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Explore the Influence of Plant Fiber Reinforced Composites on Green Low-Carbon Cycle System

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Abstract: ***The first step for Yiyang City to follow the national pace and establish a sound green and low-carbon circular development economic system is to promote industrial transformation and upgrading. The most important step in the transformation is the production link of the economic system. The production process is embodied in upgrading materials, reducing resource consumption, realizing lightweight and recycling of materials, and realizing green and low-carbon recycling. Based on this, taking plant fibre-reinforced composites as an example, this paper focuses on its ageing mechanism and how to reduce resource consumption and pollution emissions, realize the lightweight and recycling of the manufacturing industry, and establish a green, efficient and low-carbon economic system, energy system and resource utilization system.***
Keywords: green low-carbon cycle, Yiyang, production links, plant fibre-reinforced composites

I. INTRODUCTION

On March 5, 2023, the Central Committee of the Communist Party of China Li Keqiang, Premier of the State Council of the People's Republic of China pointed out in his government work report that in the past five years, we have strengthened the ecological environment protection and promoted green and low-carbon development. "Lucid waters and lush mountains are invaluable assets", we should establish and improve the system of ecological civilization system, properly handle the relationship between ecological environment development and protection, and continuously improve the ability of sustainable development. Ecological priority and green development. Integrate ecological environmental protection into the whole process of economic and social development, and establish a green, efficient and low-carbon economic system, energy system and resource utilisation system. With the acceleration of industrialization and urbanization, Yiyang's economic development is bound to maintain a growth trend. At the same time, the carrying capacity of resources and the environment is gradually approaching the upper limit, the structural, root and trend pressures of ecological environmental protection have not been fundamentally alleviated, and the ecological environmental protection situation is still severe and complicated.

II. THE PRIMARY PROBLEM OF GREEN AND LOW-CARBON CIRCULAR DEVELOPMENT IN YIYANG CITY

Lv Zhichen and Hu Angang[1] put forward relevant suggestions on the path of building a modern economic system with green and low-carbon development in line with China's national conditions. The most important one is to strengthen the control of the green ecological cycle in operation from the aspects of production, distribution, exchange and consumption of the economic system, so as to lay a solid foundation for building a modern economic system with green and low-carbon cycle development; In the production process, it is embodied in optimizing and upgrading materials, reducing their consumption, prolonging life, improving utilization rate, reducing environmental pollution, and realizing material lightweight and resource utilization.

The first step to strengthen the source management and promote the development of green and low-carbon cycle in Yiyang City is to promote industrial transformation and upgrading. Accelerate the construction of a green manufacturing system, focus on the construction of ten emerging advantageous industrial chains, take the central city as the core pole, and take Yuanjiang City, Nanxian County, Datong Lake District, Taojiang County and Anhua County as the expansion, optimize the spatial layout of industrial development, and form a multipolar development pattern in which the central city drives development and the lakes and mountains develop rapidly. The central city will focus on developing industries such as equipment manufacturing, auto parts and new materials. What is closely related to the manufacturing industry is high-performance composite materials. One of the most widely used representatives of high performance composites is plant fiber reinforced composites. As an important member of high-performance materials, it has been widely used in aerospace, civil engineering, automobile industry, wind power generation and other industries since its birth, such as the ceiling and luggage rack of aircraft; Automobile seats, bumpers, decorative panels, instrument panels, etc.; Insulation board in civil engineering, etc.

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Plant fiber reinforced composites have the advantages of easily available materials, wide sources, high modulus, high strength, low density, high temperature resistance, corrosion resistance and many forms. With the large-scale application of fiber-reinforced polymer composites, its characteristics of easy water absorption and aging and difficult recycling and degradation of wastes have aggravated the ecological problems in China.

III. A NEW PATH TO PROMOTE THE DEVELOPMENT OF GREEN LOW-CARBON CYCLE-TAKING PLANT FIBRE REINFORCED COMPOSITES AS AN EXAMPLE, GREEN LOW-CARBON CYCLE TREATMENT

Green, low-carbon and circular treatment is to meet the inevitable needs of the people for the development of ecological civilization. With the popularization of the concept of environmental protection and the requirements of green and low-carbon life, plant fibre, as the reinforcement of composite materials, has become a new research direction in the field of new materials. As a new green material, plant fibre has the incomparable advantages of traditional synthetic fibres (such as carbon fibre, glass fibre, aramid fibre, etc.), and plant fibre is convenient to source, widely sourced, green and environmentally friendly, low energy consumption, low cost, renewable, and degradable[2,3], not only that, high strength, high modulus and low density make it have a high-performance ratio, and has good sound absorption effect[4], good thermal insulation performance[5] and significant damping effect[6], Plant fibre reinforced composites have gained more and more attention for their excellent properties.

Although the attention of plant fiber reinforced composites is very high, there are still some serious problems in the realization of green and low-carbon recycling of plant fiber reinforced composites. For example, the weak interfacial adhesion between plant fibers and polymers and their high water absorption properties greatly limit the wide range of use of such composites. In a hot and humid environment, the material will age and its mechanical properties will be reduced.

A. Water Absorption and Diffusion Mechanism of Plant Fiber Reinforced Composites

Natural plant fibers are composed of cellulose, hemicellulose, lignin, pectin, and wax[7]. Among them, cellulose is the most important component, and the hydrophilicity of hydroxyl, hemicellulose and pectin of cellulose makes plant fibers also have hydrophilic properties, while the polymer matrix is mostly hydrophobic, and the interface bonding performance of the two is poor, which leads to the deterioration of the interfacial adhesion and mechanical properties of the reinforced composites, and the interface of the plant fiber reinforced composites plays an important role in stress transmission. Therefore, the research and understanding of the material interface is helpful to improve the mechanical properties of plant fiber reinforced composites, improve the recycling of materials, so as to save resources, avoid waste, protect the ecological environment, and promote the further development of the green and low-carbon circular economy system in Yiyang City.

Plant fiber-reinforced composites have tubular cavities inside, and when in contact with liquids, the internal cavities of the materials absorb water, resulting in an increase in the mass of the material, which is called hygroscopicity[8]. Water absorption is the quality of water absorbed by a material per unit mass, indicating the degree of moisture absorption. Due to its special internal structure and hydrophilicity, plant fibers are easy to absorb water and have high water absorption in humid environments and even when soaked in water. The specific mechanism is as follows[9-11]:(1) When water infiltrates into the matrix, the spacing between the polymer chains is large, and the matrix swells, resulting in plasticization; (2) With the increase of temperature, the movement of water molecules is intensified, the intermolecular force is weakened, and the molecular voids are increased, so that the ability of the matrix to absorb water is enhanced, and the moisture absorption rate and saturated moisture absorption of the material are significantly increased, thereby accelerating the aging of plant fibers. (3) On the other hand, the diffusion of water to the matrix will form osmotic pressure, which will cause new cracks or microcracks to occur inside the matrix, and the diffusion of cracks will further increase the moisture absorption of the body until the matrix ruptures; (4) At high temperature, the hydroxyl polar group forms hydrogen bonds with water molecules, and the hydrolysis reaction with the hydrophilic group in the matrix occurs, resulting in chain breakage.

B. Changes in Mechanical Properties of plant fibre-reinforced Composites after Water Absorption and Ageing

Plant fibre-reinforced composites are inevitably in the natural environment, and the material will reduce the mechanical properties of the material after water absorption and ageing, and in serious cases, the material will fail. Wang[12] investigated the effects of natural and accelerated ageing on the flexural properties of plant fibre-reinforced composites. The ageing mechanism of natural ageing and artificial accelerated ageing is different. Damp heat ageing will reduce the adhesion of the fibre and matrix interface, which will reduce the mechanical properties of the composite.

At the same time, the material is also exposed to harsh environments for a long time, such as ultraviolet light irradiation and acid and alkali salt erosion, which will affect the damp heat ageing behavior of plant fibre reinforced composites, and further affect their mechanical properties. Therefore, different schemes are used in advance to improve plant fiber-reinforced composites, such as: chemical, physical or biological methods to improve and enhance plant fibres, reduce water absorption, and improve interface properties; In addition, the improvement and promotion of polymers can also effectively improve the mechanical, thermal and electrical properties of plant fibre reinforced composites. It provides support for plant fiber reinforced composites to adapt to more engineering applications, and makes important contributions to the development of green, low-carbon and circular economy.

IV. CONCLUSIONS

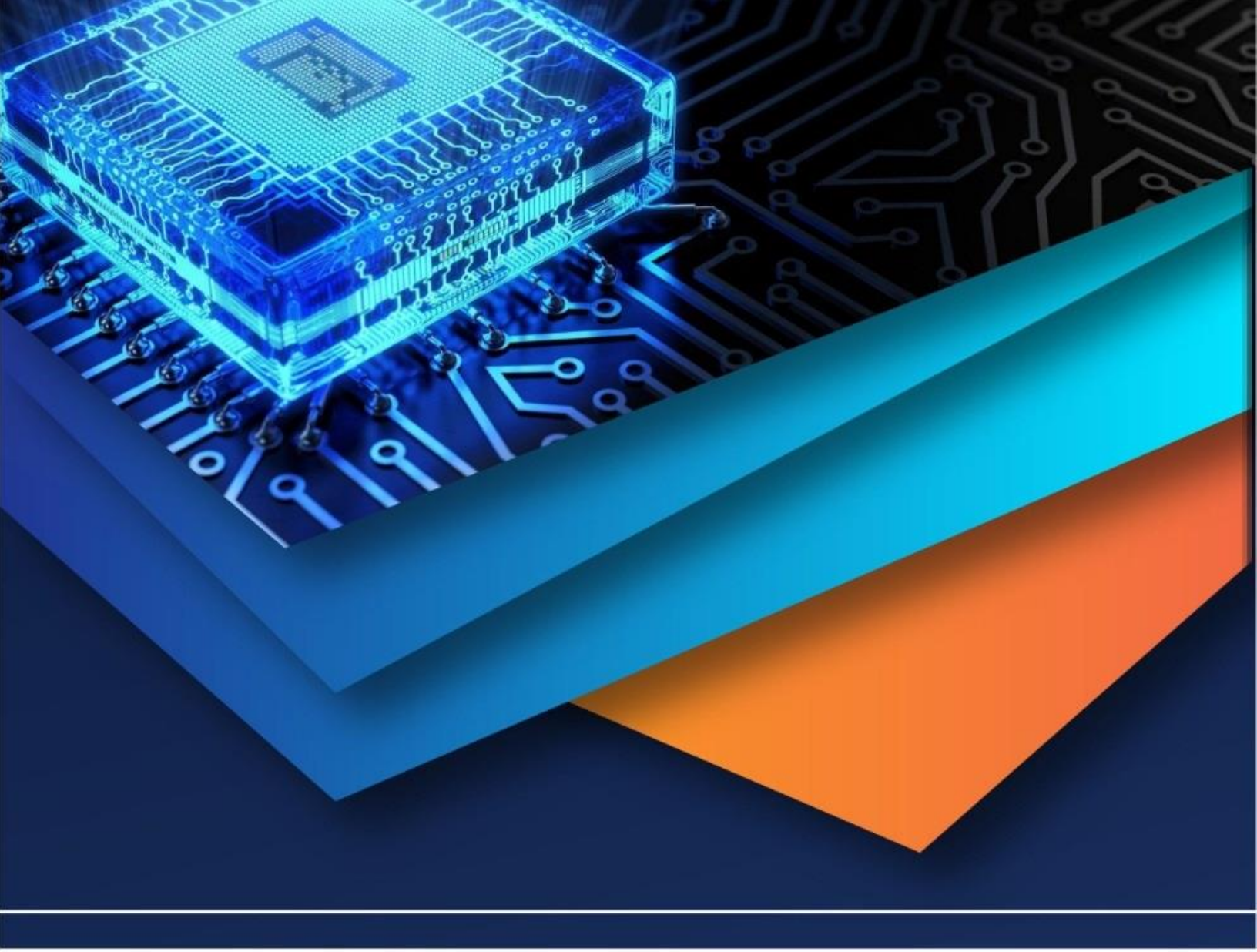
China predicts that by 2035, a green, low-carbon and circular development economic system will be built in an all-round way, and Yiyang City will keep up with the pace, focus on the construction of ecological civilization on a green, low-carbon and circular economic system, comprehensively move towards the realization of the dual carbon goal, form a green and low-carbon production and lifestyle with Yiyang characteristics, vigorously promote the green transformation of economic development, and make efforts to protect and beautify the ecological environment. As an important part of economic transformation, industrial transformation and upgrading are imminent. The research on the aging of plant fiber reinforced composites can effectively reduce energy consumption, reduce pollution emissions, and realize reduction and resource utilization in the production process, which plays an important role in the green and low-carbon circular economy system of Yiyang City.

In view of the fact that there are many research methods for the performance prediction of fiber reinforced composites at home and abroad, there is no unified standard, and the mesoscopic model for the prediction of the aging performance of plant fiber reinforced composites is still blank. Therefore, according to the specific market conditions of Yiyang City, this paper analyzes the principle of moisture absorption and the failure criterion of plant fiber reinforced composites, summarizes the influence of damp heat aging on the mechanical properties of plant fiber reinforced polymer composites, and discusses the damp heat durability of plant fiber reinforced polymer composites, which is of great significance for expanding its application and responding to the country's vigorous promotion of green and low-carbon circular development.

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