Предложена возможность самовосстановления проницаемых кристаллических трещин, что повышает срок службы всего бетона на основе химической реакции, что не только продлевает срок службы, но и повышает прочность и компактность матричного бетона. Когда бетон высыхает, действующее вещество находится в состоянии покоя из-за отсутствия диффузионной среды; когда бетон трескается и вода просачивается, вещество реактивируется и продолжает катализировать новую реакцию кристаллизации, чтобы реализовать возможность самовосстановления трещин в бетоне.

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STUDY ON THE DEVELOPMENT OF NATURAL NON-METALLIC FIBERS WITH NANOFIBERS AND STEEL FIBERS IN CONCRETE

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Summary. *In recent years the application of fiber in concrete is more and more extensive, this paper for, plant fiber, nano-fiber, steel fiber to make a relevant comparison of the classification, and discusses the fiber in the concrete in the relevant problems, I hope to provide readers with relevant reference around.*

Fiber concrete, is a composite material consisting of a cement paste, mortar, or concrete as the matrix and metallic fibers, inorganic nonmetallic fibers, synthetic fibers, or natural organic fibers as the reinforcing material. Concrete with one type of fiber is called single-fiber concrete, and concrete with two or more kinds of fibers in the matrix or the same fiber in different scales or different shapes of types of fibers is called mixed-fiber concrete.

Cement and concrete products are high-strength, low-cost materials used in large quantities in construction and civil engineering. However, conventional cement concrete has defects and deficiencies in performance, such as: low tensile strength, when subjected to tensile stress, it is very easy to produce brittle damage

spalling or crushing; poor durability, in the face of the environment, chemical erosion, and other external factors, the concrete continues to expand the cracks will greatly undermine the durability of the structure and affect its service life. All these greatly limit the use of concrete and the expansion of new applications.

Since the middle of the 20th century, scientists in various countries have tried to improve the performance of concrete by adding fiber materials, and their efforts have been successful. Cement concrete reinforcing fibers mainly include glass fibers, steel fibers, asbestos fibers, nanofibers, other fiber materials are mainly natural fibers, including coconut fiber, reed fiber, straw fiber, etc., chemical fibers, such as polyolefin fibers, carbon fibers, aromatic polyamide fibers, and regenerated cellulose fibers. The performance of fiber-reinforced cement concrete, crack resistance, ultimate flexural strength, compressive strength, and toughness, depends on the mechanical properties of the fibers, ease of adhesion, dispersibility, and the number of additives in the fibers. This paper only briefly discusses the use of non-metallic fibers with nanofibers and steel fibers in concrete products.

The chemical composition of reed fiber is mainly cellulose, hemicellulose, lignin and ash. Generally speaking, the cellulose content of reed fiber is between 50–60 %, hemicellulose content is between 20–30 %, lignin content is between 10–20 %, ash content is between 5–10 %, length is between 0.9–1.1 mm, fineness is between 11–13 dtex, gloss is low, moisture absorption is high, thermal stability is poor, and resistivity is high [1].

Research on reed fiber concrete first originated in the early 21st century. Researchers began to explore and experimentally investigate the feasibility of reed fiber as a concrete reinforcement material. At this stage, the focus was on the effects of the extraction technology, fiber length and admixture of reed fibers on the performance of concrete.

The length of coir fibers is generally between 10–25 cm, with an average length of about 17.5 cm, with poor length uniformity and high dispersion. The fineness of coir fiber is coarse, the average fineness is about 275 microns, and the fiber longitudinal fineness uniformity is poor. Of the coir fiber, the bulk density is about 0.3 g/cm^3, and the porosity is about 80 %. The main component is cellulose, accounting for about 46–63 %, but also contains lignin, hemicellulose, pectin and other concomitants.The 1970s, when scholars began to focus on the potential of using plant fibers to strengthen concrete. After years of research and experimentation, coir fibers were found to be effective in improving the toughness, crack resistance and durability of concrete. Early studies focused on exploring the effects of coir fibers on concrete strength, crack resistance, and durability, and researchers found that coir fibers were effective in increasing the compressive strength, flexural strength, and impact strength of concrete. In addition, coir fibers have good resistance to penetration and carbonation.

The main component of nanofibers is related to its source, which can be different substances such as cellulose, carbon, metal, oxide, sulfide, etc. It is very small in fineness, generally between tens and hundreds of nanometers, and it can even reach the size of a single atom, and the density of nanofibers is related to its

constituent elements, which is generally between 1–2 g/cm³.Nanofiber concrete has good strength properties, can significantly improve the building load-bearing capacity, reduce the thickness of the building structure, save resources and reduce costs. In sustainable development, the development trend of NFC is highly favored because it can be prepared from waste materials, which is conducive to the recycling of resources and also helps to solve the problem of environmental pollution.

Steel fiber concrete is currently the most widely used in the field of engineering materials, the largest amount of research malefactor the most adequate kind of fiber concrete. Usually in the experiment usually use corrugated steel fiber, 40 mm long, 4 mm wide, 0.8 mm diameter, density 7.8 g/cm³; tensile strength greater than 1200 MPa, is a very good material to enhance the mechanical properties of concrete, usually add the proportion of 1 % – 1.5 %. Started in 1907, first metal fibers into the concrete used to enhance its performance until the 1970s, the United States Battelle company steel fiber melt pumping technology invention, greatly reducing the manufacturing cost of steel fibers, so that it is widely used in practical engineering.

And the current problems of fiber concrete are nonlinear distribution and durability. The problem of fiber distribution uniformity is a major research focus of fiber concrete. In fiber concrete, the distribution of fibers directly affects the mechanical properties and durability of concrete. Due to the physical properties of fibers and factors such as the viscosity and fluidity of concrete, the distribution of fibers in concrete often has the problem of inhomogeneity, which may lead to non-uniformity in the performance of concrete, or even cracks and other destructive patterns. Therefore, research and exploration of effective fiber dispersion methods and improvement of interfacial properties between concrete and fibers in order to improve the distribution of fibers in concrete and enhance the overall performance of metal-fiber concrete is an important issue at present.

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ПРИМЕНЕНИЕ АЛЬТЕРНАТИВНЫХ ИСТОЧНИКОВ ЭНЕРГИИ В СИЛОВЫХ УСТАНОВКАХ КАРЬЕРНЫХ САМОСВАЛОВ

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Summary. *The main types of fuel for use as alternative energy sources in power plants of heavy-duty mining dump trucks are considered. A promising option has been proposed for providing electricity to both heavy-duty mining dump trucks and, in general, such mining enterprises, especially in remote regions without*