Research on iron ore tailing improving Compressive Strength of Alkali-activated Slag Foamed concrete

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Abstract. The research on whether can iron ore tailing improve the compressive strength of alkali-activated slag foaming concrete is conducted. The experiment shows that too little or too much powder from iron ore tailing will reduce the compression strength of alkali activated slag concrete, when powder from iron ore tailing achieving optimal amount, the compression strength of alkali activated slag concrete will be obviously improved, with the further increase of iron tailing powder content, Compressive Strength of alkali activated slag foaming concrete will decrease; with decreasing of the particle size of powders from iron ore tailing, alkali-activated slag foaming concrete compressive strength will increase gradually, with the increasing of fineness, its compressive strength also increases.

Introduction

Alkali-activated slag cement is a type of binding material using basic compound of alkali metal to activate slag, and alkali-activated slag concrete based on which has many excellent performance, such as rapid hardening high strength, low heat of hydration, good durability, low energy consumption and so on. Instead of cement concrete, which saves a lot of resource and energy. Various aggregate could be used, such as recycle aggregate, common aggregate and other aggregate which mud content a bit high. It is a new type of environment friendly concrete. [1-3]

Along with the development of mineral resource, people pay more and more attention to tailing pollution.The composition of iron ore tailing in our country is complicated and various,which has uneven distribution and large amount of emissions. The tailing should be disposed in time, otherwise, they would occupy land,pollute environment and even influence peoples' lives. Nowadays, how to make the tailing meeting the requirements of sustainable development and keeping coordinated development with environment became the target of the tailing development.

Foamy concrete is a kind of green environmental protection material,which is an organic whole has unique advantage of incorporating new wall material and heat-insulate into . Because of the character of light-weight, high- strength, low heat conductivity factor, thermal insulation, fire resistance,moisture proofing and sound insulation,which is widely used in modern architectures. The foamed concrete wall, which made of iron ore tailing and alkali-activated slag cement as cementitious material, have many advantages of high-weight, low heat conductivity factor, higher resistance, simple technology and little investment. It is a new building material with a great development prospect,which should be developed and disseminated with great efforts. [4]

Experimental Section

Main Raw Materials

Slag powder(specific surface area＞400 m2/g), S95, ansteel slag development company.
Iron ore tailing(Chemical Constituents shown in table 1), Gong changling, Liaoyang.
Ordinary portland cement(PO.42.5), Liaoyang Tianrui Cement Co. Ltd.
Activator, self-made.
Admixture, self-made.

Table 1 Chemical Constituents of iron ore tailing (%)

CaO	SiO_2	Al_2O_3	Fe_2O_3	MgO	SO_3	K_2O	Na_2O	Cl^-	Loss
4.55	63.75	4.77	14.46	3.68	0.04	0.82	0.63	0.012	5.53

Experimental Equipment

Shenyang Julin machinery Company constant compression testing machine for Cement.

Experimental Methods

Mix calculation: Prepared slag powder, iron ore tailing, ordinary portland cement, admixture ect., according to a certain proportion. Beat the mixture until smooth. Mix proportions of alkali-activated slag foamed concrete (AAFC)was shown in table 2.

Test sample preparing: Mix premix, foaming agent and as much of the water as you need to make a well-distributed slurry. Pouring into a mold, and standing foaming for hours.Take off the mold until its shape stabilized.Make its size into 100mm×100mm×100mm.The density was depend on the proportion of agent.

Compressive strength test: Test compressive strength after 3, 7 and 28 days.

Table 2 Mix proportions of Alkali-activated Slag Foamed concrete

composition	content（%）
slag powder	25—65
iron ore tailing	15—55
ordinary portland cement	15—35
activator	5—10
Admixture	1—5
foaming agent	3%—5%
water	water-cement ratio 0.35-0.45

Characterization

The the specimen of apparent density and compressive strength accorded with JG237 standard.

Compression testing machine accorded with GB/T10294 standard.

Results and Discussion

Influence of different apparent density on compressive strength

The influence of different apparent density on compressive strength was studied, while the components of alkali-activated slag foamed concrete at a given blending volume.

Listed in Table 3 the compressive strength of Aalkali-activated slag foamed concrete increases on account of the hydration reaction is in process with prolonging curing time. At the same time, apparent density increases gradually play an important role in adding the compressive strength. When slag powder proportion reached45%, iron ore tailing proportion reached 35%, ordinary portland cement proportion reached 15%, 28 days compressive strength of alkali-activated slag foamed concrete(apparent density is 500 Kg/m3) can reached 2.59 MPa in standard curing condition.

Table 3 Influence of different apparent density on compressive strength

apparent density（Kg/m^3）	proportion（%）			compressive strengths lag powder（MPa）		
	slag powder	iron ore tailing	ordinary portland cement	3d	7d	28d
250	45	35	15	0.17	0.19	0.25
300	45	35	15	0.26	0.34	0.45
350	45	35	15	0.66	0.78	0.97
400	45	35	15	1.14	1.27	1.58
450	45	35	15	1.57	1.86	2.10
500	45	35	15	1.84	2.13	2.59

Influence of iron ore tailing content on compressive strength of AAFC

The influence of different proportion of iron ore tailing and slag powder on compressive strength was investigated, with the apparent density of alkali-activated slag foamed concrete is 500 Kg/m3.and ordinary portland cement proportion is 15%.

Table 4 Influence of iron ore tailing content on compressive strength of AAFC

apparent density（Kg/m^3）	proportion（%）			compressive strength（MPa）		
	iron ore tailing	slag powder	ordinary portland cement	3d	7d	28d
500	15	65	15	1.26	1.53	1.88
	25	55	15	1.47	1.87	2.28
	35	45	15	1.84	2.13	2.59
	45	35	15	0.81	1.15	1.72
	55	25	15	0.33	0.44	0.65

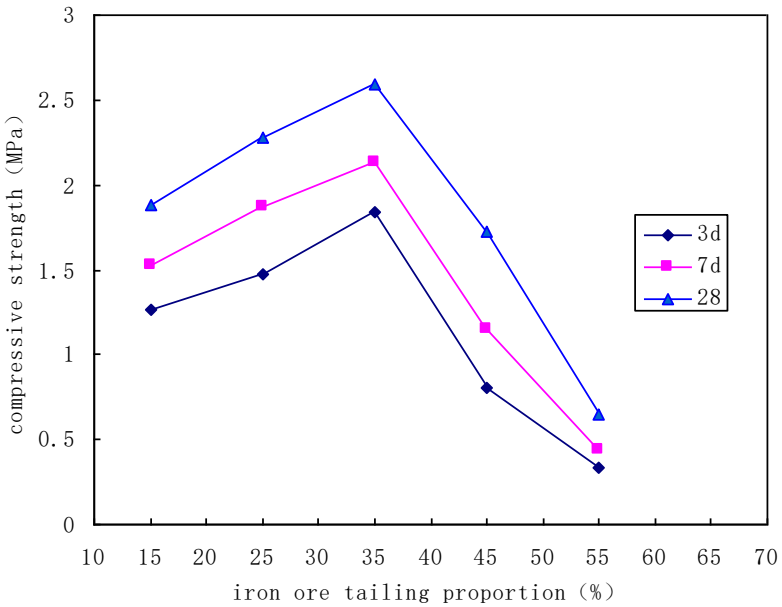

Figure 1 Influence of iron ore tailing content on compressive strength of AAFC

As shown in Table 4 and Figure, the compressive strength of alkali-activated slag foamed concrete increases gradually when the iron ore tailing content rises from 15% to 35%, but loss obviously when the iron ore tailing content rises from 35% to 55%.

Iron ore tailing particles play a role in increases the compressive strength of alkali-activated slag foamed concrete ,when it were well-dispersed in matrix with a proper proportion . Matrix interface was destroyed as the iron ore tailing particles were increased continuously, that lead to the decline of the binding power between the iron ore tailing particles and matrix. Compressive strength loss of alkali-activated slag foamed concrete was attributed to iron ore tailing particles uneven dispersing that result in segregation.

Influence of special surface of iron ore tailing on compressive strength of AAFC

The influence of different fineness of iron ore tailing on compressive strength was investigated, with the apparent density of alkali-activated slag foamed concrete is 500 Kg/m^3,and iron ore tailing proportion is 15%.

Table 5 Influence of fineness of iron ore tailing on compressive strength of AAFC

apparent density（Kg/m^3）	fineness of iron ore tailing（mesh）	compressive strength（MPa）		
		3d	7d	28d
500	50	1.60	1.82	2.18
	100	1.73	1.94	2.37
	150	1.97	2.19	2.42
	200	2.01	2.33	2.56

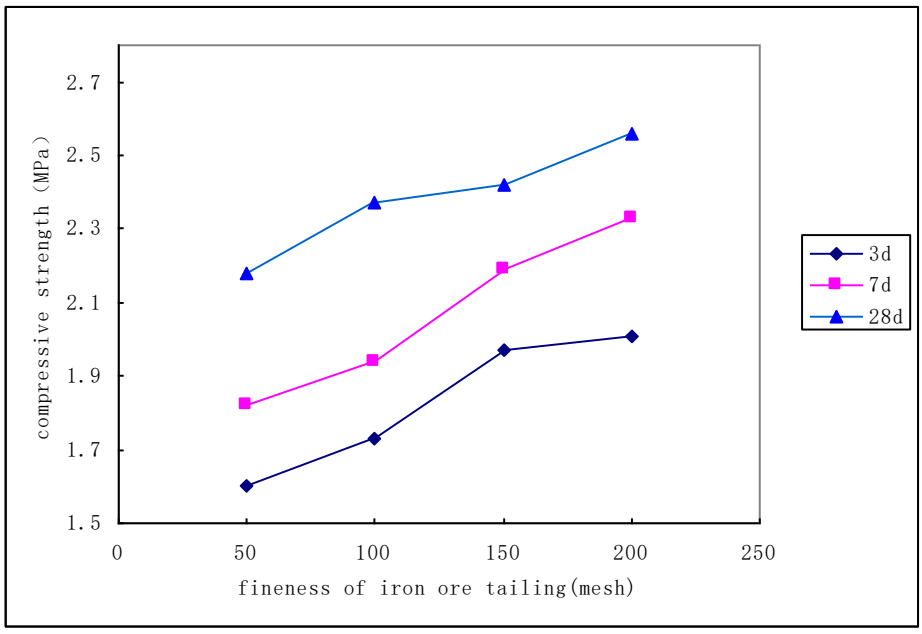

Figure 2 Influence of fineness of iron ore tailing on compressive strength of AAFC

Result are described in Table 5 and Figure 2 the compressive strength of alkali-activated slag foamed concrete increases gradually as the fineness increases of iron ore tailing When the fineness of iron ore tailing is 200 mesh, 28 days compressive strength of alkali-activated slag foamed concrete(apparent density is 700 Kg/m3) can reached 2.56 MPa in standard curing condition.

Adding of Specific Surface Area and Surface Energy of iron ore tailing because of the increases of fineness. It make iron ore tailing particles distribute more uniform and join tightly with the Alkali-activated Slag Foamed concrete.

Conclusions

(1)The compressive strength of alkali-activated slag foamed concrete increases on account of the hydration reaction is in process with prolonging curing time and adding apparent density.

(2) Too little or too much powder from iron ore tailing will reduce the compressive strength of alkali activated slag concrete, when powders from iron ore tailing achieving optimal amount, the compression strength of alkali-activated slag foamed concrete will be obviously improved.

(3)The compressive strength of alkali-activated slag foamed concrete increases gradually as the fineness increases of iron ore tailing

(4)When the fineness of iron ore tailing is 200 mesh, proportion reached 35%, 28 days compressive strength of alkali-activated slag foamed concrete(apparent density is 500 Kg/m3) can reached 2.56MPa in standard curing condition. It can satisfy the requirement of wall materials at present.

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