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Research Progress of Green Intelligent Building Materials

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Abstract

Green building materials, also known as ecological building materials, environmental protection building materials and health building materials, refer to healthy, environmental protection and safety building materials, also known as "health building materials" or "environmental protection building materials" in the world. Green building materials do not refer to separate building materials products, but the evaluation of the "health, environmental protection and safety" of building materials. It pays attention to the impact of building materials on human health and environmental protection and safety and fire prevention performance. It has the properties of degaussing, silencing, dimming, temperature regulation, heat insulation, fire prevention and anti-static, and it is a special new functional building material for regulating human function.

Keywords

Green building materials; intelligent; Intelligent concrete; Intelligent emulsion paint; Smart glass.

1. Intelligent Concrete

1.1. Self Induced Concrete

Concrete material itself does not have self induction function, but the composite part of conductive phase in concrete substrate can make concrete have intrinsic self induction function. At present, the commonly used conductive components can be divided into three categories: polymer, carbon and metal, of which the most commonly used are carbon and metal. Carbon conductive components include graphite, carbon fiber and carbon black, while metal materials include metal micro powder, metal fiber, metal sheet, metal mesh, etc. The resistance change of carbon fiber cement-based composites corresponds to its internal structure change. For example, the reversible change of resistivity corresponds to reversible elastic deformation, while the irreversible change of resistivity corresponds to inelastic deformation and fracture. The application of this composite can sensitively and effectively monitor the internal situation of materials under tension, bending, compression and static and dynamic loads. Under fatigue load, the volume conductivity of carbon fiber reinforced concrete will decrease irreversibly with fatigue times. This phenomenon can be used to monitor the fatigue damage of concrete materials. By calibrating the self sensing concrete, the relationship between impedance and load can be obtained, so as to determine the parameters such as orientation, weight and speed of vehicles on the highway made of self sensing concrete, so as to provide a material basis for the intellectualization of traffic management.

However, due to the high modulus and low ultimate elongation of carbon fiber, carbon fiber reinforced cement-based composites have good agility in the elastic deformation stage, but it is difficult to effectively perceive the internal damage degree of the material in the inelastic stage. In this regard, some studies have used special technology to coat a layer of carbon on the surface

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of nylon fiber to make nylon fiber conductive, and then composite it into concrete. This composite can effectively perceive its internal conditions in elastic and inelastic stages.

1.2. Self Regulating Concrete

It is hoped that the concrete structure can adjust the bearing capacity and reduce the structural vibration during natural disasters such as typhoon and earthquake in addition to normal load. Concrete itself is an inert material. In order to achieve the purpose of self-regulation, component materials with driving function must be composite. In the early 1990s, the Institute of architecture of the Ministry of construction of Japan cooperated with the National Science Foundation of the United States to develop self-adjusting concrete with adjustable building structure bearing capacity. The basic method is to embed shape memory alloy in concrete, make use of the sensitivity of shape memory alloy to temperature and the characteristics of restoring corresponding shape at different temperatures, and redistribute the internal stress of concrete and produce certain prestress through the change of shape memory alloy under the interference of abnormal load, so as to improve the bearing capacity of concrete structure.

In order to achieve stable humidity control for some special buildings, such as various exhibition halls, museums and art galleries, many humidity sensors, control systems and complex wiring are often required, and their cost and use and maintenance cost are high. The concrete material developed by Japanese scholars to automatically adjust the environmental humidity can detect the indoor environmental humidity by itself and adjust it according to needs. The key component that brings the function of automatically adjusting environmental humidity to concrete materials is zeolite powder. The silicalite in zeolite powder contains pores that can selectively adsorb water, NOx and SOX gases. Through the selection of zeolite types, concrete composites that can automatically adjust the environmental humidity can be prepared according to the actual needs. This material has been successfully used in the indoor walls of many art galleries and achieved very good results.

1.3. Self Repairing Concrete

Self repairing concrete is a new type of composite material, which imitates the bone tissue structure of animals and the regeneration and recovery mechanism after trauma, adopts the composite method of bonding material and matrix lining, has the function of self healing and regeneration of material damage, and can restore or even improve the properties of materials. Japanese scholars add the hollow capsule containing adhesive into the concrete material. Once the concrete material cracks under the action of external force, the hollow capsule will break and release the adhesive, and the adhesive flows to the crack to re bond it, which has the effect of callus; The University of Illinois adopted a similar method to prepare self-healing concrete in 1994. The difference is that glass hollow fiber is used to replace hollow capsule, and acetal polymer solution is injected into it as adhesive.

Strictly speaking, intelligent concrete is a multifunctional material with the characteristics of self sensing and memory, self adaptation and self repair. However, with the current level of science and technology, it is still quite difficult to prepare intelligent concrete with perfect functions. The above intelligent concrete only has some characteristics of intelligent concrete and is a simplified form of intelligent concrete. Therefore, it is also called "smart concrete".

2. Intelligent Emulsion Paint

On the basis of weather resistance, waterproof, mildew proof, antifreeze and brushing resistance, the intelligent paint can also change the luster and brightness of the wall according to the strength of indoor and outdoor light, play the role of daylighting in the greenhouse, and solve the problem of poor indoor light. The emulsion paint mainly uses the invented "inverse variable light agent" and "composite polymer stabilizer" to make the product intelligent. For

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the automatic adjustment of gloss, the emulsion paint uses a special "reverse variable gloss agent" and cooperates with the film-forming agent of American Eastman Kodak "Texanol", which can automatically adjust the brightness under light conditions, so as to "become dumb when the light is strong and mercerized when the light is weak". The refraction of light presents invertible characteristics, making human vision more natural and comfortable. As for automatic adaptation to the environment, a special "composite polymer stabilizer" is used to cooperate with the additives of Angus company of the United States and Thor company of the United Kingdom, so that the product can be automatically activated in different environments, stabilize the molecular structure of the product, and automatically adjust and adapt to different environmental states.

3. Smart Glass

In the 21st century, ecological building glass with various functional characteristics such as daylighting, dimming, photocatalysis, focusing, light storage, photoelectric conversion and thermoelectric conversion will play an important role in the effective utilization of solar energy, improving the current energy structure, preventing greenhouse effect, saving energy and creating a comfortable living space for human beings, and become the main body of building glass materials. Moreover, most photoelectric functional glasses may be used in smart windows on the premise of reducing their manufacturing cost. Such as glass optical fiber, photochromic glass, electrochromic glass, frequency up conversion glass, fluorescent concentrating glass, etc. Once these glasses are used in building glass, they may change the traditional building glass industry. For example, a layer of reversible thermotropic material sandwiched between two layers of colorless and transparent glass can obtain a smart glass that can automatically change color according to light intensity. At present, inorganic, organic, liquid crystal, polymer and macromolecule materials have been developed. The blend solution of polystyrene and oxidized polypropylene is a reversible thermotropic material. When the temperature is low, they can simultaneously dissolve in water (i.e. have compatibility). When the temperature is higher than its "on-off" temperature, their compatibility disappears, and the polymer is insoluble in water and precipitates. When the glass made of the material is irradiated by strong light, part of the light energy is converted into heat energy, resulting in precipitation of the copolymer, and the color becomes turbid white, so that part of the light is diffusely scattered, so as to weaken the intensity of sunlight entering the room.

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