

WASTE CARPETS (AND SIMILAR TEXTILE ITEMS)

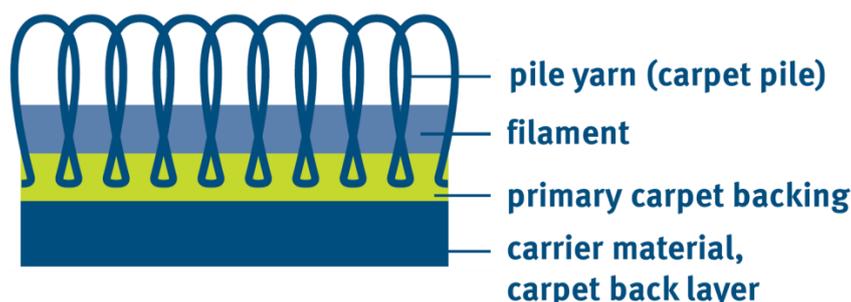
RELEVANCE OF WASTE STREAM

- old carpets produce a waste stream of high volume, a separate collection is necessary to prevent an overload of the general collection system and negative effects to treatment plants (i.e. smouldering fire, blockades)

COMPOSITION/ MAIN MATERIAL COMPONENTS

Carpets can be made from many single or blended natural and synthetic fibres. For the seam or filament chemical fibres such as polyamide (PA), polypropylene (PP), polyethylene (PE), polyethyleneterephthalate (PET) or polyacrylnitril (PAN) but also herbal fibres such as cotton, sisal, jute, coconut or animal hair like wool and silk can be used, depending on the manufacturing method and style. Nylon is the most popular synthetic fibre used in carpet production and is petroleum-based. Polypropylene is used for the carpet yarn and polyester or "PET" in both spun and filament constructions. The latter is typically used in mid- to low-priced carpeting. For the carpet backing styrene-butadiene-rubber (XSBR) is often used for the primary layer and networked, foamed styren-butadien-styren (SBS) or XSBR, irregular atactic polypropylene (aPP) or acrylate-rubber (ACM) for the back layer. Carpet tiles are often made with amorphous polyalphaolefines (APO), bitumen, ethylene-vinylacetate (EVA) or polyvinylchloride (PVC) at their back layer. An herbal fibre regularly used for knotted carpets is jute.

Figure 1: Scheme of a carpet construction



EUROPEAN LEGISLATION AND REFERENCE DOCUMENTS

There is no specific legislation such as a directive in place for this type of waste in Europe; however, the stipulations made by Directive [1999/31/EC](#) on the landfilling of waste do also apply here, excluding this waste from landfill disposal and demanding other forms of treatment and utilization.

NEEDS AND PRINCIPAL REQUIREMENTS FOR HANDLING THE WASTE STREAM

Being large-sized items of waste, waste carpets need to be collected together with bulky waste as part of a separate collection scheme for house-holds or through the commercial outlets and points of generation. Afterwards waste carpets should be subject to recycling and/or energetic utilization as carpets in general have a high calorific content and components suitable for material recycling. As of the moment, energetic utilization is still the priority option available.

APPROPRIATE COLLECTION STRATEGIES AND SCHEMES

To ensure high recovery rates and a good amount of old carpets being used in thermal processes, it is highly recommended to establish extensive take back schemes (for example via mandatory producer responsibility), for example in such a way as Germany has done this to some extent already. In such system, the old carpets can be taken from households either to public recycling points (take back centres) from where they are picked up from a commercial recyclers, or the latter companies provide shops, retailers and households with special containers or bigbags (see fact sheet "[Big Bag](#)") which are then picked up by them once they are filled up. Where such schemes are absent, old floor coverings are to be given to the bulky waste collection or disposed of together with waste from C&D sites. The material can then be recovered by sorting plants, as it is the case in Germany, too.

<p>APPROPRIATE TREATMENT AND RECOVERY SCHEMES</p>	<p>Until now, old floor coverings are mainly sent together with other waste materials to waste combustion facilities for energy recovery. Chopped into small pieces they can however also be used for thermal processes in cement kilns or for power generation in industrial incinerators (see fact sheet "Industrial co-incineration"). An alternative to the energetic utilisation is the recycling of carpets made out of polyamide, polypropylene or wool.</p>
<p>APPROPRIATE RECYCLING TECHNOLOGIES</p>	<p>For the recycling of waste carpets made from polyamide (PA) a technical process was developed in Germany. Plants of similar type are nowadays operated in the U.S.A. These plants also receive significant quantities of old carpets from Carpet Recycling Europe GmbH (CRE) after their collection in Europe. Old carpets or processed carpet components from PA can be material or chemically recycled and processed to new polyamide this way. The process scheme that was adopted for this purpose in Germany worked as follows:</p> <p>Figure 2: Process scheme of the polyamide recycling line of Polyamid 2000</p>

After receipt, the unsorted and untreated carpets are automatically sorted with the help of spectroscopic analysis of the shag material into the fractions PA 6, PA 6.6, and others. Carpets that do not contain polyamide will be shredded and used in a thermal power station to generate process energy. Next to this the polyamide carpets get chopped and forwarded to multi-stage centrifuges where their disintegration takes place into polyamide fibres, chalk and other fibrous substances (carrier material). The chalk is used as raw material; the other fibrous substances are used in the thermal processes, too. PA 6-fibres are prepared for further utilisation and undergo a chemical treatment (refining) at the next stage. The polyamide 6-fibre is first split in a chemical depolymerisation process to Caprolactam. What follow is a multistage cleansing and eventually the polymerization to virgin polyamide 6 which can be used like original polyamide for the production of textile fibres.

Due to yet existing technological limits and for economic reasons proceedings in the PA 6.6-line are different. Instead of the novo synthesis a physical treatment process is applied to the polyamide 6.6-fibres after the mechanical processing. In this process the granule is melted with the help of an extruder, physically cleaned and mixed with additives in a compounder to obtain a marketable, compounded polyamide 6.6. This product is different from the product generated in the novo synthesis in that it has a limited usability but is also less expensive in its generation. It has not been possible to produce textile fibres from this product but it can replace original polyamide compounds in the growing field of "Engineering Plastics".

Carpets made from wool

A technology has been developed to produce a biological insulation material from carpets made from wool. With that process the insulating material can be produced from 100% recycled material. First wool and polypropylene fibres are ripped off from the collected carpet material. Next to this a mixing of the recovered fibres to obtain the desired material ratio (e.g. 80/20) is taking place. The mixture is used to produce a non-solidified dolphin pile. The hardening of this dolphin pile is achieved in a thermal treatment step where polypropylene fibres meld together with the wool (Thermobonding). The hardened dolphin pile can be equipped with flame retardant substances such as boric salts for better fire protection. By using polypropylene, chemical hardeners and insecticides for the protection of the material won't be necessary. The new insulating material can be produced at fewer costs than insulating products from virgin wool.

Carpets made from polypropylene

Different processes for the material recycling of carpets made from poly-propylene have been developed and tested in the frame of the RECAM-project, however no large scale applications are known in Germany until today.

Other carpet materials / sorting residues

Fibre mixtures and carpet materials for which no economical use has been existing in the past are becoming increasingly used as fuel substitutes. Sorting and processing can be done decentralized from specialized firms. Used in cement kilns and calcinators, it is not just a substitution of fossil fuel with fibres and rubber components that takes place but also the chalk will be used (see fact sheet "Industrial co-incineration"). It is for this reason that the process is considered a combination of energetic and material recovery.

REFERENCES AND PROVIDER FIRMS

(important note: the list of firms does not constitute a complete compilation of companies active in the specified fields)

Reference facilities for carpet recycling in Germany are for example:

- Recotex GmbH, Würzburg www.recotex.de
- Pallmann Maschinenfabrik GmbH & Co. KG www.pallmann.eu

Information concerning all recycling phases for carpet backings, beginning from the collection of used carpets until the production of new carpet backings are provided from the European research project RECAM (Recycling of Carpet Material)

www.cordis.europa.eu/result/rcn/80438_en.html

Further information about the carpet recycling sector and links to technology and service providers in Germany can be obtained from:

- Fachverband Textilrecycling www.bvse.de/fachverband-textilrecycling.html