ISSN: 2664-9640

Discuss the application of sodium carboxymethyl cellulose in clay

Chao Yi, Xin Wu, Yingqun Li, Yinjia Miao, Lu Gan

Chongqing College of Electronic Engineering, Chongqing, China

Abstract

In this paper, the grouting process is analyzed, and the traditional grouting process has certain defects, so different grouting processes are derived. In this paper, through the defects of the traditional grouting process, in view of the defects of the grouting process, we talk about the role of cellulose nanofibers in clay and the similarity between carboxymethyl cellulose and cellulose nanofibers, and analyze the application principle and possible application results of carboxymethyl cellulose in clay according to the principle of cellulose nanofibers in pottery grouting molding and the application of carboxymethyl cellulose in soil. The traditional grouting process causes the appearance of bubbles, which leads to defects in pottery and slow sales. Nevertheless, the traditional grouting process is still widely used in small and medium-sized factories today, and with the continuous change of market demand, it is imperative to reduce the defect rate of pottery, which is of great strategic significance for the sustainable development of the pottery industry.

Keywords

Conventional grouting process; carboxymethyl cellulose; cellulose nanofibers.

1. Traditional grouting process

Since the 1950s, China's Rongchang pottery has gradually followed the development trend of the times, sought the development and breakthrough of process technology, analyzed the pottery technology in various regions, and formed a grouting molding process and impression technology that mainly goes through mold making, grouting, pulping, pulping, demoulding and drying. At that time, many large pottery factories promoted modern production lines on a large scale, and comprehensively developed gypsum impression technology, etc., which was a good way to save human resources, and at the same time, it was more in line with the objective needs of the development of the times in terms of excellence in production and accuracy of process technology. At present, more than 90% of the production process of Rongchang pottery uses grouting molding technology, and can use Rongchang white clay to make different printing decorations and direct decals, etc., which has very unique advantages and high artistic value, showing the characteristics of Rongchang pottery with excellent production and variety of the times.

Grouting process is to prepare a good mud injection plaster model, gypsum model has breathability and water absorption performance, mud contact model, the model wall will gradually absorb the water in the mud, when the mud dry molding to achieve the expected thickness, both can be the model of excess mud poured out, this is the solid grouting process. The moisture in the blank is continued to be absorbed by the model, and after independent molding, the body can be removed and dried for repair. At this point, the grouting process has come to an end. The grouting molding method requires simple equipment, simple operation method, and can produce the same product in large quantities, which is a practical means of ceramic production billet.

ISSN: 2664-9640

Wet method	Grouting molding	Under the action of physical dehydration and chemical coagulation, ceramic powder particles are deposited and formed on the gypsum mold wall	The appearance, density, strength, etc. are poor, and the labor intensity of the workers is large and not suitable for automated operations	Suitable for the preparation of large ceramic parts with complex shapes
	Thermoforming	At a higher temperature (60 ~ 100 ° C), the ceramic powder is mixed with the binder (paraffin wax) to obtain the slurry for hot die casting, the slurry is injected into the metal mold under the action of compressed air, the pressure is cooled, the demoulding is obtained, the wax blank is de-waxed under the protection of the inert powder to obtain the plain blank, and the plain blank is then sintered into porcelain by high temperature	The temperature of the wax paste and mold needs to be strictly controlled, otherwise it will cause under-injection or deformation, so it is not suitable for the manufacture of large parts The two-step firing process is more complex and the energy consumption is high	The raw blank size is precise, the internal structure is uniform, the mold wear is small, the production efficiency is high, and it is suitable for various raw materials
	Cast molding	The ceramic powder is fully mixed with a large number of organic binders, plasticizers, dispersants, etc., to obtain a viscous slurry that can flow, the slurry is added to the hopper of the caster, the thickness is controlled with a scraper, and the feeder flows out to the conveyor belt through the feeding nozzle, and the film blank is obtained after drying.	It is necessary to strictly control the process parameters, which are easy to cause defects such as peeling, streaking, low film strength or difficult to peel off, and the organic matter used is toxic, which will produce environmental pollution, and should be as toxic as possible to use a non-toxic or less toxic system to reduce environmental pollution.	Suitable for the preparation of thin film materials
	Gel injection molding	Using an organic monomer solution, the solution can be polymerized into a high-strength, transversely connected polymer-solvent gel. The slurry formed by the ceramic powder dissolved in the solution of organic monomers is poured in the mold, and the monomer mixture polymerizes to form gelatinous parts	Due to the lateral connection of the polymer, in the drying process, the shrinkage rate of the embryo body cannot be densed with the migration of the solvent, which is easy to lead to the deformation of the embryo body; Some organic monomers have oxygen barrier polymerization, resulting in surface	It is easy to remove solvents from gel parts through drying steps, and is used to manufacture single-phase and composite ceramic parts, which can form ceramic parts with complex shapes and quasi-net sizes, and their billet strength is as high

			peeling and shedding; Due to the temperature-induced organic monomer polymerization process, the temperature shaving caused by the presence of internal stress 9 causes the blank to be broken.	as 20 to 30Mpa or more
	Direct solidification injection molding	Solvent water, ceramic powders and organic additives are thoroughly mixed to form an electrostatically stable, low viscosity, high solids content slurry, in which chemicals that can change the pH of the slurry or increase the concentration of electrolyte are added, and then the slurry is injected into a non-porous mold	Additives are expensive, and gases are generally emitted during the reaction	No or only a small amount of organic additives (less than 1%), the body does not need to be degreased, the density of the body is uniform, the relative density is high (55% to 70%), and large-size complex shape ceramic parts can be formed
	Injection molding	Using thermoplastic organic compounds to cure at low temperature or high temperature curing of thermosetting organic compounds, the powder and organic carrier are mixed in a special mixing equipment, and then injected into the mold under high pressure (tens to hundreds of MPa) to form	The organic content in the raw blank of injection molded ceramic parts is as high as 50vol, which takes a long time to eliminate organic matter and is prone to quality defects	The size of the blank is precise, the finish is high, the structure is dense, the production efficiency is improved, the degree of automation is high, and the size of the molded body is precise

1.1. Traditional grouting process defects

The traditional grouting process mainly has the following disadvantages:

(1) Due to the high moisture content of the mud, the body is not easy to dry, and it is easy to deform.

(3) It is necessary to add a huge model to create auxiliary sections.

(3) Occupy a large area of the plant.

(4) The moisture content of the mud material is high, and the body firing is prone to bubbles.

(5) Labor intensity is relatively large.

2. Cellulose nanofibers

Nanofiber characteristics, most materials are so small that when the length of the nano is short, its own physical and chemical properties will change, mainly manifested in:

1, surface effect The smaller the particle size, the larger the surface area, because the surface particles lack the coordination of adjacent atoms, so the surface can increase extremely unstable, easy to combine with other atoms, showing strong activity.

2, small size effect When the size of the particle is small to the wavelength of the light wave, the de Broglie wavelength of the conduction electronhttps:// baike.baidu.com /item/%E5%BE%B7%E5%B8%83%E7%BD%97%E6%84%8F%E6%B3%A2%E9%95%BF/53966038 and the coherent length of the superconducting state, the transmission depth is similar or smaller, its periodic boundary conditions will be destroyed, and the acoustic, optical, electromagnetic, and thermodynamic properties of the particles will change, such as reduced melting point, discoloration, absorption of ultraviolet rays, shielding electromagnetic waves, etc.

3, quantum size effect When the particle size is small to a certain time, the electronic energy level near the Fermi energy level changes from quasi-continuous to discrete energy level, at this time, the original conductor of the material may become an insulator, otherwise, the insulator may become a superconductor.

4, the yang tunneling effect of macroscopic quanta Tunneling effect refers to the fact that tiny particles can pass through objects under certain circumstances, just like there is a tunnel inside

Cellulose nanocrystals (CNCs) are a kind of nanoscale cellulose extracted from natural fibers, which not only has the characteristics of nanoparticles, but also has some unique strength and optical properties, with broad application prospects.

Cellulose nanocrystals themselves are biomass tissues, which have a natural affinity for composite materials, which can form an "adaptive structure" and produce the effect of weakening local stress at the interface; under the action of stress, cellulose nanocrystalline particles will slip along the surface of the filled substance, and the broken keys will be reconnected into new bonds, so that the polymer matrix and the filling material can still maintain a certain adhesion strength and reduce the degree of damage of the composite material, so the cellulose nanocrystals can be used as a reinforcement phase to improve the composite The properties of the material.

Nanocellulose due to its good physical and chemical properties and ecological properties, in recent years as a filler has been widely used in the field of composite materials, the current containing nanocellulose composite materials have been widely used in packaging, engineering plastics, 3D printing, biomedical engineering and other fields.

2.1. Application of cellulose nanofibers in pottery

In the process of ceramic grouting molding, the rheology of the slurry plays an important role in the blank forming process of the ceramic slurry. Factors affecting the rheology of the slurry generally include: particle morphology, particle size and gradation, solid content, surface charge, pH value and admixtures and other factors.

The influence of different solids content on the viscosity of the slurry High solids content slurry is an important factor in the preparation of high-density, high-strength ceramics by grouting molding, and excessive solids content will significantly enhance the viscosity of the slurry. In this experiment, the viscosity of the slurry at different solids content and the corresponding bending strength curve of the ceramic were studied when the mass content of CNFs was 0.1%. When the solid content is greater than 52% of the volume fraction, the viscosity of the slurry is too large to be measured and cannot meet the fluidity of the slurry; when the solid content is less than 42% of the volume fraction, the molding shrinkage of the slurry is larger. Therefore, the solid content of this experiment ranged from 42% to 52% by volume. As shown in Figure 1, the viscosity of the slurry gradually increases with the increase of the solid content, and the bending strength of the ceramic shows a trend of increasing first and then decreasing with the increase of the solid content. When the solid content is 50% of the volume fraction, the viscosity of the slurry reaches 271,20 Pa·s for the application of cellulose nanofibers in ceramic grouting

molding, which has good fluidity; at this time, the bending strength of the ceramic reaches the maximum, which is 290.67 MPa·s. As can be obtained from Figure 2, the increase in solid content promotes a sharp increase in the viscosity of the slurry, the fluidity of the slurry is weakened, the uniformity of the slurry is poor, and the bubbles wrapped inside the slurry are difficult to discharge, which in turn affects the firing strength of the ceramic.

3. Carboxymethyl cellulose

Carboxymethyl cellulose (CMC) is a water-soluble polyanionic cellulose compound obtained after natural fibers are chemically modified, easily soluble in cold and hot water. The hydroxyl group on the cellulose molecule can be introduced into the functional group or other elements, thereby changing the cellulose properties, with wettability, dispersion, adhesion, thickening, emulsification, water retention, film formation, and impermeability of grease and other unusual and extremely valuable comprehensive physical and chemical properties, has been widely used in food, medicine, construction, wastewater treatment and papermaking and other fields, is an important basic chemical materials. Carboxymethyl cellulose is modified from natural bio-based material cellulose, is a white or slightly yellow powder, granular or fibrous solid, odorless, tasteless, non-toxic. The production raw materials are the most widely distributed, the largest yield, the most widely used and the most convenient natural polymer renewable resources in nature, accounting for more than 50% of the carbon content in the plant kingdom.

3.1. Carboxymethyl cellulose

CMC added blanks can enhance the adhesion of the blanks, make the embryo body easy to form, the bending ability to increase by 2-3 times, improve the stability of the blanks, more used in mechanical processing ceramic products, reduce processing costs, and at the same time, due to the addition of "modified CMC", not only improve the processing speed of the embryo, reduce production consumption, but also make the moisture in the blank evenly evaporate to prevent drying and cracking.

4. Summary

With the increasingly sound production equipment, the production process is becoming more and more perfect, and the quality of the sodium carboxymethyl cellulose produced today has been significantly improved, and the viscosity has become larger and larger, how to improve the dissolution rate of sodium carboxymethyl cellulose and open up a wider range of applications is a major problem facing it. Japan previously used a disperser to develop a kind of instantaneous dissolving machine, the principle of action is to rely on the decompression effect generated by the water flow to suck the powder in, so that it is swollen and dispersed in the water, the use of this device product dissolution time is very short.

It should be known that sodium carboxymethyl cellulose occurs swelling before dissolving, so when dissolved in water, it should be made as much as possible

Each individual particle first produces a uniform dissolution, and when the powdered sodium carboxymethyl cellulose is concentrated in water at one time, the swollen particles bond to each other, forming a tough film around the powder and producing a pimple-like viscous mass that is not easy to disperse.

The pathway of sodium carboxymethyl cellulose is the introduction of other hydrophilic active genes and additions within the inter-cellulose structure

Suitable surfactant to achieve instant dissolution without changing the basic properties, the second is granulation in the product of sodium carboxymethyl cellulose, due to the use of special methods to make the product into fine sand granules, in the water is easily dispersed, will not form a knot, and then replaced by stirring can be dissolved in a short time. Although

instant solution is not a prescribed indicator, if there is an instant product, it is more conducive to occupying the market, increasing the competitiveness of the market, broadening sales channels and developing potential markets.

At present, the cost of instant solution is still relatively high, so instant products are more expensive than ordinary products

The technology used to make instant products varies, and the prices vary.

The application of sodium carboxymethyl cellulose in ceramics has two large branches, - for the blank body, and the second is for glaze (known in the industry as printing).

flowers). Before we know, we must know the production process of building sanitary ceramics. Understanding the process is very helpful to both suppliers and buyers, because in this case sodium carboxymethyl cellulose has become a bridge between suppliers and buyers, understand the application of sodium carboxymethyl cellulose in ceramics for buyers to find handy, then familiar with the production process of ceramics Sodium carboxymethyl cellulose index control and the important parameters of the product is different, for suppliers, the most suitable goods are like pushing the boat. Whether it is a traditional process or a modern production line, ceramic production is inseparable from three major processes: (1) raw material processing, (2) molding, and (3) firing. In the raw material processing process, wet ball grinding pulp is usually used, and the resulting slurry or glaze pulp is generally made, in which ceramic additives (industry terminology) are indispensable in the preparation process. I will elaborate on ceramic additives, which are pure literacy. From the definition of the product name, it can be understood as an additional substance added to the ceramic production formula. Its use is not large, the main role is to improve the physical properties of the blank, glaze paste, the most prominent feature is to play a role below 1000 °C, decomposition and volatilization at high temperature. For ceramic additives, chemically speaking, they are divided into inorganic additives and organic additives. Inorganic additives mainly include (according to the degree of common use and so on): sodium silicate, sodium carbonate, sodium metasilicate (alias water glass), sodium metaphosphate, trisodium phosphate, ammonium chloride and so on. Organic additives mainly include (according to the degree of common use and so on): methylcellulose, sodium carboxymethyl cellulose, sodium humate, citric acid, industrial starch and extreme derivatives (ambiguous essence), glycerin and various polyesters, polyvinyl alcohol and so on. Knowing this, we can better understand what kind of category sodium carboxymethyl cellulose is. So what is the role of the additive, usually used to its deagulation is dilution or water reduction, sustained release, plastic, plasticizing, bonding and suspension. Here, there are no carboxymethyl fibers in additives such as decoagulants

Vegetarian sodium, therefore not discussed herein. We still mainly understand the application of sodium carboxymethyl cellulose in ceramics, so we need to introduce it systematically. The production and role of sodium carboxymethyl cellulose I will not elaborate too much, there have been more than a hundred product descriptions repeated. We understand its physicochemical properties, which is very helpful for the use of the user. The appearance is not much to say, say that the preservation, solid CMC is susceptible to moisture, sealing dry environment is more stable to light and room temperature. The aqueous solution of sodium carboxymethyl cellulose has excellent adhesion, thickening, emulsification, suspension and film forming, water retention and anti-enzyme properties. Encounter with heavy metals to form a precipitate, sodium, magnesium, calcium salts do not precipitate, but the viscosity will decrease, sodium carboxymethyl cellulose and water-soluble animal glue, ethylene glycol, glycerin, sorbitol and soluble starch solution can be mixed. In the glaze paste, the original sodium carboxymethyl cellulose is introduced as a binder, while playing a suspension role, and low viscosity sodium carboxymethyl cellulose at the same time has a deagulation effect, therefore, the introduction of an appropriate amount of carboxymethyl cellulose sodium in the glaze paste, in addition to improving the fluidity of the glaze pulp, can improve the grinding efficiency, but

also increase the strength of the raw glaze, because of its good water retention, but also to prevent the glaze dry contraction, but also to make the glaze flat and smooth, so that it and the blank body is firmly combined, not easy to peel off. The mechanism of action of bonding, suspension and decoagulation are all professional forces, which are too written to be repeated.

References

[1] Application of cellulose nanofibers in grouting molding of alumina ceramics_Zhao Xiaoqing.

[2] Rheological properties and grouting of nano-Y_2O_3 suspensions_Chang Yukun.

[3] Preparation and electrolysis efficiency of sodium carboxymethylcellulose gel_ Kailin Wu.