

⁶ The health and safety review conducted by PPS Systems Ltd for BAMA (see Footnote 1) considers the recycling of aerosols in the context of a general MRF Health and Safety Code of Practice. The report includes general guidance on operational safety, health/hygiene, fire precautions, electrical hazards and personal protection. A copy of the general guidance or the full report can be obtained from BAMA.

- 9) Operators should not stay within the Zone 2 area during operation of the baler.
- 10) New bales should be promptly removed from the baler and aerated for at least 30 minutes to allow any residual vapours to disperse.
- 11) Fire extinguishers should be available for use in the vicinity of the baler. Dry powder or foam extinguishers are effective for combating fires involving inflammable liquids, carbon dioxide extinguishers are suited for use on fires involving flammable gases (BS 5306).
- 12) A good standard of housekeeping should be maintained throughout the MRF and no debris, especially of combustible material should be allowed to collect in particular around and underneath the baler.
- 13) A written standard operating procedure/code of good practice should be drawn up for the MRF, with operators trained to follow it. A good standard of supervision should be maintained throughout the MRF.
- 14) Adequate and suitable training should be provided for all persons working in the MRF to ensure they are familiar with, and understand, the precautions that must be taken and the emergency procedures to be followed in case of a fire or other incident.

Further recommendations for MRFs using can flatteners

- 15) Mesh screens should be placed over the can flattener in-feed and output hoppers to prevent can component escaping as missiles.
- 16) Open (mesh) sided skips should be used to store newly flattened aerosols to prevent the accumulation of flammable gas released during can flattening.
- 17) The can flattener and mesh skips should be checked and cleaned periodically to prevent build-up of flammable residues.

These recommendations are based on published experimental work and risk assessments with feed streams containing up to 5% post-consumer aerosols. If the proportion of aerosols in the feed stream were to be higher, the risks associated with handling the material would also be expected to increase.

Frequently Asked Questions

People interested in recovering aerosols commonly ask a number of questions before commencing a scheme. Answers to some such questions are identified below, based on the above guidelines.

Why restrict the scheme to just empty post-consumer aerosols?

The hazards associated with handling empty post-consumer aerosols are well characterised and have been considered in the risk assessments upon which this Guidance is based. The hazards associated with handling other aerosols are outside the scope of these risk assessments and consequently the handling procedures outlined here may not be appropriate.

Practical experience of recycling aerosols in the USA, Canada and Europe indicates that the occurrence of post-consumer aerosols containing more than minimal residues is low and does not create a problem during processing at the MRF. Effective householder education should however be used to minimise the residual content of aerosols recovered for recycling. Research shows that no significant differences as regards the composition of municipal solid waste, particularly of metal containers, were observed among different countries.

Batches of aerosols from industrial sources should be sent to a specialist waste disposal company for disposal. A fatal accident has been documented in the USA in which a large number of full aerosols, derived from disposal of bankrupt stock, were processed as a batch at a MRF. An activity such as this contravenes the most basic safety precautions. Separate guidance on the disposal of full or part-full aerosols is available from BAMA.

Are any other restrictions necessary on the range of aerosols recovered?

None of the schemes in the USA, Germany France or The Netherlands restrict the range of post-consumer aerosols recovered.⁷ The range of products contained is broadly similar to that encountered in other forms of packaging and is summarised below in Table 1.

The UK National Household Hazardous Waste Forum (1998) has defined household hazardous waste as 'any material discarded by the household which is difficult to dispose of, or which puts human health or the environment at risk because of its chemical or biological nature'. Classification is based on the contents of the packaging and so empty aerosols are not regarded as household hazardous waste.

⁷ In principle the German Duales System Deutschland (DSD) recovers all aerosols that are purchasable by private households, provided they are technically emptiable, hence products such as oven cleaners and fly sprays are acceptable. The United States Environmental Protection Agency (1994) has stated that recycling of empty pesticide aerosols can be safely and appropriately accomplished.

TABLE 1 EMPTY AEROSOLS IN UK HOUSEHOLD WASTE STREAM (1999)

Product Category	Percent of Total (%)	
	Steel	Aluminium
Insecticides	1.3	
Paints	3.6	
Air Fresheners	9.5	1.7
Polish	8.1	
Oven Cleaners	1.2	
Starches	1.6	
Surface Cleaners	2.7	
Shoe/Leather Cleaners	0.5	0.2
Hairsprays	9.1	3.9
Hair Mousse		4.7
Antiperspirants/Deodorants	14.0	18.5
Shaving Foams/Gel etc.	7.0	1.0
Automotive Products	5.2	1.2
Vet/ Pet Care	0.4	
Miscellaneous	4.6	
TOTAL	68.8	31.2

What can I do with my recovered material?

Markets exist for recovered material containing aerosols which can add revenue to the recycling scheme and avoid landfill costs and taxes. The Save-A-Can scheme operated by Corus Packaging Recycling accepts recovered steel containing aerosols. Alcan Aluminium Can Recycling accepts aluminium aerosols mixed in with used beverage cans as long as they make up no more than 2% of the material and are de-pressurised once baled. Many other secondary metals dealers also accept recovered steel or aluminium containing aerosols. It is important to discuss the actual specification for the recovered material with your secondary metals dealer.

What about CFCs?

In the UK, consumer aerosols have not contained CFCs since 1989.

What if full aerosols get into the MRF material stream?

Inevitably a small number of aerosols with significant residual content will be recovered and get into the baler and be crushed. However, practical experience shows they do not create problems. Full aerosols found in the MRF feed stream should be removed and diverted to the special wastes stream or emptied using special equipment.

The MRF operator should avoid handling batches of full aerosols, which are outside the scope of this Guidance.

Why not segregate aerosols from the steel and aluminium streams?

The risk assessments reviewed consider the situation where aerosol aerosols are 'diluted' with other cans. If aerosols were segregated and processed separately, the quantity of flammable gas or liquid and hence the hazard associated with each batch would naturally be increased.

Do I need additional ventilation?

Good ventilation in the area of the baler feed hopper, baling press and last two bales formed facilitates rapid dilution of flammable vapours released during compaction. Air changes of about six per hour would be sufficient to prevent the lower explosion limit (LEL) concentration being approached.

In a large and draughty MRF, very little additional ventilation may be required; open sided units, with no pits⁸ or depressions in which gas could collect, should not require mechanical ventilation. If the baler is located in a corner or relatively confined area, then mechanically assisted ventilation may be required.

Gas sensors in the area which would switch on mechanically assisted ventilation when 25% of LEL and alarm at 40% - 50% of LEL are one option. If used such sensors require the implementation of a programme of routine tests to ensure they are maintained in effective working order.

What does 'Zone 2' classification mean?

The EC Directive⁹ on safety of workers at risk in flammable atmospheres includes a classification of places where as a result of local and operational conditions an explosive atmosphere either exists or may occur. In such places precautions must be taken to protect the health and safety of the workers concerned. Hazardous places are classified on the basis of frequency and duration of the occurrence of an explosive atmosphere.

An area in which an explosive atmosphere consisting of a mixture of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation, but if it does occur, will persist for a short period only is classified as 'Zone 2'.

As far as possible, all potential sources of ignition should be removed from the baler area. For example smoking should be prohibited and only equipment suitable for a Zone 2 protected area should be used within one metre in all directions around the baler and finished bales. Lighting over the area should, therefore, not need to be protected if it is installed outside the Zone 2 area.

The performance of work in this area is permitted only if these precautions for this zone are applied.

⁸Propellant gases are generally heavier than air so will collect in pits or depressions.

⁹ Explosive Atmospheres (ATEX) Directive 1999/92/EC due to be implemented in the UK in as the Dangerous Substances and Explosive Atmospheres Regulations.

What precautions are necessary for 'explosion control'?

No loose panels or grids etc. should be allowed on the baler. All employees should be outside a zone marked round the baler while material is being compacted. This is good practice even where aerosols are not being handled.

What precautions are necessary for handling newly formed bales?

The area one metre horizontally and half a metre vertically around new bales should be considered as coming within the Zone 2 classification.

A proportion of any flammable material released during compaction may be retained in the bale, and subsequently released over a period of time. This may result in the LEL being exceeded briefly in the immediate vicinity of the new bale. Volatile substances such as propellant gases are released rapidly, with less volatile substances such as solvents released more slowly. Bales should be promptly removed from the baler to prevent their involvement in a subsequent fire¹⁰.

What fire precautions should I take?

i) Fire Extinguishers

Portable fire extinguishers should be provided, and maintained in working condition. When the MRF is set up the location of the fire extinguishers should be determined, taking advice from the Fire Authority and following the guidance given in BS 5306. It is recommended that fire extinguishers be mounted on the wall, or fittings, in clearly marked fire points, and where the emergency procedures are posted. These should be beside fire exits and in other prominent positions. The extinguishers should be checked daily as part of a supervisor's/manager's audit.

ii) Fire Alarm

A fire alarm, clearly audible throughout the building should be provided.

iii) Housekeeping

A high standard of housekeeping should be maintained to prevent the accumulation of combustible material beneath or around the baler and in the bale store. Then, even if a small flash fire of flammable gas or vapours should occur, it would be unlikely to spread.

¹⁰ In a study in Germany 15-30 minutes was required for evaporation of less volatile components at room temperature (20°C), leading to the recommendation that bales are allowed to aerate under supervision for approximately thirty minutes, longer at low temperatures.

Conclusion

A comprehensive report by the Factory Mutual Research Corporation in 1996 concluded that the additional risk associated with the inclusion of aerosols in MRF materials is comparable with the risk already faced by the MRF from other hazards. Systematic addition of empty aerosols may not increase the risk level in a MRF in any significant way. Aerosols of various degrees of emptiness may reach the recycle stream accidentally and randomly irrespective of the existence of aerosol recycling policies. The risk associated with aerosols when no policy exists for their systematic processing may be much higher than the risk of systematic processing of such aerosols.

Potential hazards for the recycling process are clearly identifiable from the residual contents of empty post-consumer aerosols. In practice there are a number of basic and effective control measures that can be put in place to reduce the risks to an acceptable level.

The report of the review of the health and safety literature for aerosol recycling from which this Guidance for recycling post-consumer aerosols is derived is available from BAMA.