

# Research and Progress of High Admixture Gangue Concrete

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## Abstract

Substituting solid waste for gravel in concrete is an effective way to build a resource-saving society. Coal gangue is a waste product of the coal mining process, at present, the domestic stock of coal gangue is extremely high, seriously occupying arable land and polluting the environment. Re-applying it to civil engineering materials, on the one hand, opens up the use of gangue and reduces environmental pollution; on the other hand, it reduces gravel mining and saves resources. Therefore, the study of gangue concrete is of great significance. This paper summarises the research results of gangue concrete, which provides a certain reference value for future development.

## Keywords

Gangue; Proportioning; Mechanical Properties.

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## 1. Introduction

Coal slurry is a solid waste product released during the coal mining process, and its emissions account for around 10-20% of annual coal production. The cumulative inventory of coal slurry in my country has exceeded 5 billion tonnes, and continues to grow at a rate of 300 to 350 million tonnes per year. Coal gangue has become one of the main solid wastes in China [1]. At present, gangue is mainly processed by open-pit piling, which not only takes up a large amount of land, but also causes serious soil and water pollution around the extraction area [2].

Coal gangue and coal strata symbiosis, is a grey, grey-black and grey-green sedimentary rock system, mainly including sandstone gangue, calcareous rock gangue and aluminous rock gangue. Gangue is characterized by high concentrations of silicon oxide and alumina in its chemical composition, and commonly used in concrete sand, stone aggregates, whether in the "quality" or in the "amount" of bulk has a double proximity. Therefore, according to the rock properties and physical and chemical composition of the gangue, the gangue as concrete coarse and fine aggregates, the use of the rock properties of the gangue, the use of gangue as a coarse aggregate for the preparation of concrete, not only help to achieve the resourceful use of gangue, but also effectively alleviate the pressure on the supply of natural aggregates [3].

## 2. Current Status of Research at Home and Abroad

Huang et al [4] used calcined gangue powder as a gelling material to prepare geopolymers with slaked lime and slag. Gangue can be used as a grinding regulator, 20% gangue instead of red mud, co-grinding together for 20 minutes can effectively promote red mud activity.

Xing Dunning and Zhao Zhiman [5,6] use the gangue to produce zeolite, gangue ceramic bricks, gangue ceramics in-depth study, the study shows that the gangue ceramic bricks have better mechanical properties, but also at the microscopic level reveals the gangue ceramic bricks mechanical properties are affected by the factors. Research using gangue powder instead of clay production of cement, the results show that the cement 3d, 28d compressive strength and flexural strength have

increased, with better mechanical properties. This contributes a new perspective for the comprehensive utilisation of waste gangue.

Ma Hongqiang [7] used 700°C of calcined gangue and uncalcined gangue as coarse aggregate in place of crushed stone to study the cubic compressive strength and various durability properties of gangue coarse aggregate before and after calcination. Furthermore, the researchers utilized a scanning electron microscope (SEM) and an X-ray diffractometer (XRD) to investigate alterations in the internal structure and composition of concrete, focusing on a microscopic scale. The results confirmed the feasibility of gangue as a coarse aggregate, but due to its own defects, maximum addition is affected by the environment and design strength.

Chen Yanwen [8] used to change the gangue to replace the amount of concrete to carry out compressive strength and modulus of elasticity test, and to establish a mathematical model, the test results show that the gangue mixing amount of C20 concrete strength of the impact is not great, but when the strength level gradually increased, the gangue on the strength of the impact of the gangue is gradually become larger.

Chen Xian [9] studied the compressive and tensile strengths, and the test results showed that gangue concrete was inferior to ordinary cement concrete. With increasing gangue addition, the crushing strength and fractional tensile strength of gangue concrete continue to decrease; however, with increasing water-cement ratio, the loss rate of gangue addition on the compressive strength of gangue concrete gradually decreases.

Bai Guoliang and Liu Hanqing [10] through experiments show that the gangue carbon content, apparent density, bulk density, crushing index and water absorption rate is one of the physical and chemical characteristics of the gangue concrete cube compressive strength of the index, but the indicators of the correlation between each other, can be expressed as a function of the amount of carbon content, the amount of carbon content is a major indicator of the impact of the crushing strength of the recycled concrete cube. Through the regression analysis to establish the carbon content as a variable in the recycled concrete cube crushing strength of the formula, the calculated theoretical value and the test value match well, can provide theoretical reference for the estimation of the crushing strength of the recycled concrete cube in the project.

Cao Shuang [11] conducted an experimental study on the slump, compressive strength, fractional tensile strength and flexural strength of concrete specimens containing large quantities of gangue and fly ash. The results are as follows. With decreasing addition of fly ash, the increase in compressive strength of concrete specimens also decreases; with increasing addition of gangue and fly ash, the 7-day compressive strength of concrete specimens decreases, but the 28-day compressive strength is not very high; with decreasing addition of gangue and fly ash, the fractional tensile strength of concrete specimens shows an increasing trend; the flexural strength of concrete specimens decreases and increases with decreasing addition of fly ash. The flexural strength of concrete specimens increases with decreasing fly ash addition.

Shan Doudou [12] studied the effect of activated gangue powder (CGP) on the mechanical properties of coarse gangue aggregate (CGA) concrete. It was found that the contribution of CGP to the crushing strength of the samples increases progressively with increasing CGA substitution rate, and when the CGA substitution rate is less than 50%, the boundary voids formed between mortar and natural coarse aggregate are small, and the contribution to strength from secondary hydration caused by CGP is less than the strength loss caused by clinker reduction, leading to a decrease in mechanical strength. When the CGA substitution rate is 100%, the damage pattern of the sample after CGP mixing shows more fractures of the coarse gangue aggregate itself, as the absorption of the coarse gangue aggregate is greater, and the water film attached to the surface does not participate in the hydration reaction, in order to form more interfacial capillary pores, the CGP mixture consumes the  $\text{Ca(OH)}_2$  in the capillary pores, and the resulting C-S-H gel fills the interfacial capillary pores, increasing the strength contribution of the mortar and the natural coarse aggregate due to secondary hydration. The C-S-H

gel generated fills the interfacial capillaries, increasing the bond strength between mortar and coarse aggregate and improving.

Qiao Lidong [13] through experiments to prove that the crushing strength of recycled concrete is more affected by the water-cement ratio, with the increase in water-cement ratio strength reduction with the increase in gangue admixture gradually decreases, and the trend of reduction increases, 10% gangue admixture on the concrete's mechanical characteristics has less impact. The mixing of gangue optimises the pore characteristic parameters of concrete, and the proportion of tiny and small pores rises.

### 3. Conclusion and Prospect

With the rapid growth of China's construction industry and the government's increasing attention to environmental protection and energy saving issues, in order to solve the huge challenges brought by the massive accumulation of coal gangue on the environment, the gangue as a coarse aggregate instead of ordinary crushed stone as well as the activation of the gangue powder part of the less alternative to cement. It can achieve the call of green environmental protection and has economic benefits, and also maximises the savings while playing an effect. It can be said that gangue concrete has become a new hot spot in the research field.

The main content of this article is to summarise the development of the research on gangue concrete at home and abroad. Mainly includes mechanics, physical properties, the best fit ratio, etc. At present, most of the domestic scholars only studied the mechanical thermal activation way to stimulate the activity of the gangue, in order to more objectively evaluate the activity of the gangue, a variety of composite activation means should be used for the comparative analysis to ensure that the gangue's optimal activity of the volcanic ash, the future research can try to add some admixtures to enhance the activity of the gangue through different preparation methods. And then improve the strength of gangue concrete, add admixtures and additives modified concrete after the constitutive relationship needs further in-depth study.

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