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STUDIES ON THE CHEMICAL COMPOSITION AND PROPERTIES OF PORTLAND CEMENT

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ABSTRACT

This research on Portland cement includes research on the application of a new method of mixing colloidal nano-silica. Previous studies used powdered nano-silica or colloidal nano-silica and applied binder weight replacement based on methods and processes. In this study, we tried to use ordinary portland cement as binder and replace colloidal nano-silica and observed the process studies and we determined the changes based on the possibilities of comparison with the weight of mixed water. Colloidal nano-silica 10-20%, replaced by 30% mixed water. weight status has changed. Current value, setting time, compressive strength, hydration reaction, structural composition, thermal analysis and scanning electron microscopic analysis was performed. Experimental results show that the new replacement method improves mechanical and microstructural properties through two effects. This is one of them replacement by weight of mixing water shows the effect of homogeneous dispersion of nano-silica particles did not lose the property of anisotropy in their microscopic appearance. The second is the effect of reducing the composition ratio when colloidal nano-silica is replaced, because colloidal nano-silica is denser than mixed water. Therefore, we have confirmed the application of water mixing weight replacement method as a new method of mixing colloidal nano-silica we can analyze from the process.

Introduction

Cement is used in various fields. Concrete as the main component in all forms of reinforced concrete, construction blocks, mortar, roads, asphalt, roof tiles, etc. - our entire modern urban lifestyle is completely dependent on it. simple material. About 2.7 billion tons of cement are produced in the world every year. The most common cement, Portland cement is made by burning limestone and clay at temperatures above 1400°C to form calcium silicates, but many other types cement will have a composition based on mixtures of silicates, alkalis, phosphates and sulfates. These are dusty materials that develop strong adhesive properties when combined with water. These materials are more accurate known as hydraulic cements. A mixture of gypsum, ordinary lime, hydraulic lime, natural pozzolan and portland cements can further increase the hardness of the cement. Chemical technological processes of cement production. It was determined that the main chemical component of Portland cement is limestone (70-75)% and alumina. (Al_2O_3) and silicon oxide (SIO_2) (15-20) %. Alumina and silica are usually found combined as clay. All cement included the main materials are impure in nature and are found in other ingredients resulting from contact with fuel in calcinations. Some these random ingredients can improve the cement, while others are inert and harmless except in such quantities for displacing important constituents, etc., due to chemical action, which, if in quantity, is positively harmful. widely used hydraulic cements, portland cement is the most important in construction. Cement – various the powder hardens after a few hours when mixed with water and then becomes a hard, strong material within a few days. Cement is mainly used to bind together fine sand and coarse aggregates in concrete. Research in the field of advanced building materials such as the use of nanoparticles as cement mixture reported significant improvements in the properties of traditional building products. In previous studies, various nanoparticles were mixed with cement and their performance evaluated. Nanoparticles such as nanoclay, Al_2O_3, Fe_2O_3, TiO_2 and $CaCO_3$ were evaluated; however, SiO_2 has been studied the most. Nano-silicon refers to small particles consisting of a hydroxylated amorphous SiO_2 core. surface, which makes the substance insoluble in water. The size of the particles can be different 100-150 nm; therefore, they are small enough to be suspended in liquid media without sinking. Parameters such as specific surface area, particle size, and size distribution can be controlled synthesis technique. Nano-silica particles provide a high surface area to volume ratio high chemical reactivity. They act as nuclear centers and contribute to their development the amount of additional components to cement is determined as hydration of ordinary portland cement or cementitious materials.

Materials and methods

A commercial grade with an average particle size of 10 nm and a density of 20 nm was used. 0.0012 g/mm3 and an aqueous solution with an alkaline pH of 10. Amount of SiO_2 in water solution was 35%, and the viscosity did not exceed 10 cps at 20 ◦ C. Chemical The X-ray determined properties used in this study are summarized in Table 1 fluorescence analysis.

	Chemical Components (%)							Density (g/mm^3)	Fineness (m^2/kg)	L.O.I (%)
	SiO_2	Al_2O	Fe_2O	MgO	CaO	K_2O	SO_3			
OPC	20.51	5.27	3.64	2.86	62.58	0.69	2.72	0.00315	330	0.76

Chemical Component	Cement	Limestone	Sand	Clay
Silica SiO_2	18-24	1.5	41.8	88.4
Alumina Al_2O_3	4-8	0.5	10.3	2.9
Iron Oxide Fe_2O_3	2-4	0.5	5.8	1.6
Calcium Oxide CaO	60-69	53	17.2	2.8
Magnesium Oxide MgO	2-5	0.4	5.0	0.5
Sulfate SO_3	0.3-2.7	0.4	0.4	0.4
Loss Of Ignition L.O.I	0.1-0.5	42.4	17.8	2.0

Table 1. Chemical properties and composition of ordinary portland cement

The most common combination of ingredients is limestone (for calcium). combined with very small amounts of clay, shale and sand (as a source of silicon, aluminum and iron). Other "alternative" raw materials such as mill scale, fly ash and slag are sourced from other industries and usually rely on nearby quarries to reduce limestone transport. transported to the primary crusher, where the large "mine" rocks are broken into pieces of approx. 10-100 mm. Usually other raw materials do not require grinding. Then it is proportional to the ratio of raw materials the correct chemical balance and reduced to a fine powder state. It is passed through a mill together for grinding. To ensure the high quality of cement, raw materials and raw material chemistry are very carefully controlled. Furnace exhaust gases used in the mill for drying raw materials. Some gases with wet materials have additional heat sources required for drying. Materials are also homogenized to ensure consistency of product quality. Creation stages cement are:

Some components of cement are obtained from limestone quarry. It is the main component required for the production of cement. Smaller amounts sand and clay are also needed. There are four main elements required for production: limestone, sand and clay indicates the percentage of equal composition of cement components. The four essential elements are calcium, silicon, aluminum and iron.

Limestone pieces then pass through additives (components) that are added to other raw materials on the right.

The raw material is ground into powder. This is sometimes done with rollers that grind the material processes are carried out against the rotating platform.

Everything then goes into a huge, very hot, rotating furnace to go through a process called "sintering." Sintering is the process of turning into a coherent mass by heating without melting. In other words, raw materials become partially dissolved. The raw material reaches about 2500-2700°F (1500°C) internally furnace. This causes chemical and physical changes in the raw materials and they come out of the furnace as large, glassy, red-hot slags are called "clinkers".

The clinker is cooled and reduced to a fine gray powder. A small amount of gypsum is also added in time the final grinding process is carried out. Now it is a finished product - Portland cement. The cement is then stored in silos.

Conclusions

Chemical testing has shown that the strength of all types of cement comes from two components. A decrease in the value of the alumina modulus leads to an increase in the resistance of cement to salts. The experimental data evaluated as part of this study led to the following conclusions. As the exchange rate of colloidal nano-silica increases, the current value and setting time decreased. In addition, compressive strength increased at all measurement ages. Especially the hole The structure increased the amount of strength of cement and affected the increase of large capillary pores. This trend was evident at 30% replacement rate, aided cement hydration and affected ettringite, calcium-silicate-hydrate, gypsum, and portlandite. Especially, portlandite showed a decreasing trend with increasing substitution rate. Through it thermal analysis confirmed that the amount of ettringite and and portlandite was modified as the amount increased, type ettringite and the dense hydration reaction is carried out in a variable environment. The analysis showed a downward trend It can accept values without changes in Ca/Si ratio. The formation of cement paste is caused by temperature under the influence of slightly low compression and low heat of hydration. An excess of Fe_2O_3 involves a change in chemical composition. An increase in the amount of Fe_2O_3 can cause the concrete to expand and crack, and the strength property will change. Chemical oxides (MgO, SiO_2, CaO) were determined to be compatible with all types of cement standards. Structural properties of cement such as compressive strength and setting time in all types of compatibility for strength limits Standards specifications can be followed.

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