European Isocyanate Producers Association

Fact Sheet

RECYCLING AND RECOVERING POLYURETHANES

Compression Moulding

Compression moulding: air duct for the BMW 8-series made from RIM polyurethane waste

ISOPA and its member companies have dedicated considerable resources to study the recycling requirements of individual polyurethane user industries, so that the most effective recycling options can be identified. In the automotive industry particularly, encouraging results have been achieved with compression moulding technology, one of the recycling routes for reaction injection moulded (RIM) polyurethanes.

Recycling initiatives have focused on two areas: production trim from polyurethane processing and polyurethanes retrieved from scrapped vehicles.

Research and development programmes, undertaken together with the automotive industry, have examined the potential of compression moulding technology for both these types of polyurethane waste. The process has been used commercially for BMW in Europe and for Chrysler in the USA.

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COMPRESSION MOULDING: THE PROCESS

RIM and reinforced RIM polyurethanes are ground into fine particles and subjected to high pressure and heat to generate a material which is ideal for automotive applications. The grinding techniques and compression moulding process need to be controlled accurately for individual applications:

- While there can be a small reduction in elongation or impact resistance, optimum timing, pressure and temperature can preserve the valuable properties of the original polyurethane.
- The use of finely ground polyurethane powder in the compression moulding process allows for property recovery of up to 100%.

Typical processing parameters

Grain size (screen size)	0,5-3 mm
Preheating time	1-12 minutes
Preheating temperature	140-150°C
Mould temperature	180-195°C
Mould residence time	1-4 minutes
Specific mould pressure	> 350 bar

Typical physical properties of amine extended RIM: comparison of original RIM parts and compression moulded parts, painted and unpainted (1mm granule)

PROPERTIES		ORIGINAL		COMPRESSION MOULDED	
		PAINTED	UNPAINTED	PAINTED	UNPAINTED
Density	kg/m³	1260	1220	1260	1260
Shore D-hardness		68	67	66,5	65-67
Tensile strength	MPa	25	26	23	25
Elongation at break	%	120	130	70	120
Flex-E-modulus	MPa	1100	1300	700	700
Impact, Dynstat -25°C	kJ/m²	8,5	12	9	7

Typical physical properties of glycol extended RIM: comparison of original RIM parts and compression moulded parts

PROPERTIES		ORIGINAL	COMPRESSION MOULDED
Density	kg/m³	1030	1200
Shore D-hardness		55	67
Tensile strength	MPa	23	33
Elongation at break	%	204	143
Flex-E-modulus	MPa	600	613

Glycol extended RIM parts, compression moulded at the optimum temperature of 195°C, have mechanical properties which can actually be superior to those of virgin polyurethane material.

BENEFITS

- Compression moulded parts are free from internal stresses and display improved heat resistance, sag value and torsion modulus compared to the original material.
- Good flowability of RIM polyurethanes in the compression moulding process allows the production of complex shaped products and high quality flat parts.
- Acceptable energy efficiency can be achieved through short processing cycles.
- Compression moulded parts contain 100% recycled material.

Compression moulding technology is capable of producing high performance recycled products from RRIM and RIM polyurethane granules.

STATUS

Currently, compression moulded parts are no longer produced, mainly because of economic reasons.

SUGGESTED READING

H. Brückner, U. Frank, H. Fransen, W. Raßhofer, H. Schaper and H-U. Schmidt, Kunststoffe 81, 751 (1991)

R. Taylor, R. Eiben, W. Raßhofer and U. Liman, SAE Conference, Detroit 1991

"Druck von oben"; Bild der Wissenschaft, 1991, Heft Nr. 6, S. 116-117

W. Raßhofer, U. Liman, and J. Wagner, Proceedings of the Polyurethanes World Congress; 1991, Nice, p.636,

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DE 38 40 167 (29.11.88) (Bayer AG)
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LE. Poston, "Automotive Bodywork: The Challenge of Competing Materials"; Utech '90, Conference Papers, p.94

R.E. Morgan and J.D. Weaver, "Recycling of RIM Thermoset Polymers"; SAE Conference, Detroit 1991

R.E. Morgan, G.H. Dean, R.I. Tabor and M. Zawisza, Proceedings of the Polyurethanes World Congress; 1991, Nice, p.653

W. Raßhofer, H-A Freitag, L. Klier, U. Liman, H. Münzmay and J. Wagner, Utech '92, Conference Papers; p.229

W. Raßhofer (ed.),"Recycling von Polyurethan-Kunststoffen"; p.189 and p.359, Hüthig Verlag, Heidelberg 1994, ISBN 3-929471-08-6

Companies actively practicing polyurethane recycling and recovery are kindly invited to submit their references to ISOPA.

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 affliated organisation within the European Chemical Industry Council (CEFIC).

Since the original polyurethane material has not been designed for use in articles in contact with food, relevant EU (such as Directives 90/128/EEC) and national legislations need to be consulted, if and when recycled materials are used to manufacture articles and goods for possible direct and indirect food contact.

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