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Opinion

Perfect Combination of Natural Fiber and Geopolymer: A Green Building Composite Material

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Opinion

As is known to all, compared with cement-based materials, geopolymer is an environmentally friendly cementitious material with low energy consumption and less emission of pollutants in the production process. Geopolymers were synthesized by French scientist Davidovits in 1978. Geopolymer is a kind of inorganic polymer material, which has high early strength, fast hardening rate and wide raw material source. Geopolymer is an active low calcium silicon-aluminum material mixed with alkaline activator, which is formed by curing later. Geopolymer is a new type of inorganic silica-aluminum cementite with a three-dimensional network bonding structure similar to that of organic polymer. It has a three-dimensional network structure composed of SiO4 and AlO4 tetrahedral units. The synthesis of geopolymers requires active solid silicoaluminate and alkaline solutions containing alkali metals and silicates. The alkaline solution plays the role of binder, alkali activator and dispersant. Under strong alkaline condition, geological minerals were excited by alkali silicate solution to form polyaluminum silicate materials. Today, terrestrial polymers are successfully produced from industrial wastes such as fly ash, volcanic ash and finely ground blast furnace slag. The acid and alkali resistance of geopolymer is obviously better than Portland cement. However, as a new material, geopolymer mortar has low flexural strength and tensile strength. Geopolymer has poor toughness and is very sensitive to microcracks. In order to improve the brittleness of geopolymer mortar, using fiber reinforced composite material is an effective and simple method. Through fiber reinforcement, the fiber in geopolymer can limit the growth of crack and enhance the ductility, toughness and tensile strength of geopolymer mortar.

At present, the reinforcement fibers used in polymer composites mainly include metal fibers, inorganic fibers, synthetic fibers and natural fibers. Synthetic fibers such as Polyvinyl Alcohol (PVA) and Polypropylene (PP) are difficult to meet the requirements of sustainable development. Due to its natural abundance, low cost, light weight, rough surface, strong adhesion, simple manufacturing process and biodegradability, natural fiber has attracted a large number of scholars' attention. In particular, plant fiber, as one of the most abundant natural resources in the world, mainly includes agricultural residues such as straw, rice husk, crop straw, bagasse, shavings, wood chips, bamboo chips, etc. Cellulose fibers commonly used for geopolymer reinforcement include bast fiber, leaf fiber, stem fiber and so on. Bast fibers include hemp, flax, jute, ramie, Kemaf, Curaua and so on. Most bast fibers have a good strengthening and toughening effect on polymer composites. There are many kinds of leaf fibers, including bacoa fiber, pineapple leaf fiber, sisal fiber, canna fiber, agave fiber, urra fiber, etc. Sisal fiber reinforced polymer was studied more. In addition, this kind of fiber also includes cotton fiber, kapok fiber and other seed fibers. Agricultural waste straw mostly belongs to

stem fiber, such as rice, wheat, sorghum, bagasse and so on. These plant fibers are mainly composed of cellulose, hemicellulose, lignin, pectin, wax and some water-soluble materials.

Generally, fiber-reinforced polymer composites are composed of fiber and matrix. The contact surface between fiber and matrix forms an interface. The best properties of polymer composites can be achieved by using effective adhesion between fiber and matrix and optimizing the properties of interface layer between fiber and matrix. Improving the interfacial adhesion between fiber and polymer matrix is the most important factor in composite interfacial control technology. The forms of interfacial adhesion between fiber and matrix generally include mutual diffusion, electrostatic adhesion, chemical bonding and mechanical interlocking. Geopolymer can form an impermeable layer under the action of fiber, which makes the matrix structure of geopolymer more compact. The good adhesion between fiber and matrix can prevent crack propagation, resist freeze-thaw and infiltration erosion, and enhance the durability of geopolymer composites. It can be said that natural fiber reinforced polymer composites are green, environmentally friendly, and cheap. It is especially suitable for the development of buildings in rural areas and is a new development direction of composite materials in the future construction field.