Use of natural fibres in composites for the German automotive production from 1999 till 2005

Slowed growth in the past two years –
new production techniques arising

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Introduction – methodology and data correction

Since 1996 the nova-Institut has been surveying data on the use of natural fibres (NF) in the German automotive production. In a comprehensive investigation by means of e-mail questionnaires and telephone interviews, the data for the years 2004 and 2005 were surveyed in the summer half-year of 2006. Like in previous years, here the data of the suppliers active in Germany were focused upon and could almost entirely be surveyed. Additional exemplary interviews of employees of automotive companies, NF mat producers, machine manufacturers and raw material suppliers served the purpose of further ensuring the data.

Almost all data prove to be consistent with the surveys of previous years. However, the data on the amounts of NF composites have to be considerably revised: The 45,000 t in 2003, as published so far, retrospectively proved to be wrong, it was not before the year of 2005 that 30,000 t could actually be achieved – and this at a continuously increasing use.

The reason for the miscalculation back then was the conversion of the natural fibre amount into the composite amount. Here up to now - in coordination with branch representatives - an average natural fibre share of 40% had been presumed. But because for this year's survey for the first time not only the natural fibre amount, but also the composite amount could be surveyed, the natural fibre share for thermoset and thermoplastic techniques could precisely be calculated now – and it is clearly beyond 40% (see below). In addition, for the first time also the edge trim was taken into consideration, with a presumed average loss of about 20% in the course of the moulding process.

On the whole, given consistent data for the use of natural fibres, this results in newly calculated data for the respective composites. This correction was done retroactively for the years 1999 till 2005, in order to obtain a new, coherent database.

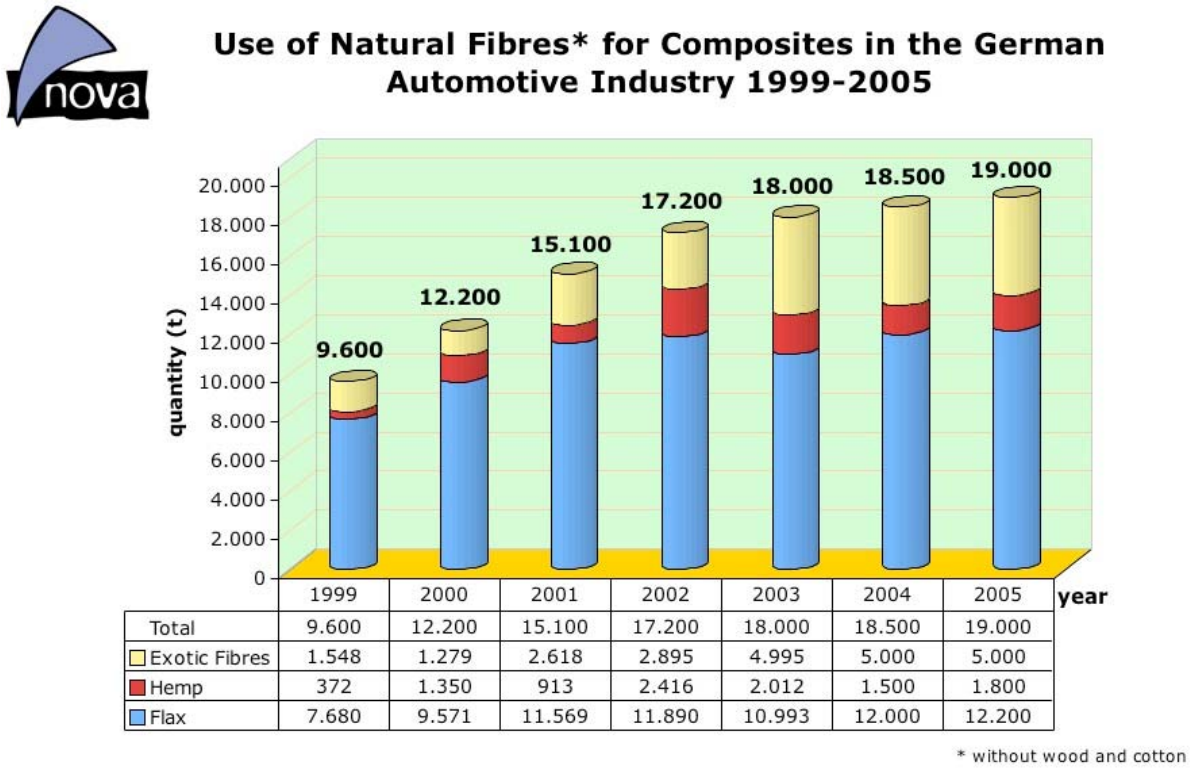
Results and their interpretation

The first chart shows that the use of natural fibres (NF) in the German automotive production has further increased also in the years 2004 and 2005 – even though merely with slowed growth rates of less than 3%. This growth is primarily based on the rising use of the press flow-moulding and injection moulding technique (both new to natural fibres), while the established compression moulding is stagnating.

Natural fibres in motorcars

In 2005, for the first time 19,000 t of natural fibres (without wood and cotton) were used in automotive composites. At the same time the shares of natural fibres used have changed. While exotic natural fibres – jute & kenaf, sisal, coir and abaca – could increase substantially between 2000 and 2004 both on a percentage basis and absolutely, there has been a stagnation ever since. This is directly linked to the prices of European flax fibres that were quite high in the same period and have been decreasing again as recently as since 2004; simultaneously in recent years there were significant price increases for jute and kenaf on the world market. Accordingly flax could expand its market position again in the 2004 and 2005. The shares of hemp are mainly determined by the short supply. Due to the failure of a large producer, the use decreased in 2004, then recovering again.

Chart 1: nova-Institut, Nov. 2006



Present market shares of different natural fibres

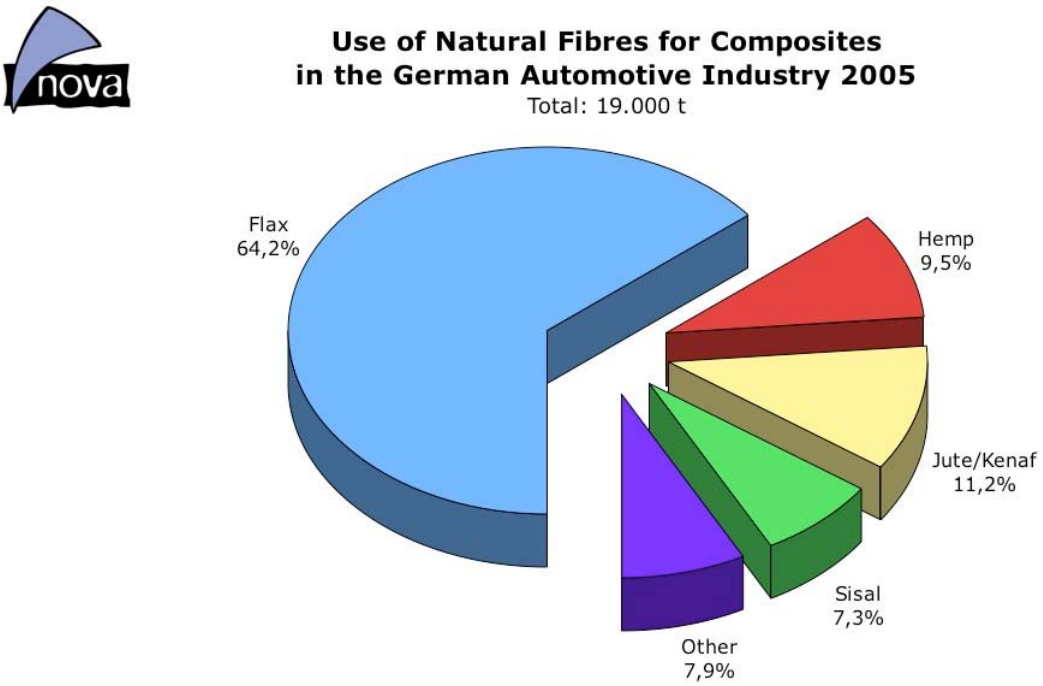
The following chart 2 shows the present shares of different natural fibres for the year of 2005 in the form of a pie chart. The predominance of flax fibres (market share of almost 65%) becomes clear which are almost exclusively produced in Europe, in most cases as by-product of textile long fibre production. Hemp fibres, also almost exclusively from European production, presently show a market share of just under 10%. Larger shares are possible not until further processing capacities will be established or the hemp insulation material market will decrease.

For the year of 2005, “exotic natural fibres” could be itemised, what had not been possible in recent years do the lack of respective data. The most important exotic fibres are jute and kenaf with 11%, followed by sisal with 7%.

While jute is by far the fibre with the highest turnover worldwide, thus being the “leading fibre” amongst technical natural fibres, there are only little data available for kenaf. In the trade sector, jute and kenaf are often not properly differentiated from one another. This is the reason why these two Asian fibres are always listed together. Sisal is the second most important technical natural fibre worldwide, mainly coming from Africa and South America.

Other exotic fibres are particularly coir from Southern Asia that are primarily used in composites for high-class seats, and abaca fibres from the Phillipines that are used in a first exterior part in the framework of the press flow-moulding process. A couple of other natural fibres can be used for composites.

Chart 2: nova-Institut, Nov. 2006



Shares of different production techniques

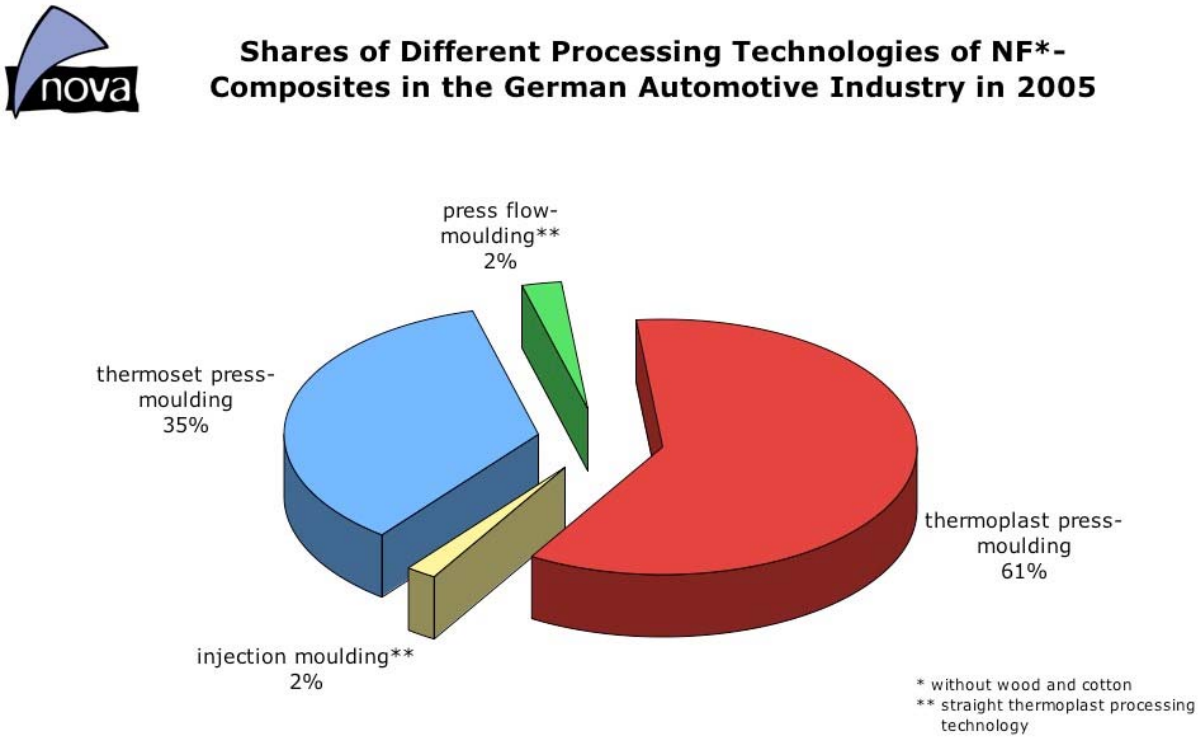
Chart 3 shows the share of different production techniques for natural fibre composites. Like in recent years, compression moulding is dominant, though slightly less than previously. The share of the compression moulding technique amounted to more than 99% in recent years, now it has decreased to 95%.

For the first time – for the use of natural fibres – new techniques can be observed: press flow-moulding and injection moulding. For both techniques, in the following years considerable increases are possible, while compression moulding seems to have entered a phase of saturation. This is partly due to the fact that its main field of application are high-class interior parts of the medium and luxury class, where it is hard to achieve further growth (also see section “future development”).

Presently it is often said that natural fibre compression moulding has passed its peak, already being on a downswing. Our survey cannot confirm this, but merely detect a stagnation. However, a shift amongst suppliers is noticeable that could explain the impression mentioned above: While, indeed, the production of NF compression moulding parts is quantitatively decreasing among many small and medium suppliers, the production is accordingly increasing among a few large suppliers, thus compensating the decrease among smaller suppliers. When asking all suppliers, one necessarily gets the impression that compression moulding is declining for the most part – although it qualitatively remains constant.

A closer estimate of the future market chances of different NF techniques is provided farther below.

Chart 3: nova-Institut, Nov. 2006



Excursus: Wood and cotton

In the framework of the survey, there was the attempt to also survey the amounts of wood fibres and cotton that are used in the German automotive production. Unfortunately, however, this was not possible in the framework of the investigation.

As important companies from the wood fibre and wood flour processing sector did not take part in the survey, merely about 16,000 t of wood fibres could be verified. In the framework of our market study of 2004, we had assumed about 25,000 t of wood fibres and about 36,000 t of wood fibre composites for the year of 2003. Because growth is generally expected for this sector, we estimate the amount for 2005 at about 27,000 t of wood fibres and about 40,000 t of respective wood fibre composites.

The wood fibre composites used in the automotive industry have a large fibre content (see below) and an almost exclusively thermoset matrix. WPC granulates made from a thermoplast, wood flour and fibres respectively, as well as additives, constitute an exception. Their market share still is less than 1%, but will increase.

The data for cotton are even sparser. Only a few hundred tons could be verified, although our previous study (2004) had stated about 45,000 t of cotton and about 79,000 t of respective composites for the year of 2003.

This discrepancy is due to the fact that the survey was conducted primarily amongst passenger car sub-suppliers, while thermoset cotton composites today are almost exclusively used in lorry driver's cabs.

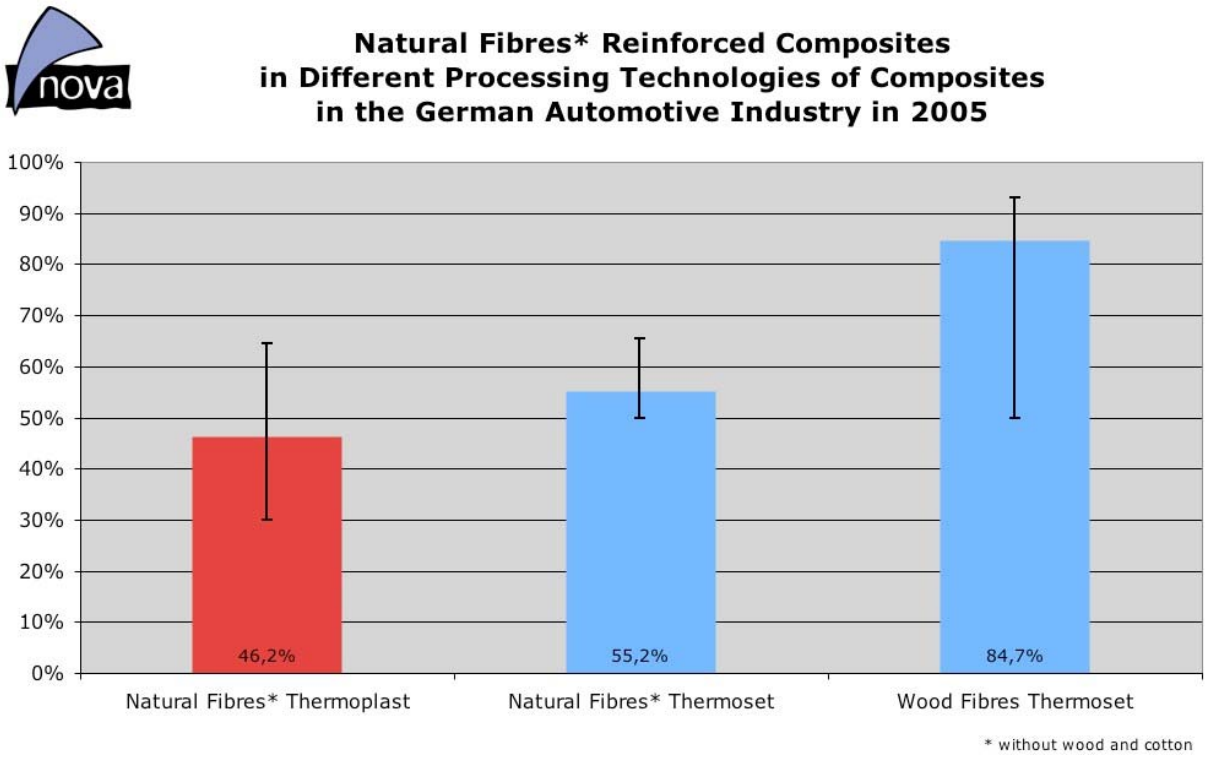
Natural fibre shares for different production techniques

Chart 4 shows the natural fibre shares for different production techniques. This year, as mentioned in the introduction, these data were surveyed for the first time. As expected, the fibre shares for thermoset wood composites were the highest with just under 85%. When

natural fibres (without wood and cotton) are processed on a thermoset basis, the fibre share amounts to approx. 55%. The large share of natural fibre in thermoplastic composites came as a surprise. While, in accordance with exemplarily interviewed producers, in the past we had assumed a fibre share of rather 30 to 40%, the current survey resulted in an average share of 46%. Averaged over all techniques, the average natural fibre share amounts to 51.5%.

In chart 4 also the fibre share ranges are shown. For thermoplastic composites, the range reaches from 30 to 65%.

Chart 4: nova-Institut, Nov. 2006

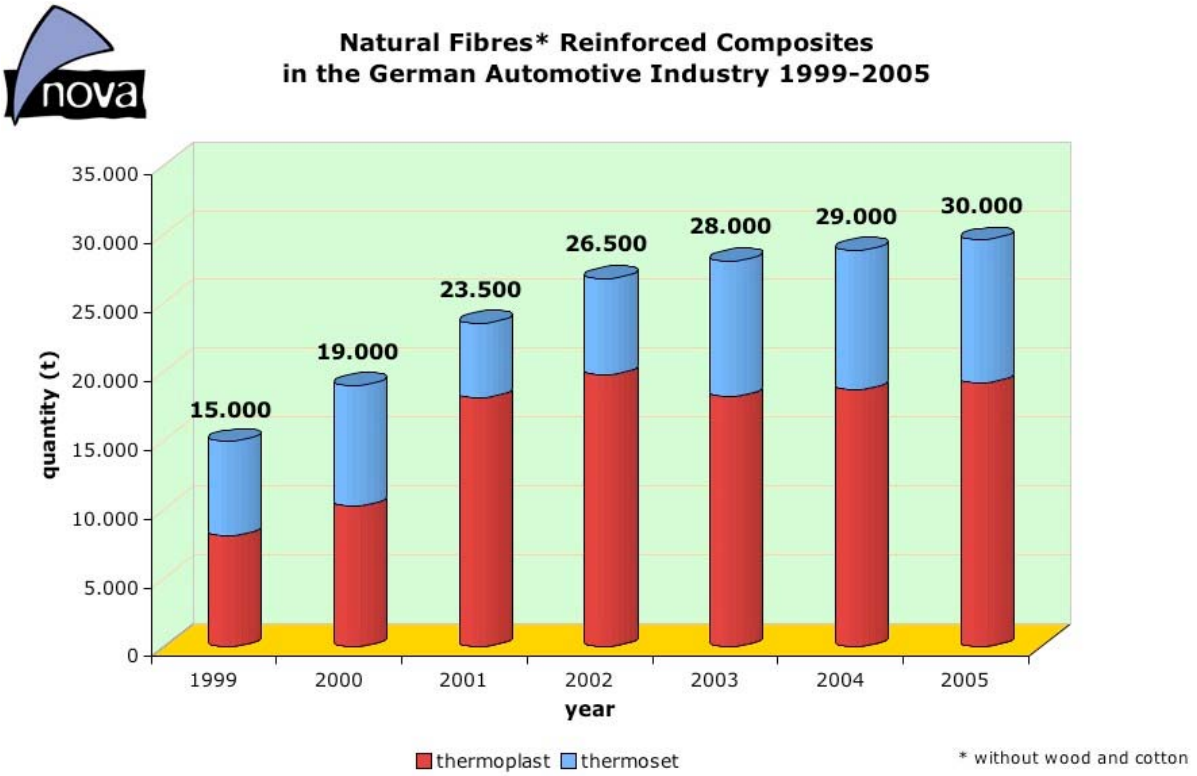


Natural fibre composites in motorcars

Based on these now confirmed natural fibre shares and an assumed average edge trim of 20% (with compression moulding), the following amounts of natural fibre composites arise. As discussed in the introduction, the data of 1999 till 2003 had to be corrected accordingly, making inconsistencies with previous nova publications inevitable here.

In addition to the increasing total amounts, chart 5 also shows the changing shares of thermoset and thermoplastic techniques. Since 1999 the share of thermoplastic composites has considerably increased, in the past three years, however, there were no further shifts.

Chart 5: nova-Institut, Nov. 2006



Natural fibres per passenger car

According to the Association of automotive industry („Verband der Automobilindustrie“, www.vda.de), 5.2 million passenger cars (2004) and 5.4 million (2005) respectively were produced in Germany. Based on these figures, together with the data from chart 1 the average natural fibre amounts per passenger car can easily be calculated. For the years 2004 and 2005, this results in 3.6 kg/passenger car, a value only slightly higher than in 2003 (3.5 kg/passenger car).

Natural fibre composites beyond the automotive industry

The interviewed automotive suppliers were asked whether they are also producing composites for other branches. Several small and medium suppliers affirmed this and together amounted to approx. 150 t that were mainly processed with PP-NF granulates using the injection moulding technique. The carrier material of grinding wheel is an example for this, with the aforesaid material successfully replacing PP glass fibre injection moulding material.

Future developments

Regarding the future market development of natural fibre reinforced composites, there presently isn’t any clear trend noticeable. Estimates are wide apart within the automotive branch. There is belief on the one hand that natural fibres have already passed their peak and their applications will decrease, and on the other that there is a stabilisation with a (slight) market growth and interesting potentials in the medium term. “No clear direction for NF materials: Successes in the past, weakening at the moment, and an interesting future” – this is how an insider summarised the current situation in the summer of 2006.

Also the material choice of OEMs and tier-one supplier is hard to assess, depending on the series of models, decisions pro and contra natural fibre reinforced composites are made at the

same time. At the moment, NF compression moulding is in a phase of stagnation, while NF press flow-moulding and PP-NFinjection moulding are increasing, however, based on a (yet) very small level.

It is clearly noticeable that the setting for new materials has substantially changed in recent years. Under heavily increased cost pressure for which also quality is partly sacrificed, since the year of 2004 new materials have had considerably more difficulties than before. Suppliers want to use existing processing lines to capacity and not invest in new machines. New materials shall be better and cheaper, what can hardly be achieved.

From an economic point of view, NF and wood materials exhibit decent price stability, being less dependent on the mineral oil price than other materials, particularly if large NF and wood shares respectively can be realised. Should CO_2 emissions be financially punished more severly in the future, further economic benefits would come about.

Compression moulding

NF compression moulding is an established and proven technique for the production of extensive, lightweight and high-class interior parts in medium and luxury class cars. Advantages (lightweight construction, crash behaviour, deformation resistance, lamination ability, depending on the overall concept, also price) and disadvantages (limited shape and design forming, scraps, cost disadvantages in case of high part integration in construction parts) are well known. Process optimisations are in progress, in order to reduce certain problem areas such as scraps and to recycle wastage. By means of new one-shot compression moulding presses, also soft surfaces can be directly integrated, what has not been possible so far with injection moulding.

As far as preferably inexpensive door concepts with a high part integration are concerned (up to the point of doing without lamination), NF compression moulding does not have good chances against injection moulding. As far as high-class door concepts are concerned, NF compression moulding remains to be a first choice technique. Against this background, it is not astonishing that NF compression moulding is stagnating right now in the German automotive industry. The decreases among small and medium suppliers are presently fully compensated by increases among large tier-one suppliers. A structural problem is the fact that there are only a few compression moulding machine manufacturers and mat producers, that compression moulding is a specialised technique (dependence!). The suppliers would preferably use their existing (injection moulding) line to capacity. Under a heavy price pressure, this can become a disadvantage for NF compression moulding presses.

The future of NF compression moulding depends on numerous factors (price pressure, strategies, and interior concepts of the OEMs and suppliers, mineral oil, plastics and glass fibre prices, advancement of compression moulding as well as correction concepts and materials respectively). We assume that this technique will find its markets also in the future. This is also indicated by the fact that presently more NF compression moulding lines are installed worldwide than ever before – not in Europe, but in China, India and Iran. There, in view of the current world market prices for natural fibres, NF compression moulding seems to be regarded as economically interesting and seminal technique.

Press flow-moulding

So far only a few companies have dealt with the topic of NF press flow-moulding. Those who have dealt with it are seeing interesting technical and economic possibilities for this new technique.

PP-NF injection moulding
There are big differences in the estimation of market developments in the field of PP-NF injection moulding. Some people don't see any relevant application of PP-NF in motorcars, neither their technical data nor prices were attractive, others attest PP-NF large growth rates and a big potential. This especially applies to the material WPC with wood flour and fibres.

NF granulates and their processing are often regarded as not yet sophisticated and too expensive, in addition, it is complained that there are no established, bigger suppliers with respective support yet. Should these problems be solved, there seems to be real interest among OEMs and suppliers. Furthermore PP-NF granulates are becoming more and more interesting in view of increasing mineral oil and glass fibre prices.

The different estimates are partly due to the fact that the current market of PP-NF granulates is very confusing and the various granulates can differ in their mechanical properties and prices at a factor of up to 2. Many potential customers do not know the presently biggest and best suppliers.

Political framework
A favourable political framework could help bio-materials experience considerable growth. For example forced measures for the reduction of CO_2 emissions are to be mentioned here. In this sector, particularly natural fibres can score well, the production of which is ten times less energy-intensive than the one of glass fibres.

A new EU End-of-Life Vehicle Directive, which is under revision at the moment, could also have a big influence. If attempts were successful to achieve a renewable resources deduction at source like e.g. the steel quota, as representatives of the natural fibre branch have been claiming for years, there would be considerable advantages for natural fibre reinforced composites. A practical solution could be that the actual share of renewable resources is credited to each vehicle as material recycling – regardless of whether the part is used energetically or materially. This approach would be justified by the fact that even in case of burning the renewable resources shares, the CO_2 balance would almost be neutral. Right now this would merely result in 3.6 kg natural fibres per vehicle on the average; but vehicles with considerably larger amounts of 20 or also 30 kg have been successfully produced in series for years and could credit these amounts in the future, according to the model mentioned above. A respective revision of the End-of-Life Vehicle Directive would cost Bruxelles nothing and have crucial steering effects.

Sources of previous data
Comparable nova market studies from previous years:

- **Use of natural fibres in composites in the German automotive production 1996 bis 2003** – The use of natural fibres has further increased despite recession and pricing pressure, PP natural fibre injection moulding with first series applications. Publisher: nova-Institut, Hürth, September 2004, 16 pages (long version); Authors: Karus, M., Ortmann, S., Vogt, D. (also a free short version is available (4 pages))

- **Use of natural fibres in composites in the German and Austrian automotive industry - Market survey 2002: Status, Analysis and Trends**. Publisher: nova-Institut, Hürth, Februar 2003, 5 pages; Authors: Karus, M., Kaup, M., Ortmann, S.

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The **present study**, like also the two previous studies, can be downloaded at: „www.nachwachsende-rohstoffe.info -> nova publications".

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