European Isocyanate Producers Association

Fact Sheet

RECYCLING AND RECOVERING POLYURETHANES

BING

Recovery of Rigid Polyurethane Foam from Demolition Waste

INTRODUCTION

The definition of "producer responsibilities" with the objective of "resource optimisation" has lately come to the fore in the overall debate involving environmental policy-makers. The recovery of rigid polyurethane foam from demolition waste is one process which illustrates where resource optimisation can be improved, notably by the incineration (leading to energy recovery) of used rigid polyurethanes at the end of their service lives as compared with the usual practice of burying rigid foams in landfill.

Municipal Solid Waste Incinerator

The rigid foam industry has provided resources to test and demonstrate that "energy recovery" from old insulant foams is meeting society's current demands for safety. This Fact Sheet summarises the critical issues, provides information about the work completed to-date and summarises the conclusions drawn from this work. A publications list is also included for readers requiring further scientific information on the subject.

ONE voice

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THE EFFICIENT SERVICE LIFE OF RIGID POLYURETHANE FOAMS

Rigid polyurethane foams are energy efficient materials throughout their service life. When salvaged from the demolition of buildings, insulation foams are usually expected 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. It seems logical therefore to optimise the efficiency of these materials by using the foams for energy recovery by incineration.

Energy recovery is also a recommendable option in the campaign for the reduction of CFC emission. The composition of rigid foams obtained from building demolition is usually unknown and, as these foams often contain CFCs (used in past production processes as blowing agent), it is recommended that the foam should not be compacted, but transported to the nearest suitable municipal solid waste incinerator.

Source: ICI library

Efficient service life: rigid foams used in buildings

THE ISSUES

Social Acceptability

The social acceptability of waste incineration varies greatly throughout Europe and, in many countries, remains largely misunderstood. This is reflected in the differing numbers of municipal solid waste incinerators in each of the European countries, as demonstrated in figure 1.

Figure 1

Municipal solid waste combustors (1999) with energy recovery

Country	Number of combustors per country	Country	Number of combustors per country
Austria	3	Netherlands	11
Belgium	15	Norway	10
Denmark	24	Portugal	2
Finland	1	Spain	9
France	104	Sweden	27
Germany	52	Switzerland	28
Greece	1	United Kingdom	12
Italy	29	W. Europe	328

Source: TN SOFRES Consulting for APME, 2000

Transport of Lightweight Insulant Materials

The transport emissions of waste trucks should be considered a significant factor when choosing the appropriate waste management facility. The polyurethanes industry has, as any other supplier of insulant materials, an interest in managing its post-consumer waste in the proximity of the demolition site.

Influence of Nitrogen from PUR on NOx-Emissions During Combustion

The formation of NOx depends on the combustion chamber temperature, the adjustment of primary and secondary air and, if necessary, on the De-NOx-rawgas cleaning device. It has been proven in tests that nitrogen emissions from the combustion of polyurethanes or nylon do not increase the production of NOx in controlled conditions.

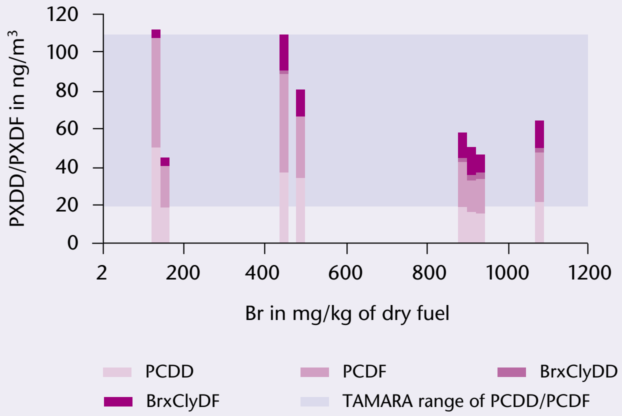
Need to Eliminate Ozone-Depleting Substances

CFCs are microencapsulated in old insulation foams. From a CFC destruction point of view, it is not advisable to separate CFCs from the foam (by compaction), firstly, because a significant part of CFCs are dissolved in the matrix and, secondly, the combustion efficiency of CFCs in foam is better than as a gas.

Emissions

Emissions from the combustor have been of concern. CFCs can be a prime source of halogens in old foams. Flame retardants can be another source of halogens. These halogens do not cause an increase of critical emission in a modern state-of-the-art MSWC.

Figure 3



The levels of all halogenated dibenzo-p-dioxins and dibenzofurans remain well within the usual concentrations.

Feeding of Lightweight Post-Consumer Foams

Rigid polyurethane foams have densities of 30-80 kg/m^3 while municipal solid waste exceeds 400 kg/m^3. Thermal decomposition of rigid polyurethane foam takes place above 300 °C and this without forming droplets. Like any other organic material, it is flammable. The self-ignition temperature depends on the individual foam but will always be higher than 415 °C.

Polyurethane materials can have an energy content similar to coal (rigid insulant foam is approximately 25,000 kJ/kg). While this is higher than municipal solid waste, the energy density of foam is much lower than that of MSW. Combustion, therefore, will be completed in a shorter period of time.

To stop ignition within the feeding device of the combustor and balance the effects of the low density, it is advisable to avoid localised high concentrations of foams and to mix the foams well with the municipal solid waste prior to feeding. Foam addition should not exceed 2% by weight. This can be more than 30% by volume.

Is There a Need to Separate Rigid Polyurethane Foam from Other Old Foams?

When taking a building down, it is often not possible to separate the different categories of foams. As far as incineration with MSW is concerned, the mixing of foams does not matter.

European industries have completed tests on foams other than polyurethanes. Many of the afore-mentioned issues are relevant to several low-density insulants. Nothing is known to our industry that would require any plastics foam to be singled out prior to energy recovery.

Landfill as an Alternative?

Most insulants, whether foams or fibres, will eventually be excluded from landfill, principally because of organic content and/or stability requirements of the landfill sites.

THE ROLE OF THE POLYURETHANES INDUSTRY

The polyurethanes and associated industries have undertaken a number of trials and studies to further knowledge of all aspects of incineration with energy recovery of polyurethanes. These tests include:

1989
Trial in rotary kiln which demonstrated that emissions, including dioxins, do not increase, despite the presence of CFCs and flame retardants in polyurethane foam.

1989/90
Emissions measurements in TAMARA pilot incineration plant (MSWC) to examine destruction of CFCs in polyurethane foams (supervised by German authorities). This trial, conducted by independent scientists, demonstrated a CFC destruction rate of better than 99.9 %.

1990
Foam incineration trials in Thyssen pilot plant (fluidised bed). Mono-combustion of foams was difficult to control, while combustion of foams with sewage sludge was technically feasible.

1991
Emission measurements in Göppingen MSW combustor, focusing, on destruction of CFCs in polyurethane foams (supervised by German authorities). These trials confirmed, on a large scale, the findings of the previous TAMARA work, which demonstrated that foams within the MSW matrix can be handled safely.

1994
Emission measurements during co-combustion of flame-retarded rigid polyurethane foams in TAMARA pilot plant (MSWC). Tests were conducted on the reduction of HCl, HF and HBr in the fluegas as well as the possible formation of dibenzo-p-dioxins and dibenzofurans. Heavy metals, in the context of increased halogens, were also tested. These trials delivered scientific evidence that rigid polyurethane foam waste could be incinerated in safety within the municipal solid waste unit, even if it contained brominated flame retardants.

Refer to figure 3, page 3.

1996
The Association of Plastics Manufactures of Europe has performed scientific trials on co-combustion of electrical and electronic waste. The combustion process was not negatively influenced even if 12% of E & E materials with high Br and Cl levels were added.
(source Tamara/APME).

1991ff
Further incineration trials have been carried out with flexible polyurethane foams. These trials answered questions about problems such as the formation of NOx in the presence of polyurethanes. For further information see ISOPA Fact Sheet: Energy Recovery from Flexible PU Foams.

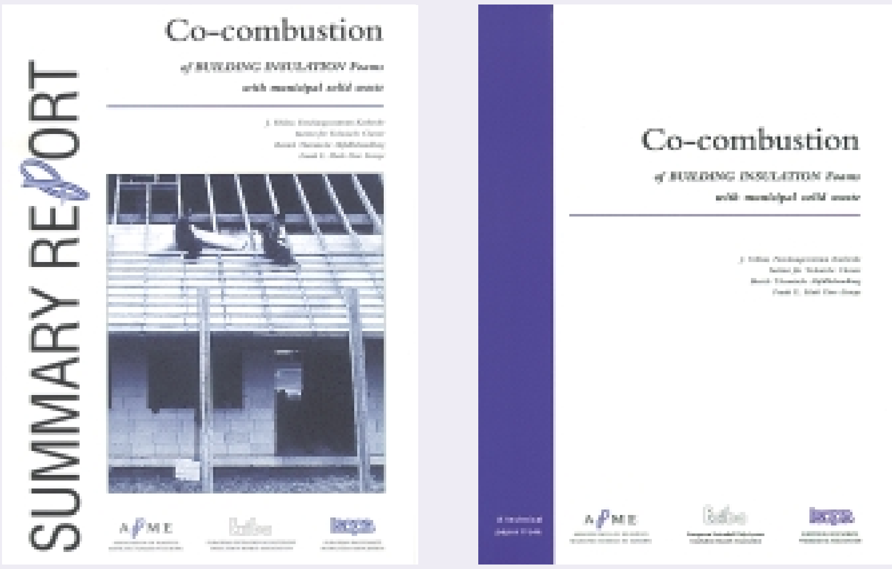
AN ENVIRONMENTALLY RESPONSIBLE SOLUTION

Combustion, or incineration with energy recovery, is a realistic and environmentally responsible solution for polyurethane waste management. It offers the best solution where other recycling options are ecologically or economically more costly (for further information on the recycling options of polyurethanes, please refer to ISOPA Fact Sheets).

Although more needs to be done to establish the necessary infrastructure throughout Europe to increase the popularity of this process, there can be no doubt that energy recovery is a key process in the clean management of post-consumer rigid foams, even if these contain ozone-depleting substances or halogens from flame retardants. It is important to stress that the *proximity* of municipal solid waste incinerators minimises impact on the environment.

Detailed scientific evidence has been published in the reports shown below in figure 4.

Figure 4



SUGGESTED READING

"TNO Report"; 1992, TNO Apeldoorn, NL. Survey of Solid Municipal Waste Incinerators. Available through APME.

"Verbrennen von Polyurethanen"; K.-W. Kroesen in Recycling von Polyurethanen; W. Raßhofer ISBN 3-929471-08-6.

"Fact Sheet: Energy Recovery from Flexible PUR Foams"; ISOPA-EUROPUR, June 1996, J. Stoute, 05-96-REC.-0009-FACT SHEET.

"The Influence of Plastics on the Combustion of Municipal Solid Waste"; TNO Institute of Environmental and Energy Technology, 7300 AH Apeldoorn, the Netherlands.

"Waste to Energy"; brochure, PWMI European Centre for Plastics in the Environment, Brussels, Belgium.

"Shredderleichtmull aus der Sicht der Entsorgungs-industrie"; IUTA-Workshop 'Entsorgung von Schredderleichtmull', Duisburg, - 7.9.1990, Germany.

"Energy recovery in industrial boilers - a new approach for post consumer polyurethane foam from car seats"; E. Weigand, J. Wagner and G. Waltenberger, Bayer Leverkusen, UTECH, March 1996, The Netherlands.

"Schwel-Brenn-Verfahren zur thermischen Behandlung der Shredderleichtfraktion"; Bayer-Vortrag im Rahmen der VWI-VW-Gemeinschaftstagung; Wolfsburg; 26-28 November 1991, Germany.

"Developing a Viable Polyurethane Waste Management Plan; a PURRC Update"; G.J. Wasilczyk and T.J. Cerabona; SPI Polyurethanes Congress, Vancouver, 1993, Canada.

"Large scale energy recovery trials on polyurethane, PET, acrylic and nylon"; Dr. DJ Soderberg, RA Lenton, AR Boylett and DA Hicks, "Recycle '93" Davos, March 1993, Switzerland.

08-96-REC.-0011-FACT SHEET

European Isocyanate Producers Association

ISOPA has produced a brochure and a series of fact sheets on polyurethane recycling options.
The following are now available :

Recycling Polyurethanes (Brochure)

PU in Perspective

Densification/Grinding

Re-use of Particles

Rebonded Flexible Foam

Adhesive Pressing/Particle Bonding

Regrind/Powdering

Compression Moulding

Chemolysis

Feedstock Recovery

Energy Recovery

Energy Recovery from Flexible PU Foams

Recovery of Rigid Polyurethane Foam from Demolition Waste

Options in Practice

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ISOPA - the European Isocyanates Producers' Association - is an affiliated organisation within the European Chemical Industry Council (CEFIC).

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