Research on Green Building Materials in Civil Engineering Management System

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Abstract. The development of the real estate industry has increased the application market capacity of green building materials, and the demand for green building materials has also greatly increased. The formation of the concept of pollution-free, energy-saving and environmentally friendly housing by consumers has gradually changed the choice of traditional civil engineering construction materials and Cost control. The application and promotion of a large number of green building materials in civil engineering construction has laid a material foundation for the construction of energy-saving and environmentally friendly buildings in China. The article is based on this, using inorganic raw materials potassium silicate, sodium silicate, and silica sol as base materials, add a certain proportion of organic silicon modified styrene-acrylic emulsion, and then add titanium dioxide, kaolin, talc, nano-titanium dioxide and other fillers and coating film-forming additives to prepare water-based inorganic coatings. The test results show that the prepared coating has good physical and chemical properties, environmental protection performance, and fire resistance performance, and can be widely used in the construction industry with obvious social and economic benefits and environmental protection benefits.

1. Introduction

At present, the use of traditional building materials in civil engineering in my country is costly and does not have good safety performance. The most important thing is that the toxic substances in these building materials pose a serious threat to people’s health and affect people’s health. Not only that, it will also cause serious pollution to the surrounding environment. If used in a large number of construction projects, it will cause serious waste of resources and damage to the environment, thereby aggravating the occurrence of smog and the formation of the greenhouse effect [1]. The use of green building materials in civil engineering has solved these problems and has obvious advantages. First, the structure of green building materials is environmentally friendly and does not pollute. The healthy and environmentally friendly materials obtained through research and analysis of high-tech technologies will also reduce the discharge of waste water and waste in the process of mass production. To reduce environmental pollution. Second, the materials can be recycled after use, and multiple use can reduce waste discharge and resource waste. Therefore, the use of green building materials in construction projects not only ensures the safety of people’s lives and property, but also reduces project capital...
investment and saves costs. The most important thing is that it can effectively achieve the effect of environmental protection and energy saving, which is also the country’s sustainable development.

As an important building material, high-performance water-based coatings have continued to improve their application performance. Under the conditions of green economy, all countries in the world are developing environmentally friendly water-based coatings to promote the development of green economy. From the analysis of usage, water-based coatings are more and more widely used in today's construction field due to their superior performance. Its advantages are: water-based coatings can greatly reduce pollution problems and save energy consumption. Although many water-based coatings contain trace amounts of harmful substances, But the ratio is greatly reduced. Furthermore, water-based coatings have relatively low construction requirements [2]. For example, they can still be constructed in a humid environment and have very strong adaptability. They can be washed directly with water, which greatly reduces the amount of organic cleaning solvents used. It can be seen that strengthening the preparation of water-based coatings is particularly important for the development of the construction industry and is also a huge driving force for the development of the construction industry.

2. Experimental Design

2.1. Selection of main raw materials
Silicone acrylic emulsion, pure acrylic emulsion, Dow Chemical; Mica powder, Anhui Chuzhou Gerui Mining Co., Ltd.; Titanium dioxide, Zhengzhou Jiuzhou Chemical Co., Ltd.; Light calcium carbonate, Jiangxi Chenu Powder Products Co., Ltd.; Dispersant 4010 Agent, Shenzhen Haichuan Chemical Technology Co., Ltd.; BYK-2010 wetting agent, BYK company; Huake-88 preservative, Shaanxi Petrochemical Research and Design Institute; RM-2020, RM-299 thickener, Dow Chemical; BYK-022 defoamer, BYK company; Texanol film-forming aid, Eastman Company; other additives, all industrial products.

2.2. Test equipment
Sand mill, coating 4# viscosity meter, scraper fineness meter, paint film coating rod, washing resistance test machine.

2.3. Preparation of paint
Refer to Table 1 for the reference formula of environmentally friendly building exterior wall coatings. First, prepare the dispersant, defoamer, and wetting agent in the formula into a solution, stir well, add the pigments and fillers to the above solution at room temperature, and pre-disperse; then sand to the required fineness, filter, and add Silicone acrylic emulsion and pure acrylic emulsion, adjust the pH to 7~8, add appropriate amount of film-forming aids, preservatives, thickeners and water, and adjust to the appropriate construction viscosity as needed to prepare an environmentally friendly building exterior Wall paint.

Table 1. Reference formula of environmentally friendly architectural exterior wall paint

| Raw materials            | w/% | Raw materials       | w/% |
|--------------------------|-----|---------------------|-----|
| Silicone acrylic emulsion| 43  | Thickener           | 0.7 |
| Pure acrylic emulsion    | 43  | Defoamer            | 0.1 |
| D                        | 0.2 | preservative        | 1.5 |
| Colour paste             | 7.5 | pH regulator        | 0.1 |
| Dispersant               | 0.2 | water               |     |
| Cosolvent                | 3   | margin              |     |
2.4. Performance testing

2.4.1. Scanning electron microscopy test. Cut out a 2cm×2cm aluminium alloy sample plate, wipe it clean and brush it with fire-resistant paint, with a thickness of about 1mm, and maintain it at room temperature for 15 days. After curing, the samples are subjected to weather resistance test with reference to "GBT14522-2008 Plastic, Coating, Rubber Material Artificial Weathering Test Method for Mechanical Industry Products, Fluorescent Ultraviolet Lamps", and scanning electron microscopy tests the surface structure of the test sample after weathering test [3].

2.4.2. Test method for ultraviolet radiation resistance and water resistance aging. Cut out 150mm×75mm×2mm (thick) steel plate, wipe it clean and brush with epoxy zinc-rich anti-rust paint once, dry for 24h, brush with fireproof paint, the thickness is about 1mm and the curing is 15d at room temperature. After curing, the samples are subjected to weather resistance test according to "GBT14522-2008 Plastic, Coating, Rubber Material Artificial Weathering Test Method for Machinery Industry Products, Fluorescent Ultraviolet Lamps". After the test sample is dried at room temperature for 10 days, use the ZQS6-5000A veneer tile bond strength tester (Refer to GB14907-2002 Section 6.4.5 Bond Strength Test Method) for testing.

2.4.3. Fire resistance test of laboratory small plates. Cut out 150mm×150mm×2mm steel plates, wipe them clean, and brush them with epoxy zinc-rich anti-corrosion paint once. After drying for 24 hours, apply fire-resistant paint with a thickness of about 2mm at room temperature [4]. Under maintenance for 15d. Use a muffle furnace, refer to the standard heating curve of GB14907 and GB9978 for the experiment, the test time is 1.0h.

3. Results

3.1. Selection of defoamer

According to the degree of product polymerization, ammonium polyphosphate is divided into type I and type II. The degree of polymerization of type I is ≥50, and the degree of polymerization of type II is ≥1000. As the degree of polymerization increases, the water solubility of the product is greatly reduced. In addition, the physical coating of the surface of the ammonium polyphosphate product can also reduce its water solubility and form hydrogen bonds. Coating materials include phenolic resin, silicone resin, melamine formaldehyde resin (MF), etc. Among them, the water solubility of type II ammonium polyphosphate coated with MF (25°C) is ≤0.04g, and the water solubility is significantly reduced. At the same time, MF resin Provide a large amount of N element for the coating system [5]. The TG curve of type II uncoated ammonium polyphosphate is shown in Figure 1. The TG curve of MF resin coated type II ammonium polyphosphate is shown in Figure 2. Fire-retardant coating samples were prepared with type II uncoated ammonium polyphosphate and type II ammonium polyphosphate coated with MF resin, and tested on a small plate (150mm×150mm) in the laboratory.

Figure 1. TG curve of uncoated ammonium polyphosphate
BYK-022 defoamer is especially suitable for systems based on acrylate or acrylate/polyurethane emulsion. It is extremely effective in the production and application of water-based coatings. It has excellent long-term stability, is extremely effective in the elimination of microbubbles, and is very effective in colour Acceptability and gloss have no effect, but when added, a sufficiently high shear force is required to avoid shrinkage [6]. In this experiment, BYK-022 defoamer was selected and the influence of its dosage on the system was investigated. The results are shown in Table 2. It can be seen from Table 2: When the amount of BYK-022 defoamer is too small, good defoaming and anti-foaming effects cannot be obtained, and the paint film surface is irregular; when the amount of BYK-022 defoamer is increased to 0.1% of the system mass, Its defoaming and anti-foaming ability is excellent, the paint film has no defects such as pinholes, and the emulsion stability is good; when the amount of BYK-022 defoaming agent exceeds 0.15% of the system quality, although its defoaming ability is very strong, but side effects It is also very obvious that the wettability of the paint film to the substrate is not good, it is easy to cause film defects such as shrinkage, and the gloss of the paint film is reduced, and the emulsion stability is also affected. Considering comprehensively, the proper amount of BYK-022 defoamer is 0.1% of the system quality.

### Table 2. The influence of BYK-022 defoamer dosage

| w (BYK-022 defoamer)/% | Test items | 0.05 | 0.1  | 0.15 |
|------------------------|------------|------|------|------|
| Defoaming ability      | Poor       | Poor | excellent | excellent |
| Foam suppression ability| Poor       | Poor | good | excellent |
| Constructability       | Bubbles    | The paint film is smooth without shrinkage | Low gloss, shrinkage |
| Emulsion stability     | good       | excellent | difference |

#### 3.2. UV resistance and water resistance aging test

The strength of the sample after referencing GBT14522-2008 test decreased to a certain extent, mainly due to the degradation of the polymer emulsion film-forming substance, the hygroscopicity of ammonium polyphosphate and other flame retardants and the char-forming agent pentaerythritol and the precipitation of water-absorbing substances, Resulting in a decrease in the tightness of the coating and a decrease in the bonding strength of the coating. Pilot water-based intumescent fire-resistant coating and imported water-based intumescent fire-resistant coating product water resistance test water resistance comparison test results (soaking water is deionized water, room temperature). From the electron microscope analysis of the aging test sample, as the aging test proceeded, the surface of the sample produced minor changes, from a relatively tight surface to a few holes and cracks. In outdoor
applications, natural conditions such as long-term ultraviolet radiation, acid rain washing and soaking, strong winds, and temperature differences in summer and winter will affect the surface of the coating [7]. It is necessary to apply a certain thickness on the surface of the fireproof coating. Protect the surface layer. As shown in Figure 3.

![Figure 3. Electron microscope picture of water-based paint](image)

In the fire resistance test of the small panel, the morphology and expansion height of the expanded and foamed carbon layer of the sample after the aging test did not change significantly [8]. From the sample test of the 30d test period, it was observed that although the foaming height of the carbon layer was slightly reduced, But the morphology of the carbon layer is still very good.

4. Conclusion
According to analysis and experiments, this paper selected vinyl acetate-vinyl versatile-acrylic acid copolymer emulsion as the main adhesive of the coating system. This emulsion is environmentally friendly, does not contain VOC, has high efficiency, flexibility and other properties. Tests show that the emulsion is suitable for the expansion and foaming system of the water-based paint in this paper, and the paint has excellent adhesion, water resistance and UV resistance. The thesis adopts the method of mixing silicone-acrylic emulsion and pure acrylic emulsion, adding appropriate additives, to prepare an environmentally friendly architectural exterior wall coating with excellent performance, and use the coating for actual construction. Comprehensive test results show that the weather resistance, water resistance and stain resistance of the exterior wall coating have reached the level of similar solvent-based coatings on the market. It has a good economy and society for building decoration and protection, and creating an eco-friendly home environment benefit.

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