

Fact Sheet

RECYCLING AND RECOVERING POLYURETHANES

BING

Adhesive Pressing and Particle Bonding

A variety of tailor-made recycling processes exists for Polyurethanes. One fast growing technology is “particle bonding”. It uses a high proportion of waste material in the recycled product - in many cases approximately 90%.



Courtesy of PLATEC, D-Elsterwerda

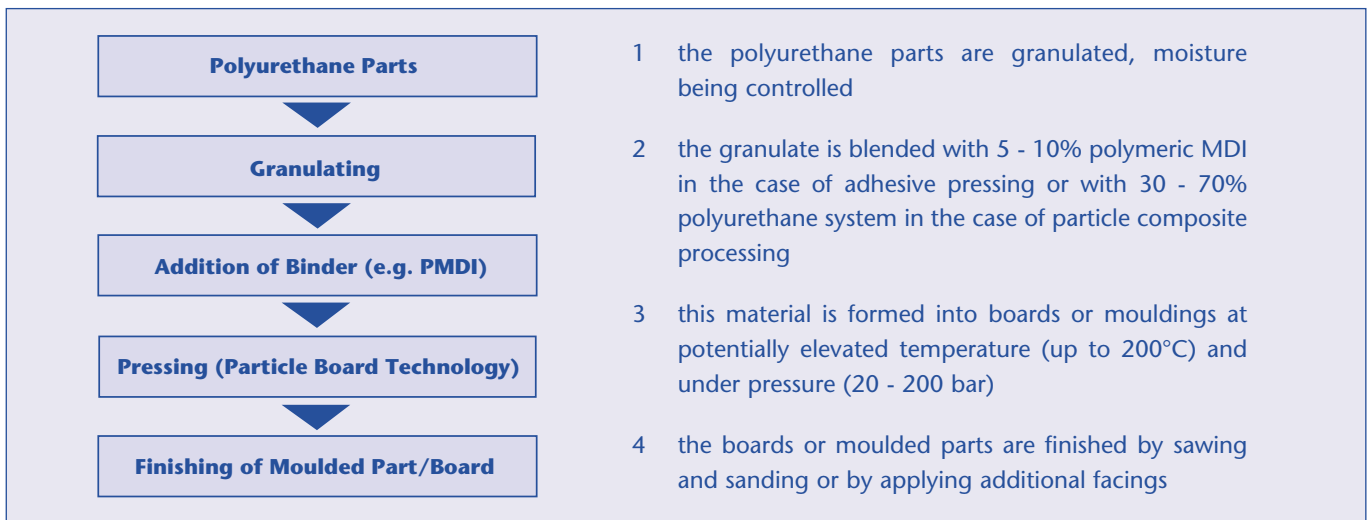
Recycling by particle bonding can be applied to flexible foam (see separate fact sheet “Rebonded Flexible Foam”) as well as other polyurethanes like rigid foam and, in fact, particles of any material. It is then often called “adhesive pressing” or “particle composite processing”.

The adhesive pressing recycling route, not dissimilar to the chipboard process, is not only applicable to polyurethanes, like rigid foams or elastomeric materials, but has also proven to be applicable to other post-consumer waste such as waste fibres, paper and scrap rubber. The key

to adhesive pressing is the powerful binder, polymeric diphenyl methane diisocyanate (PMDI), one of the major polyurethane raw materials, applied at the 10 weight % level.

Particle composite processing is making use of dedicated polyurethane systems at the addition level range from about 30% to approximately 70% by weight. It is thereby “closing the gap” between filler technologies (see separate fact sheet called “Powdering”) and the adhesive pressing process.

THE PROCESS



SOURCES OF POLYURETHANE FOR ADHESIVE PRESSING

Production trim or used polyurethane from automotive parts

- reaction injection moulded (RIM) and reinforced reaction injection moulded (RRIM) polyurethane from bumper covers and side protection panels
- energy absorbing foam from bumper systems
- thermoformable foam (TF) from headliners
- flexible integral skin foam used in steering wheels
- PVC/ABS with semi-rigid foam from instrument panels
- PVC-slush with semi-rigid foam from instrument panels

- low density glass mat reinforced RIM from door panels and seat back shells
- flexible foam-backed car carpets

Rigid polyurethane foam

- rigid polyurethane foam from end-of-life refrigerators
- production trim from block foam and panel production, where the composition is known

For recovery of rigid foams from demolition, combustion together with municipal solid waste is recommended. Please consult the special ISOPA fact sheet.

PROPERTIES OF PRODUCTS MADE BY ADHESIVE PRESSING

Boards made from automotive parts can have a range of properties. Those made from flexible integral skin parts form rubber-like mats, while RIM parts form elastic boards and headliners can be used to make stiff, self-supporting boards.

Boards made from rigid polyurethane scrap have excellent mechanical properties and extraordinary moisture resistance. Typically property ranges are:

- bending strength 10 to 20 N/mm²
- internal bond 0.5 to 2 N/mm²
- density 300 to 900 kg/m³
- thickness swell, 24 hours in water at 20°C, about 1%



Floor heating panel containing recycled polyurethane produced by adhesive pressing.

APPLICATIONS

Re-use of polyurethane reclaimed from automotive applications

The capacities for rebonded parts made from polyurethane or other wastes are growing fast. Rebonded boards are expected to be particularly suitable for

applications such as sound-proofing in the restoration of old buildings or car interior.

Polyurethane reclaimed from rigid foam blocks and panels

The boards now occupy a niche in the building and furniture industries' board market. They are particularly in demand.

- For furniture in kitchens and in sailing boats, because they are virtually unaffected by water.

- For flooring e.g. in gymnasiums, which needs to have a certain elasticity.

COMMERCIAL ACTIVITIES

Although this technology has been developed for polyurethanes, its ability to accommodate a wide range of wastes has helped to support its commercial viability. An additional driving force to use this technology, is the desire of some companies to use parts with a high content of recycled materials. Current processing capacities exceed 10 000 tonnes per annum.

For names and addresses of companies using these processes please consult the latest ISOPA "Options in Practice" fact sheet.

SUGGESTED READING

Recycling auf höchstem Niveau
 Das PLATEC-Konzept zur industriellen Aufbereitung und Wiederverwertung von Produktions-Reststoffen
 Brochure by PLATEC Plattenwerk GmbH, D-04910 Elsterwerda,
 Tel.: +49-3533-700-0
 Fax: +49-3533-700-200

EWvK Information: (Entwicklungsgesellschaft für die Wiederverwertung von Kunststoffen mbH, joint venture of BASF, Bayer and Hoechst):

- Möglichkeiten der Verwertung PUR-haltiger Verbundmaterialien aus dem Kraftfahrzeugbau
- Stoffliche Wiederverwertung von Polyurethan-Hartschaum

- Die Entsorgung von Altkältegeräten als Quelle für wiederverwertbaren Polyurethan-Hartschaum

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

Oertel (ed.), Polyurethane Handbook, Hanser Publishers, Munich, Vienna, New York 1993, Pages 615-627, ISBN I-56990-157-0

Recycling companies are kindly invited to submit to ISOPA their references in case they are active in practising PU recycling and recovery.



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

ISOPA
Avenue E. van Nieuwenhuysse 4, Box 9
Brussels B-1160
Belgium
Tel: +32 2 676 74 75
Fax: +32 2 676 74 79
E-mail: main@isopa.org
website: www.isopa.org

BING
Kriegerstrasse 17
D-70191 Stuttgart
Germany
Tel: +49 711/29 17 16
Fax: +49 711/29 49 02

ISOPA - the European Isocyanates Producers' Association - is an affiliated 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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