English Summary of
“Use of Natural Fibres in Composites in the Automotive Sector in Germany from 1999 to 2005”

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Introduction

The nova Institute has been publishing studies on the use of natural fibres in the German automobile market since 1996. The current study was carried out in the summer of 2006 for the period 2004 and 2005. In addition to the original focus group of car parts suppliers, the recent study also asked car manufacturers (OEMs), natural fibre mat producers, related machine constructors and natural fibre traders.

Based on the newly acquired data, the results of the previous years had to be revised. The yearly numbers in the current study have been corrected.
Results

Figure 1 shows that the natural fibre market has increased by a modest 3% in the past year. This growth can be attributed to the development of new applications: compression moulding and injection moulding.

Figure 1: Use of natural fibres for composites in the German automobile industry 1999-2005

Translations:
Menge (t) = Amount (tons)
Jahr = Year
Summe = Totals
Exotische Fasern = Exotic fibres
Hanf = Hemp
Flachs = Flax
Ohne Holz und Baumwolle = Excluding wood and cotton

Note: Europeans use decimals where North Americans use commas. Hence 9.600 tons is 9,600 tons in North America.

Exotic fibres include: jute, kenaf, sisal, coconut and abaca

Natural Fibre Use in Automobiles
In 2005, 19,000 tons of natural fibres (not including wood or cotton fibres) were employed in the automotive composites market. The use of exotic fibres, such as kenaf and sisal has stagnated. This is due to the steadily decreasing prices for European flax fibres and the increasing prices for jute and kenaf. The hemp fibre values are dependent on a limited number of producers and its limited availability.
Figure 2: Use of natural fibres in composites for the German automobile industry 2005

Translations:
- Gesamtmenge: 19,000 t = Grand total 19,000 tons
- Flachs = Flax
- Hanf = Hemp
- Jute/Kenaf = Jute/Kenaf
- Sisal = Sisal
- Sonstige = Other

Figure 2 shows the distribution of fibre types that were employed in 2005. Flax dominates. The flax fibres are a by-product of the long fibre processing industry. Long fibres are used in the textile industry. The hemp fibre portion could increase if additional processing capacity were available or if the demand for hemp fibre from the insulation market were to decrease.

Figure 3 shows the application fields for natural fibres. Press moulding uses the majority of the natural fibres. Two new processes have made an appearance: compression moulding and injection moulding. Further increases are expected in the coming for these applications, whereas the quantities for press moulding are expected to stagnate.

In the industry, some company representatives claim that natural fibre press moulding has reached its peak and is currently on the decline. This claim was not confirmed by the study. In fact, a shift was observed in the sector as the increased demand by large companies has more than compensated for the lower demand by SME parts suppliers.
Figure 3: Relative use of natural fibre composites among the different moulding technologies in the German automobile industry for the year 2005

Translations:
Fließpressen = Compression moulding
Duroplastisches Formpressen = Duroplastic press moulding
Spritzgießen = Injection moulding
Thermoplastisches Formpressen = Thermoplastic press moulding
ohne Holz und Baumwolle = Excluding wood and cotton
rein thermoplastische Verfahren = only thermoplastic processes

The study was not able to accurately determine the quantity of wood and cotton fibres being used in the German automotive industry. This was due to the reluctance of the large wood fibre and wood flour manufacturers to participate in the study. In 2003, it was estimated that 25,000 tons of wood fibre were being used and 36,000 tons of wood fibre composites. The estimates for 2005 are 27,000 tons of wood fibre and 40,000 tons of wood fibre composites. The key application field is in duroplastic matrixes.

Figure 4 demonstrates the fraction of natural fibres in different production processes for the manufacture of automotive composites. As expected, industrial wood fibre composites contain the highest fibre content reaching 85%. For other fibres, the average fibre content is about 55% of the final composite. Figure 4 also shows the range of fibre content that is industrially used in composites: For thermoplastic components, the content varies from 30 to 65%. The study revealed that the fibre content in thermoplastic composites is higher than expected: 46% vs. 30-40%. For all processes the fibre content averages at 51.5%.
Figure 4: Natural fibre content in different production processes for composites in the German automobile industry for the year 2005

Translations:
Naturfasern thermoplastisch = Natural fibre content in thermoplastics
Naturfasern duroplastisch = Natural fibre content in duroplastics
Holzfasern duroplastisch = Wood fibre content in duroplastics
*ohne Holz und Baumwolle = Excluding wood and cotton

Figure 5: Natural fibre reinforced composites in the German automotive sector 1999-2005
Translations:
Menge (t) = Quantity (tons)
Thermoplastisch = thermoplastics
Duroplastisch = duroplastics
*ohne Holz und Baumwolle = Excluding wood and cotton

Figure 5 presents the use of natural fibres in duroplastic and thermoplastic process in the German automobile industry. Since 1999, the portion used in thermoplastic composites steadily increased until 2002, but has remained constant in the last 3 years.

Natural fibre content per automobile
Based on the number of cars manufactured in Germany (see Verband der Automobilindustrie, www.vda.de), which was 5.2 million in 2004 and 5.4 million in 2005, it is possible to calculate that the average car contains 3.6 kg natural fibre per car. This reflects a slight increase from the 2003 value of 3.5 kg natural fibre per car.

Natural fibre applications in sectors other than the automobile industry
Car parts manufacturers were also asked if they produced composites for other markets. In most cases, the answers were affirmative and this totalled an additional 150 tons. This value predominantly represents PP-NF (polypropylene-natural fibre) granulates for injection moulding.

Perspectives for the Future
No clear trend is observable in the use of natural fibre composites. The predictions of the automotive industry diverge considerably: with some saying that the peak has been reached and use is on a decline, whereas others see a market stabilization with modest growth for certain applications.

It is difficult to predict which materials that OEMs and tier-1 suppliers will use. Dependent on the car model, arguments can be presented that are both pro and contra natural fibre composites. Currently, natural fibre press moulding is in a period of stagnation, whereas natural fibre compression moulding and PP-NF injection moulding are growing, albeit from a small starting volume.

The situation for new materials has changed considerably in the past years. The enormous pressure on prices since 2004, where quality is sometimes sacrificed to reduce costs, has made it very difficult to introduce new materials and processes. Car parts suppliers prefer to increase productivity of existing manufacturing lines rather than invest in new ones. New materials must be both better and cheaper, which is next to impossible to achieve.

From an economic point of view, natural fibres and wood fibres have excellent price stability and are less dependent on oil prices than other materials. If overall CO₂-emissions were to be penalised, further economic benefits would be created.
Press Moulding

Natural fibre press moulding is an established and reliable process for the production of large, light and high-value interior car panels in the mid to high price car segment. Advantages and disadvantages are well known. Process optimisation is being carried out, especially for problem cases such as reducing stamping waste and the recycling of waste. With new one-shot press moulding, even soft finishes (surfaces) can be integrated, which is not yet possible for injection moulding.

For economical door concepts with a high component integration (including the elimination of a laminate), natural fibre press moulding has a poor chance in comparison to natural fibre injection moulding. On the other hand, for high value door concepts, natural fibre press moulding is the best choice. In the light of this fact, it is hard to see why natural fibre press moulding is stagnating in the German automobile industry. A limiting factor for further market penetration has to do with the fact that there are few natural fibre press moulding machine manufacturers and few natural fibre mat producers. These manufacturers require specialised technologies and can make the car parts manufacturer dependent on a single source. Tier-1 suppliers prefer to increase capacity and productivity on their existing injection moulding lines. Under strong price pressure, this can be a disadvantage for natural fibre press moulding.

The future of natural fibre press moulding depends on a number of factors:

- Price of the process
- Car interior concepts
- Oil, polymer & glass fibre prices
- New developments in press moulding, other moulding technologies and materials.

Nova believes that natural fibre press moulding will continue to have a market. This market may not be in Europe. China, India and Iran have been installing large numbers of these machines, possibly because the current world prices for natural fibres are considered competitive.

Compression Moulding

Few companies are using this technology. Those that do use it are convinced of its technical and economic advantages.

PP-NF Injection Moulding

An assessment of this market is difficult. Some claim that it is technically inferior and expensive, whereas others see large growth rates and good market potential. Of interest are polymer composites (wood polymer composites – WPC) made from wood fibres and flour.

Natural fibre granulates and their processing are considered technically immature and too expensive. Another complaint is that no established, large supplier exists providing the required support. Once these problems are solved, this process would be
of considerable interest to OEMs and Tier-1 suppliers. With increasing oil and glass fibre prices, PP-NF granulates will attract more interest.

The differing assessments for NF-PP granulates can be traced back to the fact that a clear market overview is not available. Granulates from different manufacturers can vary in both their mechanical properties and their price by a factor of 2. In addition, the largest and best producers are not well known among their potential customer base.

**Political Framework**

An appropriate framework could assist the biomaterial markets considerably. For example, by rewarding reduced CO₂-emissions, a level playing field would be created, as the manufacture of glass fibres requires about 10 times as much fossil energy as natural fibres.

The EU car recycling legislation would also have a decisive impact on the market. For example, by offering recycling credits for the quantity of renewable resources used in a car. The renewable resources can be used in material applications or for energy. The justification is that incinerating renewable resources is for the most part carbon neutral. Although the current average is 3.6 kg natural fibres per car, some models contain 20-30 kg per car and can be, according to the model, appropriately credited.* The reworking of the car recycling legislation in Brussels would cost little but have an enormous influence.

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* This refers to the fact that the larger German cars emit much more CO₂ per km than their smaller Italian and French rivals. Instead of forcing German car manufacturers to build smaller cars that emit less, the *nova Institute* is recommending offsetting the high emissions through the use of renewable resources in the manufacturing process. -Steffen