Light-Fibrous Cars Made of Coconut and Rhubarb Juice, Recyclable Mobile Phones and Computers

Hemp, Flax and Kenaf Give Plastics Serious Competition. Natural fibres are fashionable – and not just in the wardrobe: it is a long time now since compostable automotive components and computer casings were utopian pipe dreams. Hemp, flax and other natural fibres that once fell into neglect are enjoying a comeback in the high-tech laboratory. Above all, the automotive industry is interested in the new biomaterials, because cars should be decomposable or recyclable by 2006. Furthermore, light-fibrous materials are also replacing conventional glass-fibre-reinforced plastics (GRPs) in other sectors – from construction to the computer industry –– so benefiting the environment.

They look like plastic, they feel like plastic, they are just as hard-wearing, difficult to break and stable. But: they are produced on a natural basis and compost easily, because these light, environmentally friendly materials consist almost completely of straw and hemp. Analyses of plant tissues gave scientists the idea of using plant stalks as models for the optimisation of composite materials consisting of plant fibres and plastic matrixes, enabling them to stand up to even high levels of mechanical stress and constant vibrations. Today, natural-fibre-reinforced plastics (NFRPs) are no longer low-tech products that industry uses when it is trying to give itself a green veneer. These old-new biomaterials are on the verge of application in series production.

Environmentally friendly, high-tech fibres

Hemp, flax, coconut and sisal are used to produce more than just cords, lamp wicks, filters and carpets. They are combined with natural resins to make, for example, computer casings, office furniture, and parcel shelves and interior panels for cars. Even though they are a bit more expensive than conventional synthetic products, they are unbeatable in one respect: Regardless of whether they are disposed of on a compost heap or in a waste incinerator, the amount of CO2 released is the same as that absorbed from the atmosphere during growth – a closed material and energy cycle.

The natural-fibre renaissance

The two most important commercial fibrous plants in northern Europe, hemp and flax, have not had an easy time in the past. Displaced by cotton, synthetic fibres and other practical, versatile, durable plastics, the cultivation of hemp and blue-flowering flax came to a standstill. Finally, parliament banned hemp cultivation in Germany to prevent hashish and marihuana being made from the female flowers. A real hemp boom broke out when this ban was relaxed in 1996. Since then, Germany and the EU have made great efforts to re-establish flax and hemp cultivation, and new varieties, cultivation and harvesting techniques, pulping

methods, process chains and markets are being developed. For renewable resources have enormous ecological and economic potential – as has become clear

at the latest since we came to understand the finite nature of fossil resources and the implications of dependence on imports in times of crisis. About 2000 hectares of fibrous plants are cultivated in Germany today (German Federal Ministry of Consumer Protection, Food and Agriculture). Hemp has the greatest significance in this part of the world, followed by flax (linen), as well as kenaf and ramie in southern Germany. According to a survey by the German Natural-Fibre Association (DNV), the indications are that the area of land being cultivated with hemp and flax will increase by 15 to 20 percent in 2003. Agriculture, biotechnology, genetic engineering and plant breeding will have to contribute equally if the requirements of the processing and chemicals industries are to be satisfied. According to a study by the German Renewable Resources Agency (FNR), several tens of millions of deutschmarks were invested in projects of this kind across Germany during the 1980s and 1990s.

On the tracks of Henry Ford

Despite the relatively weak performance of the car market in 2001 and 2002, the use of "strong plants" is booming, above all in the automotive industry. About 60 years ago, the US car manufacturer Henry Ford presented a car that was "grown from the soil". It ran on hemp oil, it was built of wood fibres, hemp, sisal and wheat straw, and its body was lighter than steel, yet capable of bearing 10 times more strain. The industry is now returning to this idea, and there are corresponding proposals for the agricultural sector to function as a materials supplier for the "mobility technology industry". Demand from the car industry, currently running at about 25,000 tonnes of natural-fibre products per annum (FNR), could be met with the yield from 12,500 hectares of land. But the potential is regarded as far from being exhausted, and the expectation is that up to 34,000 tonnes of composite natural-fibre materials will be incorporated into cars by 2005 just in Germany and Austria (nova-Institute 2005). For farmers, this opens a new area of work, encouraging them to move away from the overproduction of foodstuffs and set-aside schemes towards the supply of designer crops for industrial materials.

Luxury saloons made of coconut and rhubarb juice

Biomaterials made of hemp, flax, sisal and the US newcomer kenaf are found in parcel shelves, steering column panels, boot linings and underbody panelling. Audi uses hemp for interior door panels and tans the fine leather for the seats of its A 8 with rhubarb juices, while Volkswagen makes parcel shelves out of oilseed flax straw. Up to 10 kg of natural fibres are used in a Mercedes, and vehicles produced in Brazil contain up to 30 kg: three coconuts for the headrest, 14 for the seat back and 10 for the seat cushion. With 16 million vehicles produced in Western Europe

every year, the use of just 5-10 kg of natural fibres in each car implies a potential market volume of 80,000-160,000 tonnes of natural fibres for compression-moulded parts.

Less weight means lower fuel consumption – a healthy ecobalance!

The same strict quality standards apply to natural products as to synthetically produced materials. Two production procedures are used – in many cases on an industrial scale. Thermoplastic matrixes are made by mixing natural fibres with polypropylene fibres and processing them into a fibrous mat, which is heated and compression moulded into the desired shape. Composite matrixes are made of natural-fibre mats combined with duroplastics (e.g. epoxy resins or polyurethane), formed into the desired shape and hardened. For example, mixing natural fibres with lignin, millions of tonnes of which are produced annually as a by-product of the paper industry, gives a thermoplastic material that can replace plastics produced from mineral oil in many applications. Light NFRPs are helping manufacturers to achieve considerable reductions in the weight and fuel consumption of road vehicles, railway locomotives and aeroplanes, so improving their ecobalances.

Over the long term, the advantages of renewable resources could contribute to the solution of economically, environmentally and socially relevant problems, and their use as energy sources and materials could drive forward the development of the balanced form of economy that is the aim of "sustainable development" and Agenda 21. However, without public assistance, many products made of renewable raw materials are not – in economic terms – competitive, as their manufacturing costs are far above those of conventionally produced goods. Nevertheless, the market-introduction programme for insulating materials produced from renewable resources run by the German Federal Ministry of Consumer Protection, Food and Agriculture gives cause for hope.

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