Evaluation of a Market Survey 2002:

The Use of Natural Fibres in Composite Materials in the German and Austrian Automotive Industry

Status 2002, Analysis and Trends

Authors:

Dr. Markus Kaup

Michael Karus **Dipl.-Phys.**

Sven Ortmann **Dipl.-Ökon.**

February 2003

Short description of the nova Institut GmbH

The nova Institute GmbH was founded in 1994 as a private, independent institute and currently includes departments for renewable resources, sustainable regional development, internet databases (content management), and electromagnetic fields (EMF).
The Department of Renewable Resources examines the use of renewable raw materials in both material applications and as a source of fuel, employing the following tools:

- Market analyses and research - current and future markets for the acquisition and sale of renewable raw material product lines
- Feasibility studies - technology, economics, markets, environmental impacts and marketing of renewable raw material product lines
- Economic analyses and feasibility studies for renewable raw material product lines
- Analyses of the competitive situation both between the renewable raw material product lines and with conventional products
- Development of marketing strategies for renewable raw material products
- Project and congress management: Acquisition and coordination of national and international projects and expert meetings

The nova Institute has many years of experience in the field of market research on renewable raw materials (see: www.nova-Institut.de/NR), with extensive work on studies, business consultancy, specialist publications, presentations, seminars, specialist reports, and the establishment of the news portal for renewable raw materials (www.nachwachsende-rohstoffe.info).

Address and contact

nova-Institut GmbH
Goldenbergstrasse 2
50354 Hürth
GERMANY

Tel.: +49 (0)2233-9436-84
Fax: +49 (0)2233-9436-83

E-mail: contact@nova-institut.de

Internet: www.nova-institut.de
News portal for renewable raw materials: www.nachwachsende-rohstoffe.info

1 Methodology used for the survey and its evaluation

From June to October 2002, 139 companies (or company departments) and institutes from the natural fibre materials sector in Germany and Austria were surveyed by means of a standard one - page questionnaire.

The following questions were asked:

(1) In which value-added level is your company active?
(a) Fleece/felt/woven material/granulate (= raw material/substrate supplier)
(b) Composite materials /vehicle interior trimming (= system supplier/tier one supplier)
(c) Automotive manufacturers (= OEMs)

(2) How many tons of natural fibres were used or processed in composites in your company in 2001, and what amounts do you expect for 2002?
(a) Flax
(b) Hemp
(c) Sisal
(d) Jute and similar (e.g. Kenaf)
(e) Cotton
(f) Wood
(g) Others:

(3) What do you expect the total use of natural fibres (not including wood/cotton) to be in your company in 2005?
(a) Total use of natural fibres in 2005 in tons

(4) What processes are used in your company for the production of natural fibre composites?
(a) Natural-fibre press moulding duroplastic matrix: Share of process in %
(b) Natural-fibre press moulding thermoplastic matrix: Share of process in %
(c) Natural fibre-reinforced injection mouldings: Share of process in %
(d) Others: Share of process in %

(5) Which of the following technologies will in your opinion become more important in the future?
(a) Natural fibre reinforced injection mouldings
(b) Natural fibre woven fabric for construction materials
(c) Natural fibre reinforced bio-plastics
(d) Modified/treated natural fibres for advanced applications
(e) Others:

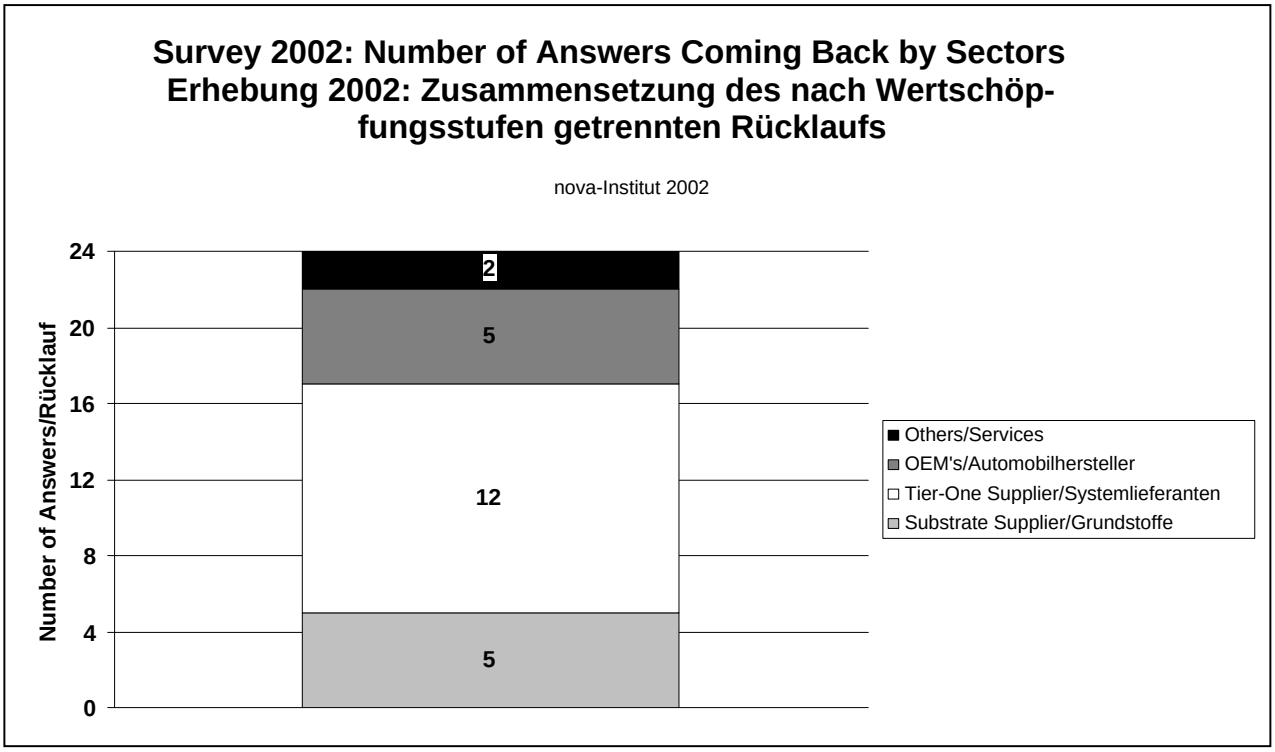
When selecting the addressees, the focus was placed on companies in the automotive and vehicle construction sector which by analogy with Question (1) of the questionnaire can be sub-divided into the following value-added levels:

- OEMs (Original equipment manufacturers/Automotive companies): 24 co mpanies (in some cases more than one department of a company was contacted).
- Tier one suppliers (system supplier): 31 companies (in some cases more than one department of a company was contacted)
- Substrate suppliers (raw materials suppliers): 62 companies
- Others/Services: 22 companies

The rate of return was 17.3% (24 of 139). Since in some cases multiple departments had been contacted in a single company and only one response per company was possible, a response rate based only on the number of companies would be significantly higher. Above all it is important to note that practically all the companies that use natural fibres to a significant extent took part in the survey.

The primary goal of the survey, analogous to the surveys carried out by nova Institute in 1996, 1999 and 2000 (2, 3, 4), was to collect reliable data both on the present status and on the market development, as it concerns the use of natural fibres in composites in Germany and Austria. Special attention in the survey was paid to tier one suppliers as they are currently the main manufacturers of composite materials made from natural fibres. This gives the resulting data relevance and reliability. Fig. 1 shows the distribution of the responses to the questionnaire in terms of the various sectors.

Figure 1



A structuring of the returns in terms of the value-added level shows that 50% of the responses came from tier one suppliers. In order to avoid double counting of the amounts of natural fibre used, care was taken to consider the contributions from the different value-added levels when evaluating the responses to questions (2), (3) and (4). The results presented in this report concerning the amounts of natural fibres used (question 2), the growth predictions (question 3), and the shares of the various processes (question 4) are solely based on the responses from the 12 tier one suppliers in Germany and Austria.

In order to determine the plausibility of the responses regarding the amounts of fibres used and the growth predictions of the 12 tier one suppliers, the following additional surveys and evaluations were varied out:

(a) Evaluation of the remaining 12 questionnaires from the other value-added levels, in particular regarding the growth predictions.
(b) Questioning of leading fibre traders in the European Union and Asia, concerning the amounts of flax, jute and kenaf fibre delivered to the German and Austrian automotive

industry. (The fibre traders that responded wished to remain anonymous.)

(c) A survey of all leading hemp fibre processing companies in the EU as part of a survey of members of the "European Industrial Hemp Association (EIHA)" (www.eiha.org); see also (1).

It should be noted that on the basis of the current survey, amendments were made to the previous surveys and evaluations of the nova-Institute (2, 3, 4). In the framework of the current analysis, the data from all surveys from 1996 onward was re-evaluated. Overly optimistic predictions from the survey participants, inconsistencies and outlying data points were corrected. The new evaluation was able to confirm the trends of the earlier surveys, but not the absolute amounts of natural fibres used. The correct data showed that the fibre volumes predicted from the earlier surveys were reached approximately two years later.

2 Market structure and major producers of natural fibre materials

The evaluation of the results shows that, in the current market, it is the large automotive companies (here: tier one suppliers) which use natural fibres for composites. The following list names the companies that are currently the most important producers of natural fibre composites in Germany and Austria for the automotive sector:

- Borgers
- Dräxlmaier
- Faurecia Interior Systems
- Findlay Industries
- Funder Industrie
- Johnson Controls Interiors
- Karmann
- Lear Corporation
- Quadrant
- Seeber

Our surveys suggest that, in the future, natural fibres will not only be used by additional tier one suppliers in the manufacture of composites (e.g. Brose, Möller Group, Molan), but also by plastics processing companies in other sectors (e.g. Ahlstrom, Zarnack Group).

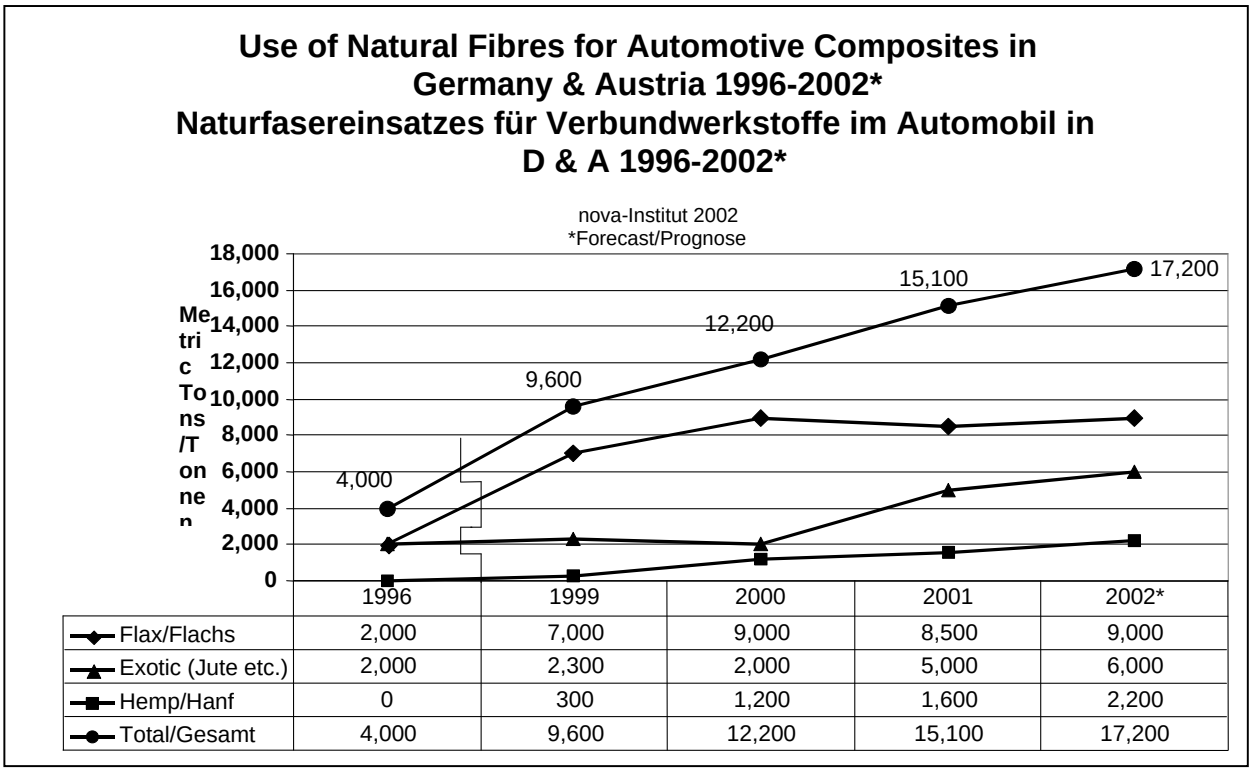
The current market structure can be described as follows: The substrate suppliers (fibres, fleece/felt) are, as a rule, small and medium-sized enterprises (SMEs), whereas the further processing to composites is mainly done by major international companies (tier one suppliers), which in turn sell their products on to the oligopolitically structured vehicle manufacturers (OEMs).
This means that numerous small suppliers of fibres and fleece/felt face relatively few large, powerful purchasers (a market structure that is defined as a demand oligopoly). In addition, the automotive industry is an example of the phenomenon of so-called supply-chain pressure (=adaptive pressure on the supply chain). In other words, the levels preceding the automotive manufacturers in the chain (composites producers, fleece/felt producers, fibre producers) pass requirements on up the chain. The consequence is that the individual small suppliers of fibres and fleece/felt are increasingly the ones required to make adaptations regarding quantities and technology. While operating within their set cost structures, the small suppliers must adjust their volumes and technologies to meet the prescribed price, the product volumes and the required quality.

However, it must be emphasised that with intelligent, innovative solutions, the small producers can deliver new impulses from the bottom up, provided that their products meet the current requirements of the automotive companies.

3 The current and future use of natural fibres in composites

The results of the survey show that, despite the relatively depressed car market in 2001 and 2002, there has been a further increase in the use of natural fibres (excluding wood and cotton) for composites.
Fig. 2 shows the development up to 2002. In 2001, 15,100 tons of natural fibres were used for composites in the German and Austrian automotive industries. The predicted market in 2002 was 17,200 tons.

Figure 2



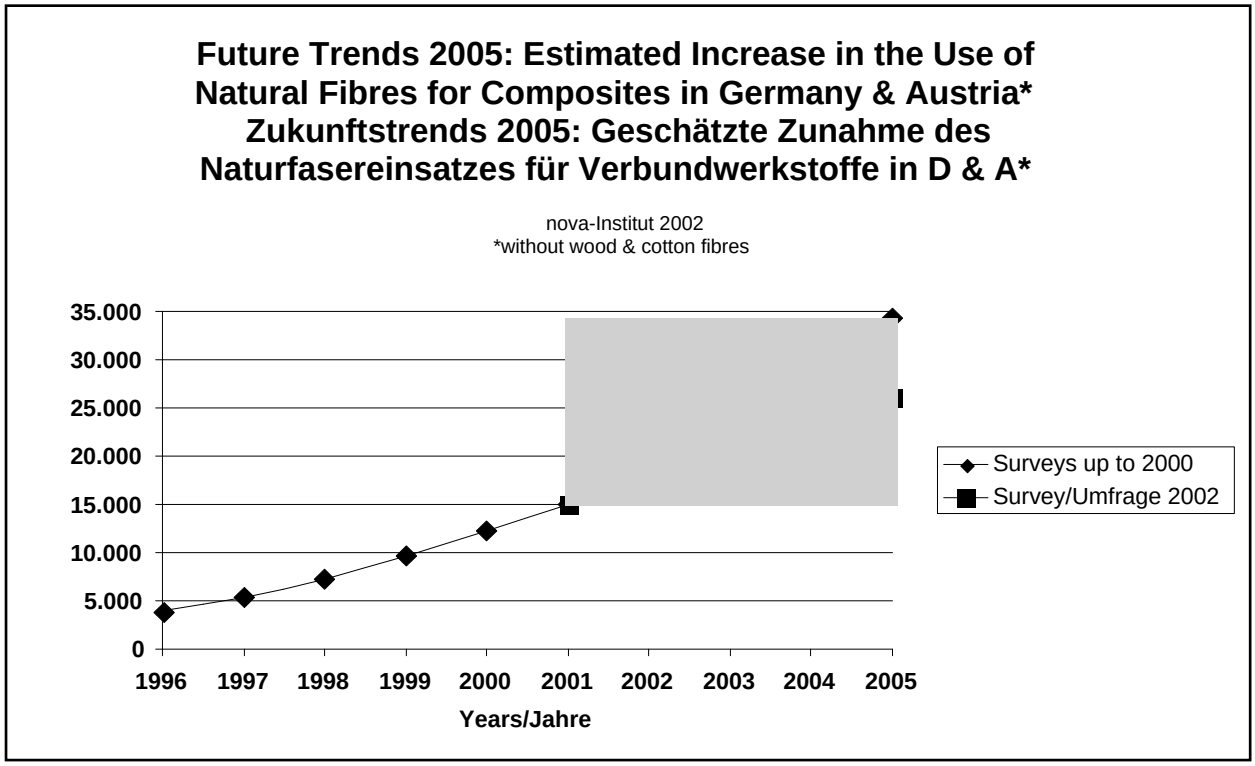
	1996	1999	2000	2001	2002*
Flax/Flachs	2,000	7,000	9,000	8,500	9,000
Exotic (Jute etc.)	2,000	2,300	2,000	5,000	6,000
Hemp/Hanf	0	300	1,200	1,600	2,200
Total/Gesamt	4,000	9,600	12,200	15,100	17,200

Between 1996 and 2002, there has been an almost linear rise in the amounts used, with an average annual growth rate of approx. 22%. However, from year to year, different natural fibres contributed to the growth rate.
Until 2000, the growth was to a large extent attributable to the increased use of flax fibres. With the re-emergence of the flax textile industry and the parallel rise in flax prices in 2001, this situation changed. The "exotic fibres" (jute, kenaf, sisal) which had been stagnating until then, or even declining, could record marked increases in 2001 and 2002.
There has been a continual increase in the use of hemp fibre since its 'rediscovery' in 1996, rising to approx. 2,200 tons in 2002. Since the European hemp industry has, until now, a comparatively small production capacity (1), the increased demand for natural fibres, caused by an increase in consumption and high flax prices, could not be met by hemp. This created an opportunity in 2001 and 2002 for exotic fibres, which were imported predominantly from Bangladesh and India.

With the cooling off of the flax market and an increase in the EU -hemp technical fibre processing capacity, a decline in use of exotic fibres is to be expected this year.
The results for 2002 show that with a market of 17,200 tons for natural fibres at an average price of EUR 0.55 to EUR 0.62/kg ($CAN 0.88 to 0.99/kg), a total market value for Germany and Austria of approx. EUR 10 million ($CAN 16 million) can be estimated (EU total: approx. EUR 15 million / $CAN 24 million for approx. 25,000 tons of nature fibre, cf. also (5)).

For the period 2001 -2005, tier one suppliers are forecasting growths of approx. 14 to 15% per annum. In comparison to earlier surveys, the estimates for the annual growth rate up until 2005 have been lowered (e.g. Survey 2000, a pprox. 22% per annum, see (6)). Fig. 3 shows the trend through to 2005. Depending on the growth rate achieved, an annual market for natural fibres of between 26,000 - 34,000 tons for natural fibre composites in the automotive sector (Germany and Austria) is predicted by 2005.

Figure 3

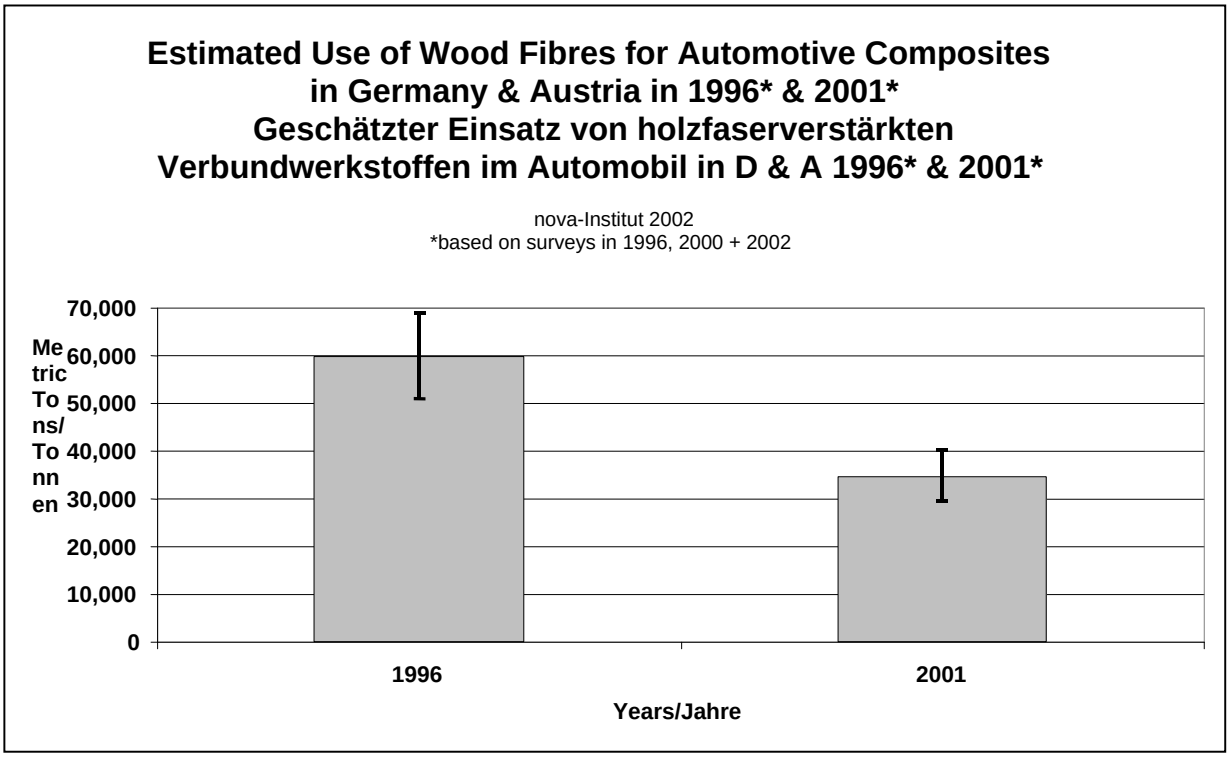


There are three key reasons for this positive development according to our surveys:
(1) Increased use of natural fibre press moulding in the entire transportation sector
For car models in which natural fibres are currently used for press moulding, the average quantity of natural fibres consumed ranges from 5 to 10 kg per car. In the future, it is to be expected that natural fibre press moulded components will be used in additional models and for oth er modes of transportation (e.g. delivery vans, trucks, railway carriages) . Other European markets, like France, are also expected to increase their demand (see also Chapter 4).
Using the current requirements of 5 to 10 kg natural fibres per vehicle – and the present production of 16 million vehicles in Western Europe, results in a market potential of 80,000 - 160,000 tons per annum for natural fibres in press moulding.

(2) Displacement of wood fibre and cotton in press moulding

Another reason for the growth in the use of natural fibres in pres s moulding is the displacement of other "natural fibres" such as wood fibres and cotton fibres. According to our surveys, there has been as sharp decline in wood-fibre reinforced press moulding since the mid-1990s. As can be seen in Fig. 4, the use of wood fibres in press moulding has almost halved in the period between 1996 and 2001 and currently lies around 30,000 to 40,000 tons per annum. According to information from the tier one automotive suppliers, natural fibres with th ermoplastic matrixes have been replacing wood fibres with duroplastic matrixes in press moulding applications (see also Chapter 4).

Figure 4



(3) Increase d use of natural fibres for composites in new proces sing technologies and new fields of application

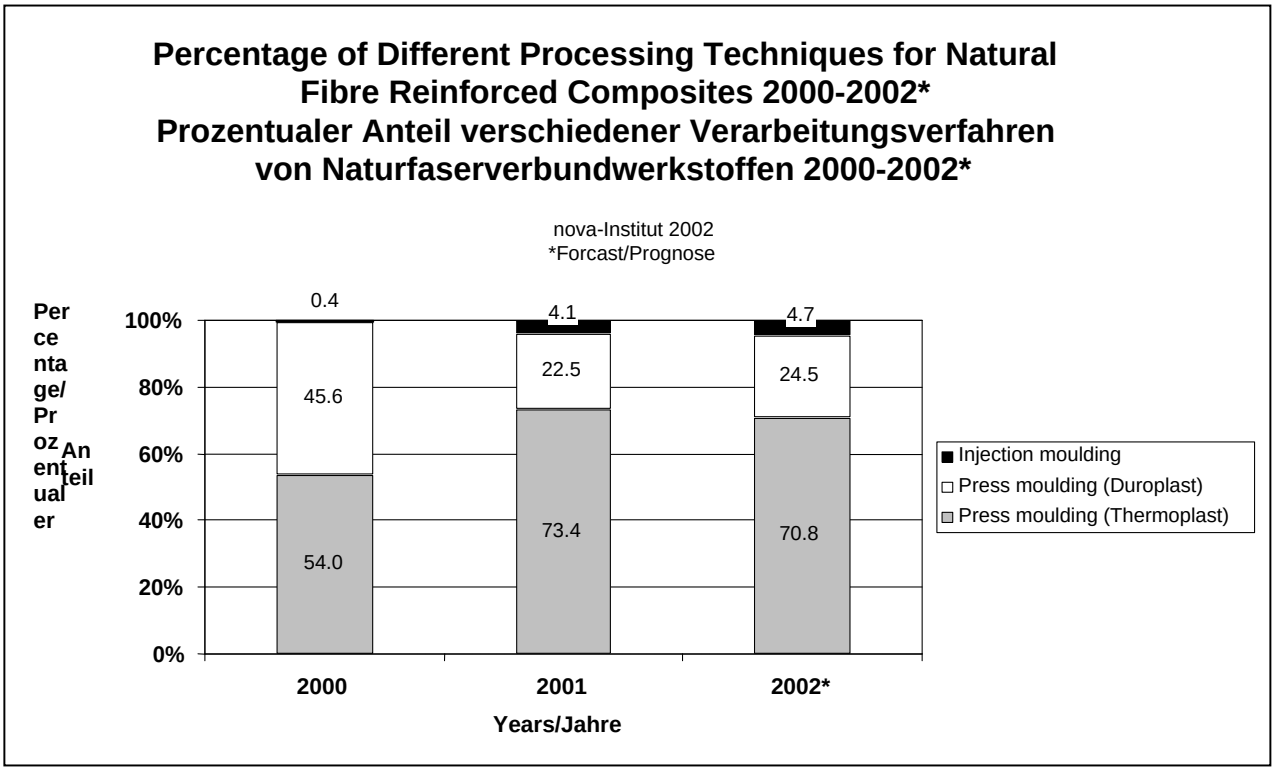
There will be an increase in the use of natural fibres for composites in new processing technologies and new fields of app lication - such as natural fibre injection moulding (see also Chapter 4). However, it is not yet clear whether the new natural fibre injection moulding composites will replace glass-fibre reinforced plastics in the automotive industry (approx. 1 million t ons per annum in the EU, of which 60,000 t ons per annum in the automotive industry) or will instead substitute other materials - such as e.g. ABS plastics. The first components produced in the plastics processing industry using natural fibre injection moulding granulate/pellets, show that applications are already possible in many sectors in cluding the automo tive industry (7). Serial production for certain components is expected to begin this year.

In conclusion, the results of the current and the previous surveys predict an annual growth rate until 2005 of 10 to 20% for the use of natural fibres in composite materials.

4 Current and future processing technologies of natural fibres in composites

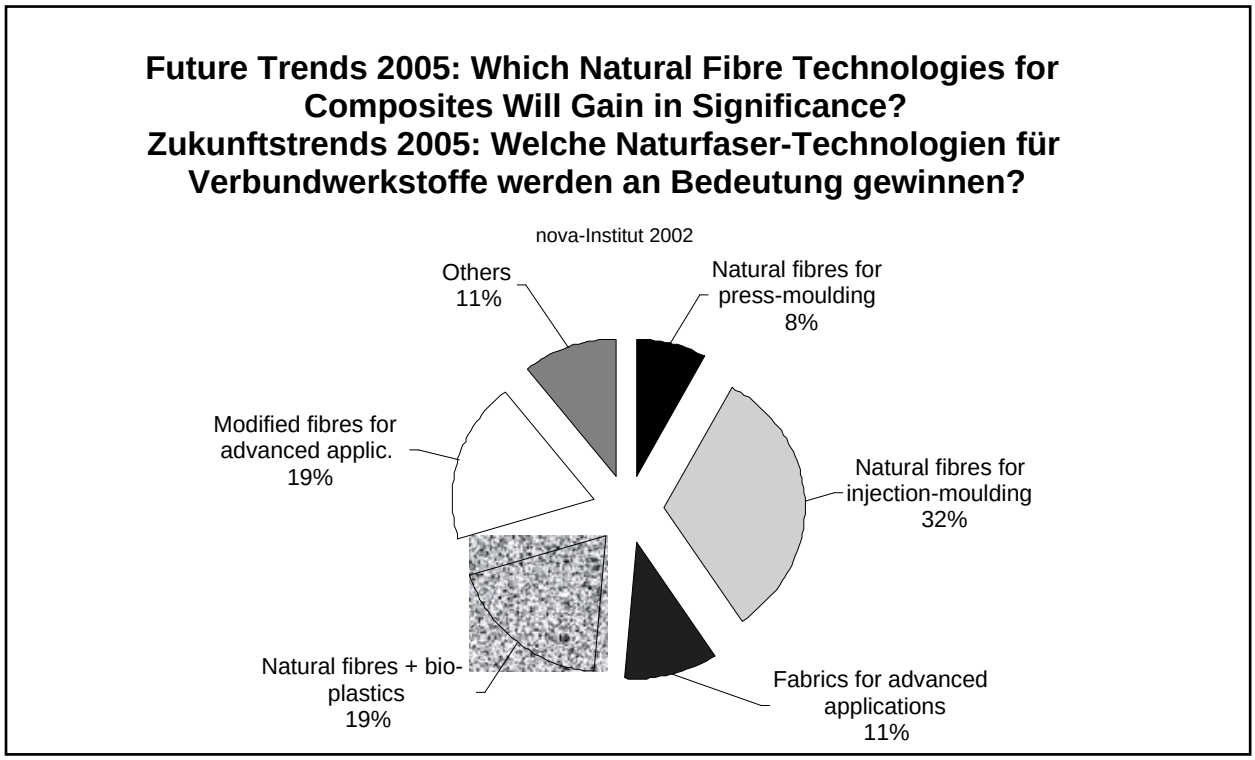
The evaluation of the responses of the tier one suppliers concerning the current processing technologies shows that, in comparison with the survey in 2000, there is a clearly identifiable trend towards thermoplastic matrix systems such as polypropylene (PP) - analogous to the plastics market in general. The reasons lie both in the easier processing of thermoplastics, as well as in fogging problems with certain duroplastic matrix systems. This trend will continue in the future in view of the anticipated increased use of natural fibres injection moulding for components.
Fig. 5 shows that in 2000 approx. 45% of the natural fibre press moulded components were made with a duroplastic matrix (e.g. polyurethane - PU). In 2001 and 2002, only 22 to 24% of the natural fibre composites still had a duroplastic matrix. It is also clear that in terms of the processing technology, press moulding continues to dominate. However, there is a slight increase in injection moulding to 4.7% in 2002, which is currently due to the use of cellulose fibre injection moulding in serial production. (The percentage figures given in this Chapter refer to composites from natural fibres in a wider sense – that is including wood and cellulose fibres.)

Figure 5



With regard to trends through until 2005, Fig. 6 shows that 32% of the companies and institutes that responded anticipate an increase in the importance of natural fibre injection moulding technologies. The sector of natural fibre injection moulding could then provide an important growth impulse for the future use of natural fibres in composites. Other innovative processes and materials such as "modified/treated natural fibres for advanced applications " or "natural fibre-reinforced bio-plastics" are expected to become more important in the future by 19% of the respondents.

Figure 6



Reference database

This market study is part of a joint project, "Development of a reference database for natural fibre reinforced materials from local renewable raw materials". The overall project is being carried out by the following partners; Institut für Kunststoffverarbeitung (IKV), Aachen ; M-Base Engineering + Software GmbH, Aachen ; Faserinstitut Bremen e.V. (FIBRE) ; and the nova-Institut GmbH, Hürth. The project receives financial support through the Fachagentur Nachwachsende Rohstoffe – FNR (Agency for Renewable Resources) from the German Federal Ministry of Consumer Protection, Nutrition and Agriculture (BMVEL) – see ref. No. 22004500.

Sources:

1. Karus, M. 2002: *European Hemp Industry 2001: Cultivation, Processing, and Product Lines*. Journal of Industrial Hemp, Volume 7, Number 2, 2002, pp. 95-99.
2. Karus, M. / Kaup, M. 2001: *Naturfasereinsatz in der europäischen Automobilindustrie* . Technische Textilien, Volume 44, 11/2001, pp. 258-262.
3. Karus, M. / Kaup, M. 2002: *Natural Fibres in the European Automotive Industry*. Journal of Industrial Hemp, Volume 7, Number 1, 2002, pp. 119-131.
4. Karus, M. / Kaup, M. / Lohmeyer, D. 2000: *Studie zur Markt - und Preissituation bei Naturfasern (Deutschland und EU)*. Gülzower Fachgespräche, Fachagentur Nachwachsende Rohstoffe (FNR), 2000, 107 p.
5. The Textile Consultancy Ltd 2000: The Use Of Natural Fibres In Nonwoven Struc tures For Applications As Automotive Component Substrates, 2000, approx. 50 p.
6. Kaup. M 2002: *Entwicklungs- und Erfolgsfaktoren für Produkte aus nachwachsenden Rohstoffen in Deutschland und der EU im Spannungsfeld zwischen Ökonomie und Ökologie*, 2000, Thesis, approx. 300 p. (see pp. 213 f)
7. Karus, M. / Knöbl, St. / Müssig, J. / Kaup, M. 2002: *Die Ergebnisse des Naturfaser - Spritzguss-Rundtests 2002 im Detail – Erstmalige Präsentation der Ergebnisse des ersten Vergleichstests dreizehn unterschiedlicher Naturfas er-Spritzgussverfahren von acht führenden Unternehmen und Instituten – Methodik und Ergebnisse des Rundtests zu den technischen Eigenschaftsprofilen von Naturfaserspritzgussteilen* . Proceedings of the nova - Conference on natural fibre injection moulding for composites in the automotive industry, Hürth, 1 October 2002. nova-Institut, Hürth.