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Application of natural fibres in vehicle interiors

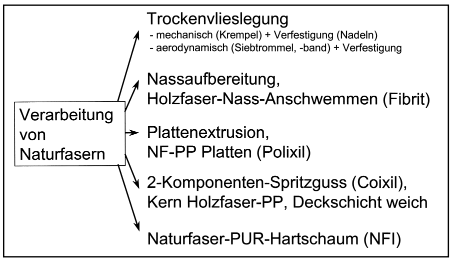

Fig. 3: Processing of natural fibres

The use of natural fibres opens new perspectives for fibre-synthetic material compounds in vehicle interiors. Alongside the perspectives the risks involved in natural fibre application are also demonstrated through selected examples.

The great variety of fibres is classified under DIN 60000 and 60001 into natural fibres, chemical fibres (from natural and synthetic polymers) and industrially manufactured fibres from inorganic sources (glass, carbon and metal fibres). Under natural fibres there's a difference between plant fibres (cellulose), animal fibres (protein) and mineral fibres (asbestos). *Figure 1* shows a classification of natural fibres from plants.

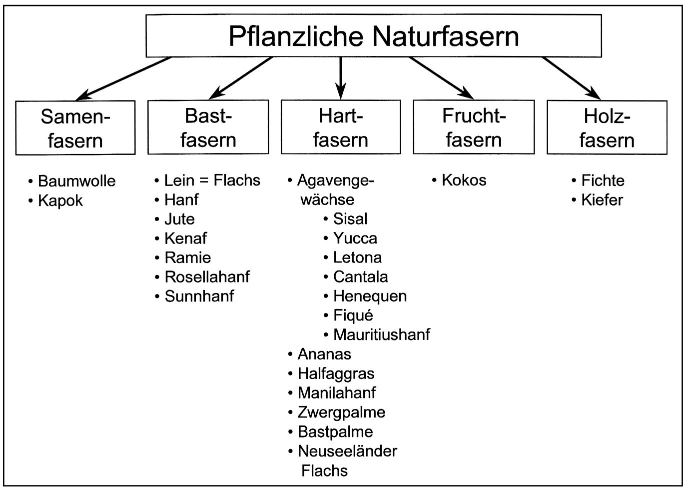

Fig. 1: Natural plant fibres - an overview

Cotton, linen, hemp, kenaf, sisal, coconut fibre and fibres from pine and spruce are used in vehicle interiors.

Use of natural fibres in vehicle interiors

These fibres are preferred in the following components:

- door linings
- dashboards
- back window shelves
- boot/trunk linings
- seating

As a rule natural fibres feature in the load-bearing materials for such components. For instance in seating natural fibres can be used in the seat backrest coverings and in the cushioning (coconut fibre).

With door lining load-bearing material, the market share of the current materials is shown (*fig. 2*). In 42% of the total 14 million vehicles no natural fibres feature in the load bearing parts (PU, ABS, PP). Sawdust-filled PP (HMPP) is used in 14% of vehicles and wood fibres in 32% (wood fibre wet, HF-non-woven fabric) whereby the wood material is gaining a greater market share. Cotton fibre is used in 1%, flax/PP up to 3%, jute EP/UP up to 7% and flax/sisal/EP up to 1%.

Selected components and their manufacture

Component manufacture recognises differing possibilities for natural fibre processing (*fig. 3*).

The processing of natural fibres can take place through dry non-weaving process (fig. 3), which will be described in more detail. Via a wood fibre wet bath procedure components with a wood fibre content of up to 95% can be cost-efficiently produced (Fibrit). The natural fibres can also be mixed with PP in an extruder and pressed to form load-bearing material plates (Polixil). One can produce a carrier in a co-injection procedure which has a wood fibre-PP core covered with a soft surface layer (Coixil). Borrowing from the glassfibre long fibre injection system (LFI) can give a similar procedure with natural fibres (NFI).

With the laying of dry non-woven material different types of fibre or charges can be mixed. Fluffy material is released on the carding machine, paralleled and purified (*fig.*

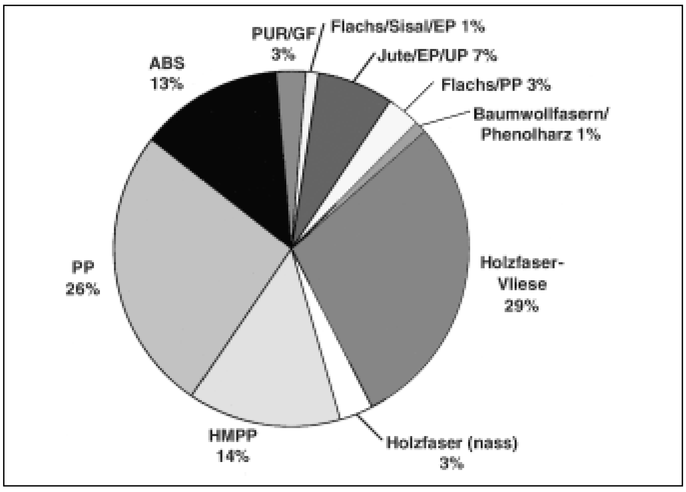

Fig. 2: Market share of carrier materials for door panels in Western Europe 1997 (Source: Marktstudie Bayer AG)

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Keywords

Fibre, composite material, fleece production, interior parts

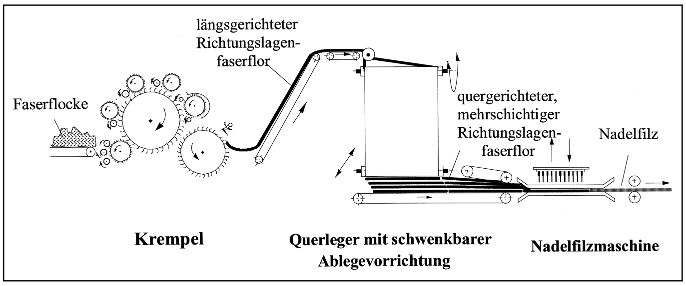

Fig. 4: Non-woven production

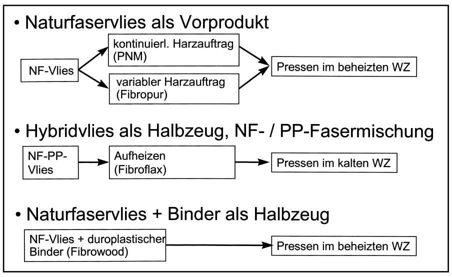

Fig. 5: Processing of non-wovens

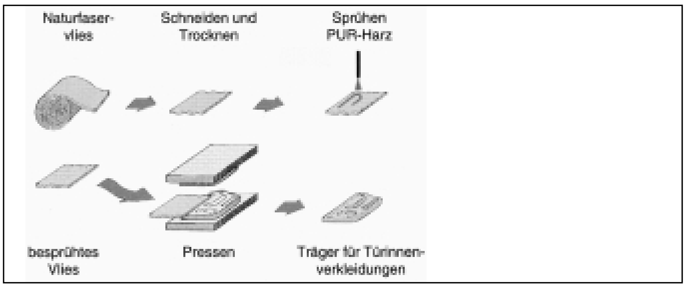

Fig. 6: Processing of non-wovens - variable resin injection

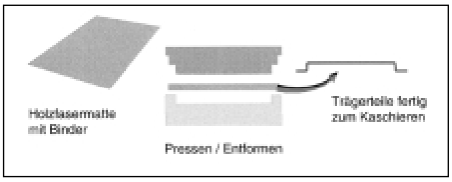

Fig. 7: Processing of non-wovens - non-woven with integrated resin

4). The web leaving the carder is applied in criss-cross stranding and the layered web is needleloomed. There are different ways of processing natural fibre non-woven materials (*fig. 5*)

100% natural non-woven material serves as ground product for resin application, either continually (roller application) with UP resin (PNM) or variably (spray application) with PUR resin (Fibropur; fig. 5). The resined non-woven material is heat-pressed. For hybrid non-woven material as semi-product, natural fibre is firstly mixed with PP fibre then carded and finally needleloomed. For plasticizing the PP, the non-woven material must be heated and then cold-pressed (Fibroflax). In a further process wood fibres are covered with duroplastic binders for dry non-woven material production. This semi-product is then hot-pressed (Fibrowood).

In the Fibropur system with variable resin application the natural fibre mats are first pre-dried before PUR resin is sprayed on via robots followed finally by pressing (*fig. 6*). At 1500 g/m², area weight is very low.

The Fibrowood process (natural fibre + binder as semi-product, see fig. 5) is characterised by very low plant expenditure (*fig. 7*) because the mat is finally hot-pressed (area weight 1800 g/m²).

Lightness is an important target in the manufacture of vehicle interior components. There are different methods for achieving this aim for load-carrying materials (*fig. 8*). Carrying components (= raw components) on the basis of natural fibres always consists of a mix of fibres and synthetic materials whereby the proportion of compound materials can be varied.

A possibility is the application of fibres with low density, or of hollow fibres (in part met by natural fibres). The density of synthetic materials can also be reduced through foam, e.g. PUR foam, glassfibre-PUR rigid foam or EPP particle foam. A third possibility is the incomplete filling of fibre interior space. Through a high proportion of natural fibre non-woven material and a low proportion of resin one can produce a homogenous component through consistent press column thickness (= raw component thickness) and suitable choice of material area weights, with a consistent air pore content (e.g. Fibropur: 40% (vol.) air pores). This is not a fibre-strengthened synthetic material in the real sense in which the fibres (without air included) can improve the component properties of the synthetic material.

In *figure 9* examples of applications for JCI load-carrying material with natural fibres are presented (JCI = Johnson Controls Interiors GmbH).

Ziel Leichtbau: Verringerung Flächengewicht (FG) bei ausreichenden Materialeigenschaften:
FG = D [kg/dm³] **x d** [mm] **x 1000 g/m²**

Möglichkeiten zur Dichte-Verringerung von Werkstoffen

- **Fasern** - mit niedriger Dichte
  - mit Hohlräumen
- **Schäumen** - PUR-Schaum, GF-PUR-Hartschaum
  - EPP-Partikelschaum
    EPP: D = 0,08 kg/dm³; d_{min} = 10 mm: FG = 800 g/m²
- **unvollständiges Ausfüllen von Faser-Zwischenräumen**
  Bsp. Fibropur: 70 Gew.-% NF-Vlies + 30 Gew.-% Harz
  = 35 Vol. -% NF-Vlies + 25 Vol. -% Harz + 40 Vol.-% Poren
  D = 0,75 kg/dm³; d_{min} = 2 mm: FG = 1500 g/m²

Fig. 8: Light weight materials for door panels (= carriers

• Fibrit N	- Türinnenverkleidung	Opel T600 Zafira
	- Instrumententafel	Opel T3000 Astra
	- Seitenwandverkleidung	VW A3 Golf Cabrio
• Fibrowood	- Sitzrückenlehne	BMW E39 5er
	- Türinnenverkleidung	Renault X56 Laguna
	- Stirnwandverkleidung	MB W168 A-Klasse
• Fibropur	- Türinnenverkleidung	MB W220 S-Klasse
• PNM	- Türinnenverkleidung	BMW E38 7er
	- Türinnenverkleidung	BMW E39 5er
• Fibroflax	- Türspiegel	Renault B65 Clio
	- Sitzrückenlehne	Opel T600 Zafira

Fig. 9: Use of JCI's natural fibre carrier materials for car interiors - examples

Summary

- Natural fibres from plants are used in many vehicle interior components.
- Processing methods proven in practice are available.
- Opportunities and risks of natural fibre application can be found in the
  - manufacturing procedure
  - non-woven/raw material/component-requirements
- Opportunities with NF application; cost-efficient, possible for light construction
- Risks with NF application: quality is still too inconsistent and reproducibility is too limited.