

Trends and Developments of Bamboo Fiber Composites for Developing Automotive Interiors

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Abstract

With the continuous progress of the development of the automobile industry, people pay more attention to the transformation of their lifestyles. In today's society requiring sustainable development and the concept of energy conservation and environmental protection, the lightweight of automobiles and the recycling of resources will inevitably become the trend of the world's automobile development. This paper reviews the current status of the development of automotive interiors with bamboo fiber composites, combs the innovation trend of bamboo fiber composites, and looks forward to the development direction of its related research.

Keywords

Bamboo fiber composite; Automotive interior; Light weight; Environmental friendly.

1. Introduction

Due to the rapid development of the automobile industry at home and abroad, people often hope to have a higher sense of experience and interaction with modern automobiles, so the design of automobile interiors is a very important part of vehicle development. People not only want to experience a variety of different design qualities, but also pay more attention to the air quality in the car and the concept of environmental protection, which requires in-depth research and innovative use of various materials for car interiors^[1]. The use of composite fiber products instead of metal products has always been an important means of lightening automobiles. It can not only reduce the fuel consumption of the whole vehicle and achieve the purpose of saving energy, but also reduce the emission of automobile exhaust gas, thereby reducing pollution^[2]. At present, bamboo and wood fiber composite materials are widely used in the interior and exterior of automobiles. Bamboo and wood materials are natural materials. Although they have no advantages in processing performance, they are superior to current thermoplastic materials in terms of recyclability, environmental protection and pleasantness. Therefore, speeding up the research on the application and development of bamboo and wood materials in automobile interiors, seeking a balance between technology and cost, and bringing out the characteristics of bamboo and wood materials as much as possible are our main research purposes.

2. Advances in Bamboo Fiber Composites in Automotive Interiors

2.1. The history of traditional car interiors

The form of the product is a product derived from the development of the times. In the early days of automobiles, when the industrial level was low, most car interiors were made of natural materials, mostly leather or solid wood, and artificial composite materials were scarce, so the result was very expensive cars. With the development of industry, artificial composite materials have gradually emerged, and their low prices and simple forming processes have replaced the status of natural materials, and gradually moved into the public's attention. Among them,

plastic material is the most widely used material, and is widely used in the interior of modern automobiles. Common plastics fall into four broad categories: Soft Polyurethane (PU), Polyvinyl chloride (PVC), Acrylonitrile butadiene Styrene copolymers (ABS), polypropylene (PP). According to the molecular structure and thermal properties of the resin, plastics are also divided into thermoplastics and thermosetting plastics. Most of the automotive interiors are thermoplastics, as well as non-woven polymers such as nylon fabrics and artificial leather. In recent years, new composite materials of carbon fiber and bamboo fiber have come to the attention of the public. Carbon fiber is a high-strength and high-modulus fiber, but because of its high cost, it is often used in advanced sports cars and aviation. Then, the composite material of bamboo fiber has become the object of new research.

2.2. Characteristics of Bamboo Fiber

Bamboo fiber refers to natural bamboo fibrils, which are natural fibers directly separated from bamboo and wood by mechanical and physical methods. It is a new type of plant fiber, which is different from chemical viscose regenerated cellulose fibers such as bamboo pulp fibers and bamboo charcoal fibers. It is the fifth largest natural fiber after cotton, hemp, silk and wool^[3]. The fiber adopts tertiary filament and secondary carding, and the obtained bamboo fiber density is low, so the fiber separation degree is the highest^[4], The fiber diameter after degumming treatment is only nearly 1/5 of that before treatment, the fiber length and diameter are 4 times longer than those before treatment, and the tensile strength is increased by nearly 27 times^[5]. Bamboo fiber has excellent product functions, and its preparation performance characteristics are: high strength, good toughness, light weight, deodorant and antibacterial, anti-ultraviolet, sound absorption and heat insulation, etc. It is not only economical, but also environmentally friendly and resource recycling. With the improvement of people's life, the availability of bamboo fiber will be higher and higher.

3. Innovations in Bamboo Fiber Composites

3.1. Development of Bamboo Fiber/Polypropylene Fiber Composites

At present, the main research and development is based on bamboo fiber/polypropylene fiber material as the main composite material. This kind of composite material is to use the high strength and high toughness of bamboo fiber to strengthen the polypropylene material. Through the composite to enhance its strength and modulus, it is suitable for the manufacture of high-strength automotive interior parts, and it is easy to process^[6]. Based on the existing domestic research results, using the advantages of abundant domestic bamboo resources to carry out research on high-performance bamboo fiber composite materials can not only transform traditional agriculture, forestry and crafts, but also promote environmental protection and resource recovery and reuse. This will be the future development trend.

3.2. Development of Bamboo Plastic Composites

Fiber-reinforced composite material is a new type of structural material. It uses bamboo fiber with good mechanical properties to composite with plastic, so that the composite product has higher strength and specific stiffness than the previous two materials. Lighter weight, better corrosion resistance, higher temperature resistance, better environmental protection and better resource recycling. Combining bamboo fiber and plastic, on the premise of improving the utilization of bamboo, also reduces the use of plastic, making it more environmentally friendly and improving economic benefits.

4. Application of Bamboo Fiber Composites in Automotive Interiors

With the continuous enhancement of human environmental awareness, bamboo fiber composite materials will play a more important role in the field of automotive interiors. In recent years, a number of automotive bamboo fiber composite materials have been developed and applied around the world. Products that have been developed include interior trim panels, coat racks, seat back panels, ceilings, and instrument panels^[7].



Fig 1. Bamboo fiber automotive interior steering wheel and



Fig 2. Bamboo fiber composite reinforced wind blade for power

A typical example is the bamboo interior used in a car of a certain brand. As shown in Figure 1, it has produced a car steering wheel mainly made of bamboo fiber material. The high-temperature steam box is subjected to high-temperature treatment, and after manual sterilization, the bamboo sheets are laminated layer by layer by mechanical and physical methods, and finally become a formed product after viscose and sanding polishing. The bamboo fiber steering wheel produced by this production process exudes a unique aesthetic feeling, which does not rely on the natural pattern of precious wood, but is a new design trend formed by ingenious artificial processing. This technology can also be applied to the production of baseplates, seats, etc., and the appearance is more satisfying to the aesthetic requirements of modern people. Economically, compared with precious woods such as solid wood, it is also quite economical. After the large-scale application of these bamboo fiber materials, it can bring people a more comfortable interactive experience^[8-9]. New bamboo fiber composite materials are widely used in various industrial fields. As shown in Figure 2, bamboo fiber is used as the main structural reinforcing material on the wind turbine blade. The wind turbine blade manufactured by the high strength, high modulus and light weight of bamboo fiber not only improves its own strength and stiffness, but also improves the on the premise of reducing its own weight, higher efficiency power generation improves its own economic benefits. Such applications also widely exist in other fields.

5. Innovation Trends and Prospects of Bamboo Fiber Composites

The development of bamboo fiber composite materials will be in the direction of lightweight, electrification and intelligence with the requirements of the times. According to relevant data, in 2010, the total application of natural fiber reinforced composite materials in the German automobile industry reached 200,000 tons, and the natural fiber reinforced composite materials used in each car reached 17 kg. The annual consumption of materials is about 1.6 million tons^[10], Among them, China consumes about 460,000 tons, and the United States consumes about 300,000 tons. Bamboo fiber composite material is a lightweight material in the automotive field, and will inevitably become the trend of the future development of the

automotive industry. In foreign countries, in-depth research on natural fiber composite materials has yielded results. For example, the load-bearing floor of the trunk of a certain brand's first all-electric vehicle, Focus Electric, is reinforced with coir fiber. Body parts made of natural fiber composites used in a brand 718 Cayman GT4 Clubsport, its two doors and rear wing are made of a blend of organic fibers derived from agricultural by-products flax and hemp fibers, which are similar in weight and rigidity carbon fiber.

At present, the main problems faced by domestic research are: the latest synthesis technology of composite materials, the optimization of the manufacturing process of finished products, and the way of thinking for environmental protection and economy. These problems need to be overcome. In recent years, some domestic bamboo fiber companies have jointly tackled key problems with universities and scientific research institutes, broke through the technical bottleneck, and adopted a special unidirectional continuous process for production. The fibers in the material are evenly dispersed and the interface is excellent. When used as an engine peripheral material, it can achieve a high retention rate of mechanical properties under long-term heat-resistant conditions; when used as an automotive interior material, it has the characteristics of no VOC and low emission, and is widely used in automotive roofs, front-end frames, replacement parts It has promoted the research and development of bamboo fiber composite materials. The second is that we optimize the current process and use the optimal needle punching process and drying and cold pressing process to prepare composite sheets^[11]. By adjusting the fiber content and the needle punching density, the distribution between the fibers of the needled felt is more uniform, the tensile properties and bending properties are improved, and the safety and flame retardancy can also meet the standards, and some automobiles based on new materials can be manufactured. Coat racks or storage boxes and other car interior parts. Among them, the bamboo fiber composite material has the characteristics of natural degradability, low density, high strength, low cost and wear resistance^[12-13], and in line with environmental protection, recycling availability, economical sustainable development. The third is that we must popularize the public concept of environmental protection, economy and intelligence, and convey the new properties and new policies of new materials to the general public. Only after being accepted by the public will it be conducive to the development of new bamboo fiber composite materials.

6. Summary

With the development of the times and the continuous advancement of process technology, the automobile industry is bound to move in the direction of lightweight, electrification and environmental protection. Today, bamboo and hemp fiber composite materials are the main materials, and new design concepts and industrial quality management systems have been introduced to enhance and improve the mechanical properties, chemical properties and physical properties of existing conventional materials to a certain extent, and can solve the problem of resource recycling and utilization. and the future development of environmental protection. Therefore, bamboo fiber reinforced composite materials, as a new type of material in the interior and exterior of automobiles, will definitely become the development trend of the industry in the future, leading the trend of new automobile materials.

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