

FACT SHEET



Thematic Strategy on the Prevention and Recycling of Waste: ISOPA's Position

INTRODUCTION

This position paper summarises the standpoint of the polyurethane industry in relation to the EU waste policy. This position is supported by examples and case studies based on industry's experience and/or research.

ISOPA represents the manufacturers in Europe of key raw materials for polyurethanes and plays a central role in the sector's commitment. It is happy to engage closely with stakeholders and public authorities to contribute to the development of sustainable development measures and contributed to both phases of the stakeholders' consultation launched by the European Commission on the Thematic Strategy on Waste Prevention and Recycling.

ISOPA welcomes the adoption of the Commission's Communication "Towards a thematic strategy on the prevention and recycling of waste" (COM(2003)301) as a first step towards the development of the Thematic Strategy on both prevention and recycling of waste. ISOPA embraces the Commission's concern to design "a number of inter-related measures to reduce the environmental impact of resources in line the EU's Sustainable Development Strategy".

Since the early days of recycling, ISOPA has been developing recycling policies and or best practices. At the end of their in-service lives, polyurethanes can be recycled mechanically or chemically and by feedstock recycling. Alternatively, their intrinsic energy value can be recovered by combustion in appropriate installations.

Existing projects demonstrate that recycling and recovery reduce the volume of polyurethane waste going to landfill. From European sources, more than 250,000 tonnes of polyurethane are recycled and recovered every year.

LIFE CYCLE THINKING – THE KEY STRATEGIC APPROACH TO WASTE MANAGEMENT

ISOPA believes that a knowledge base should be developed on the environmental impacts of waste generation and management taking into account the whole life cycle of resources and products.

Waste weight cannot be considered as an appropriate approximation for the environmental impacts of waste generation and management. Policy cannot be simply developed to reduce the quantities of waste generated, landfilled or incinerated, but it should be developed to reduce environmental impacts that are important in the life cycle of resources and of products.

This would allow an overall environmental improvement and would allow tackling the most environmentally damaging life-cycle stages rather than the end-of-life stage. This is the most appropriate approach for certain types of products, such as **durable products**.

Examples

- Polyurethanes used in the building and construction sector, may be more resource intensive from a weight point of view, but need less replacement over the full life cycle and therefore save overall in resource and waste. The ratio of plastics consumption by the building and construction sector versus plastics waste generated in the same year is relatively low: 17 % (from [Plastics: A Material of Choice in Building and Construction](#), APME, 1999).

- Composite materials, such as insulation sandwich panels, dramatically improve energy efficiency during the building lifetime. Prefabrication usually brings more quality and resource savings. At the end of the useful life of the building the panels can be relatively easily be removed from the frame of the building. However, the panels themselves could be more difficult to disassemble and hence recycle than built up systems because of the very good polyurethane to steel adhesion.

COUPLING WITH THE NATURAL RESOURCE STRATEGY – A HOLISTIC APPROACH

ISOPA finds it critically important that for durable products a holistic approach is being taken and that the waste strategy is coupled with the resource strategy.

Setting waste targets without taking into account the material functionality, including durability, and/or energy efficiency in use of certain products will work against overall environmental improvements.

Example – Durability and Energy Efficiency of Polyurethanes

It is important to note that the total of 250 kt/year of recovered polyurethane must not be compared with consumption of raw materials of about 2.1 million tons in 2000, because durable polyurethanes result in much smaller amounts of waste in the same year.

Total polyurethane waste is estimated to be about 1.3 million tons in 2000, about half of which is not suitable for collection and subsequent recycling, because of small amounts and/or wide distribution. Insulation foam has a density in the range 30 to 40 kg/m³ which results in comparatively large volumes of waste. This waste is best recovered by combustion (incineration with energy recovery) together with municipal solid waste (see discussion of energy recovery in page 4).

The amounts of waste from Construction and Demolition are currently very small. Moreover, polyurethane insulation foam salvaged from the demolition of buildings is usually estimated to have served more than 50 years and during this service life, the foams will have saved at least 100 times more energy than the fossil fuel used to produce them in the first instance. (For further insights on the energy efficiency of insulation PU foam, please consult:

http://www.isopa.org/isopa_site/documents_ns/FS%20Energy%20Buildings%2002-2004.pdf

According to the BING (www.ivpu.de) ecoprofile, the insulation of a roof attic average residential house, saves 24 000 MJ energy in 50 years. With buildings accounting for over 40% of CO₂ emissions within the EU, insulation foams play a vital role in combating climate change as they can save 50 to 60 million tons of CO₂ per year, yet only create 5 to 6 million tons of CO₂ equivalent emissions.

For instance, it has been calculated by Kingspan (www.kingspan.com) that pitched roof insulation after 50 years results in £10,394, or 485,334 kWh saved compared to an uninsulated roof. In detail*:

Insulation of a 60 m² pitched roof:

	Energy (kWh) savings	CO ₂ eq. savings	Cost (£)
Installing insulation			
Installation	- 4,269	- 1,223	- 386
After 50 years	481,763	138,024	10, 422

*Data from Kingspan ('[Lifetime Energy, CO₂ and Financial Balances for Insulation Materials](#)')

ECO-EFFICIENCY ANALYSIS AS A TOOL FOR WASTE PREVENTION MEASURES

Tools, like eco-efficiency analyses, should be made available at reasonable prices for enterprises to use, as eco-efficient solutions are win-win solutions and should be accessible (yet not imposed) as much as possible to companies.

Eco-efficiency analysis tools are able to structure the link between environmental burden and cost and are able to analyse questions concerning the efficiency of the various recovery measures. The results are displayed in an eco-efficiency portfolio, thus providing a comprehensive mapping of the results.

Case study – Eco efficiency study on recovery options for plastic parts from End-of-Life Vehicles

In an [eco-efficiency study](#), the Öko-Institut (Darmstadt, Germany) analysed and evaluated the recycling and recovery options for seven different plastic components from ELVs (weights ranging from 0.27 kg up to 3.14 kg). The study intends to provide an **evaluation tool** for the various technology options in terms of **environmental impact** and corresponding costs in a first step, based on existing data, completed by expert judgment, involving the inherent limitations of a first approach.

In this specific case study, the **eco-efficiency portfolio** provided the following main outcomes:

- Landfill shows the worst eco-efficiency performance in comparison with the other recovery options.
- The eco-efficiency ratings for recovery technologies such as blast furnace, syngas production (SVZ-technology), cement kiln and in some cases to a lesser extend for waste combustion are generally on a comparable level.
- Mechanical recycling can only compete with other recovery technologies when large, easily accessible, monomaterial plastic parts are included and a market exists for the recycled products.
- Assuming an optimistic 1 to 1 substitution of virgin plastic in an application by recycle, the purely environmental perspective shows advantages for mechanical recycling compared to the other recovery technologies. From an eco-efficiency perspective, in most cases mechanical recycling is similar to the other options.
- The dismantling costs and lack of marketability for the recycled materials are the major determining factors for the eco-efficiency performance of mechanical recycling.
- An increase in car weight e.g. due to the reduced performance of recycled materials compared to virgin plastics is counterproductive. This is because a lower performing recycled material requires additional material weight and consequently the fuel consumption during the use phase increases.
- Energy saving during the use phase should be given a higher priority. An analysis assessing the relevance of the recovery phase compared to the whole life cycle (production, use, recovery) of the car indicates that hat energy consumption (a key indicator) is dominated by the use phase.

ALTERNATIVES TO RECYCLING

ISOPA believes that for the sectors covered by current legislation and other waste streams other legislative approaches would be more appropriate and new and more eco-efficient solutions are needed.

The existing legislation on end of life products provides adequate encouragement for the recycling industry and a level playing field, that is, current municipal solid waste and end-of-life directives cover waste streams containing over 90% of all plastics wastes. Focusing on the remaining 10% seems unbalanced because other waste management options provide more eco-efficient solutions, mainly related to incineration with energy recovery.

The following case study illustrates how the choice of the most suitable option(s) for recycling/recovery is governed by a number of factors that vary from case to case and also from location to location. Some of the most important ones are the properties of the polyurethane to start from, the intended

application for the recycle and the capacity of the market to absorb the recycled material. Logistics are also frequently of key importance, especially with respect to economics.

This is the reason why maximum advantage for the environment is generally gained by a combination of options that depend strongly on the individual local conditions and may therefore differ from one place to another.

Case study – Alternative to recycling for PU flexible foams

Polyurethane foams are recyclable but, like any other plastics material, not indefinitely. For instance, **rebonding** of flexible polyurethane production waste is well established (*estimated 2000 recovery data for all flexible rebond PUs in Europe and North America is 120.000 tonnes*). In a similar fashion, post-consumer waste could be used for rebond foams. However, the volume streams for rebond foams in relation to the market capacity do not allow further expansion of this approach. (for further information on rebonded foam, please refer to:

http://www.isopa.org/isopa_site/documents_ns/rebonded.pdf).

New activities in the area of post-consumer polyurethane foam waste are emerging: e.g. grinding and re-use, particle bonding, energy recovery and others.

This case study highlights the technical feasibility of various options to **recover the energy** of flexible polyurethane foams and intends to show **how solutions exist in practice, which while providing the same level of environmental impact, are more economically and socially feasible**. Costs will largely determine the viability of any option in a defined application.

http://www.isopa.org/isopa_site/documents_ns/flexible.pdf

1. Feedstock recycling offers an alternative materials recycling option for mixed plastics waste which cannot otherwise be mechanically recovered due to technical or economic considerations. Feedstock Recycling covers a range of chemical processes by which plastics can be broken down to basic hydrocarbon units or constituent monomers, which can then be used again as raw materials in chemical or petrochemical processes. A range of technologies is available. Polyurethanes materials in a mixed plastics waste stream can be successfully incorporated into many of the existing feedstock technologies:

http://www.isopa.org/isopa_site/documents_ns/feedstock.pdf

Many of the developing feedstock recycling technologies are uneconomic at present. Under these conditions, mixed plastics waste, of which polyurethanes can be one component, will be sent for feedstock recycling where legislation prevents cheap disposal, the other recovery options being neither technically possible nor economically viable.

2. Chemical Recycling has been practised on a small scale for several years and is used in the polyurethanes industry to reform waste foam to polyols which are blended with virgin polyols to make more polyurethanes. The technology requires feedstock of known and reproducible composition and is, in general, only suited to production waste. The achievable specifications of polyols from chemical recycling result in only limited marketability and constrain the practical use of this process.

3. Energy recovery

3a. Co-fuel in MSW combustors – (*Estimated 2000 data: 110.000 tonnes of Energy recovery in Municipal 110 000 t/year from PUs*). This is a technique practised to provide local communities with electricity and heating schemes.

Environment impact - Up to 10% of domestic electricity requirements could be generated by these units. Emission data for HCl, CO, Sox, NOx, Cd, Hg and other heavy metals are shown at page 3 of this document: http://www.isopa.org/isopa_site/documents_ns/flexible.pdf . Emissions during the incineration of flame-retarded plastics have been of concern. The PU industry therefore initiated a series of trials at the incineration test facility in Karlsruhe (TAMARA). Results from these trials demonstrate that there is no impact of rigid polyurethane foam containing chlorine, bromine and phosphorus on emissions. Hence flexible foams containing fire-retardant additives can also be safely co-fired with MSW.

Social impact – The polyurethanes industry has taken on the challenge of contributing to the change the social acceptability of co-fuel generation and has initiated a number of trials and studies to further the knowledge on all aspects of incineration with energy recovery. One such trial took place at Cyclenergie, Pontivy (F), using Automotive Shredder Residue (ASR), of which a large part is formed by polyurethane foams. This was used as a co-combustion material in a rotary kiln type MSW combustion plant. The tests demonstrated that up to 15% ASR fluff could be added successfully, resulting in a more stable combustion with levels of emitted gases meeting European standards.

3b. Co-fuel for cement kilns - The use of mixed plastics waste (MPW) as co-fuel in cement kilns, either as a powder or in compacted form, is under development in several countries.

Environment Impact - Trials at Unterfaz in Switzerland, replacing primary fuel with up to 16 % by weight of MPW, showed lower emissions for SO_x and NO_x. The use of MPW as a co-fuel at these levels will require strict specifications with respect to the quality of this secondary fuel. Economic impact: Successful energy recovery via this route will depend strongly on the economics of a collection system with facilities for sorting, mixing, grinding and processing of MPW into a proper quality fuel. Polyurethane foams, after proper conditioning, can form a sensible contribution to this much larger stream of mixed plastics waste.

3c. Co-fuel for industrial boilers - Co-combustion trials of coal with polyurethanes and other plastics, have been carried out in circulating and stationary fluidised bed boilers. The feed preparation encompasses a size and volume reduction step.

Environmental impact - Energy recovery from these mixed coal and plastics fuels is very efficient (80%) and a reduction in some emissions relative to coal alone were observed. Nitrogen oxides concentrations were similar to those for coal alone and HCN from nitrogen-containing materials was not found in quantities above the trace level.

Economic impact - Energy recovery of PU foams in high efficiency industrial boilers can become a cost-effective recovery option only after a suitable logistic framework to collect foam waste is in place and the costs of logistics and foam pretreatment can be reduced. Limiting factors such as the concentration of halogen in the fuel must be considered.

4. Landfilling - Although PUs are not harmful to the environment, compliance with the EC Landfill Directive suggests that the exclusion of PUs, like other wastes, from landfill practice is preferable in the future because of the high organic content and/or stability requirement of the landfill sites. Resource optimisation should aim at optimal utilisation of the valuable raw materials and their energy content. For these reasons, and for the full resource loss, land filling is the last resort option.

Conclusions

The greatest environmental benefit will result from a planned, integrated approach to polyurethanes waste management, based on:

- avoidance of unnecessary waste
- environmental product design
- recycling, as product, on an economic and
- resource-efficient basis
- feedstock recovery where chemistry and economics are favourable (e.g. mixed plastics waste streams)
- energy recovery, as part of the MSW, or with plastics as a fuel
- controlled landfill as a last resort.

MATERIAL-BASED RECYCLING TARGETS ARE NOT THE ANSWER

Material specific targets are not appropriate for high added-value products requiring a complex mix of materials.

Developing recycling policy in the most efficient way does not necessarily result in a material-based approach. This response is not correctly addressing material-specific waste streams.

A material-based approach entails severe obstacles to the functioning of the recycling system due to the great variety of applications of complex materials and the complexity of many products in which polyurethanes are used, for example, in automobiles.

Polyurethane is used in a large range of durable and high added-value applications such as electrical equipment, vehicles and building and construction materials.

Examples

- Rigid polyurethane foams are used as thermal insulation for buildings, water heaters, refrigerated transport, and commercial and residential refrigeration.
- Flexible polyurethane foams are used as cushioning for carpet and in upholstered furniture, mattresses, and automobiles. They are also used for packaging.
- Polyurethane adhesives and sealants are used in construction, transportation, marine, and other applications where their high strength, moisture resistance and durability are required.

This great variety of products in which PUs are used entails a variety of production chains, most of them extremely sophisticated as they lead to complex products. In fact, this complexity is mirrored in a high number of different manufacturers and suppliers, in which raw material producers are only one group. Indeed, this complexity and variety of the products and processes for PUs make it difficult to identify the party which would be responsible for the original material.

It should be added that raw material producers do not have a significant influence in the choice of materials by product manufacturers, who are driven in their choices essentially by economic and design constraints.

Finally, the categorisation of materials is not a straightforward exercise. Most categories of materials, perceived as homogenous, are in fact not all the same. Polyurethanes provide a perfect example of the variety of applications of a family of polymers, mistaken for a single material:

- The term "polyurethane elastomers" includes such diverse products as thermoplastic polyurethane, cast elastomers and Reaction Injection Moulded (RIM) products. These materials go into a wide variety of applications from footwear and skate wheels to machinery housings, athletic tracks, electronic media and car parts having multiple and different functions.

In conclusion, ISOPA considers that the waste recycling policies should continue to be based on product streams. The great advantage of the product-based recovery streams is that it is the only approach that makes life-cycle considerations possible, guarantees the most eco-efficient resource management and responds to the dictates of an Integrated Product Policy.

However, the identification of product-waste streams will need to be carefully reconsidered in the framework the overall waste strategy. Defined policy objectives within this strategy should inform the prioritisation of end of life waste streams. Prioritisation of end-of-life products should take into account the availability of collectable waste, the waste stream collection channels, the availability of appropriate market outlets and the adequacy of the collected waste to fulfill the requirements of such outlets.

THE LIMITS OF PRODUCER RESPONSIBILITY

The enhanced durability/functionality of products, while ensuring resource optimisation and prevention of waste, makes the tracing back of the original manufacturers more difficult. Producers, particularly raw materials producers, are unlikely to be identifiable at the end of life of durable goods.

Polyurethanes ensure a remarkable product durability/functionality. However, the durability of products and their long-life may conflict with the concept of producer responsibility for which the implications of end-of-life collection and treatment has to be accounted for years or decades in advance.

Durability of products is a first and essential way to ensure a better performance in the use of resources, and therefore prevent waste generation. Resource optimisation is without any doubt most

closely linked to the durability of articles and materials. Indeed, the longer a product lasts the less waste it generates. Yet, the longer the life of the product, the more difficult it is to track down the producer, to whom the responsibility for the end-of-life handling of the product is to be allocated. This is why, for instance, producer responsibility will be a real challenge for thermal insulation in a building torn down 100 years after installation of the polyurethane foam.



European Diisocyanate and Polyol Producers Association

Avenue E. van Nieuwenhuysse Laan 4,
1160 Brussels
Belgium

Tel: ++32 2 676 7475

Fax: ++32 2 676 7479

Email: main@isopa.org

ISOPA is an affiliated organisation within the European Chemical Industry Council (Cefic)

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March 2005