

Experimental Study on Aerated Concrete Produced by Iron Tailings

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Keywords: Iron tailings; Aerated concrete; Compressive strength

Abstract. The non-autoclaved aerated concrete block with greater than 7.5Mpa compressive strength is produced by using iron tailings, lime, aluminum powder, caustic alkali, water, cement and gypsum in the laboratory after the experimental study on the property of iron tailings produced by Anshan Iron and Steel Group. The optimal mix proportion is finally determined by adopting orthogonal experimental method, the evaluating indicator is compressive strength. Aerated concrete block that is made from iron tailing is trial produced according to the national standards, and then its strength is determined by sample examination.

Introduction

Aerated concrete block is a kind of lightweight material for wall with good performance such as insulation properties, anti-seismic performance, simple-construction, turning waste into treasure and lower price[1] etc. With the continuous development of science and technology, green building materials have been concerned about. Producing aerated concrete block by using iron tailings is in compliance with national policy of building materials, and is consistent with the development of building materials, especially has a remarkable economic benefits and social benefits in saving energy and protecting the environment[2,3].

Technical Evaluation

In this paper, the selected mine tailing is produced by Qidashan Iron Mine of Anshan Iron and Steel Corporation. Its main chemical composition content is shown as table 1.1, and its physical indicators are shown as table 1.2.

Table 1.1 Chemical composition content of Qidashan tailings[%]

Composition	TFe	FeO	SiO ₂	CaO	MgO	Al ₂ O ₃	MnO	P	S	Burning loss
Content	10.54	1.35	79.05	0.34	1.17	1.89	0.074	0.043	0.026	1.73

Tab1.2 Performance indicators of the mine tailing

Parameters	Measure value	Standard value	Conclusion	Note
Screening [mm]	—	—	Fine sand in III area	—
Mud content [%]	2.4	less than 5.0	Qualified	Assessed by less than the C30
Clod content [%]	0	<2.0	Qualified	Assessed by less than the C30
Water content [%]	7.39	—	—	—
Apparent density [kg/m ³]	2757.9	—	—	—
Bulk density[kg/m ³]	1864	—	—	—

The result of experiment indicates that there are no noxious substances, such as mica, sulfide and sulfate, and organic substance in mine tailings of Qidashan Iron Mine of Anshan Iron and Steel Corporation, which comply with the standard of Limit of radionuclides in building materials. Thus the amount is free and satisfies the requirements of related standards for concretes fine aggregate.

Experimental Research

According to the standard of Autoclaved Aerated Concrete Test Methods, the standard rock sample is produced and vibrated into shape. 24 hours later, the form is removed. Products are put aside in lab for 3 days and nights later and then are numbered and cured for 28 days. According to standard for test method of mechanical properties on ordinary concrete, standard rock sample with the size of 100×100×100 is continuous trial pressured. The material ratio of influencing on the material strength is shown as Table 2.1. The respective strength of each groups' mix proportion is shown as Table 2.2.

Table 2.1 The material ratio of influencing on the material strength

No.	1	2	3	4	5	6	7	8	9
Tailings/cement	0.94	0.89	0.97	0.87	0.84	0.9	0.79	0.76	0.82
C/W	1.8			1.75			2.13		
M(AL)	109.7			102.17			92.594		

C/W-- the ratio of cement to water

M (AL) – the quality of AL powder, unit [Kg]

Table 2.2 The respective strength of each groups' mix proportion [MPa]

No.	1	2	3	4	5	6	7	8	9
Strength of the first group	50	45	30	125	50	65	116	70	60
Strength of the second group	55	53	40	85	55	65	150	73	70
Strength of the third group	60	50	35	95	60	65	135	79	65
Mean Strength	5.5	4.91	3.5	10.17	5.5	6.5	13.37	7.4	6.5

The Performance Influences that Different Parameter Acts on Aerated Concrete. Water-cement ratio is the most important factor to effect on the strength of aerated concrete. Strength comparison of different water-cement ratio and different Al powder content is shown as table 2.3.

Table 2.3 Strength value of different water-cement ratio and Al powder content [MPa]

	I			II			III		
	2	5	8	1	4	7	3	6	9
Mt/Mc	0.89	0.84	0.76	0.94	0.87	0.79	0.97	0.9	0.82
c/w	1.8	1.9	2.13	1.8	1.9	2.13	1.8	1.9	2.13
MAL	109. 7	102.17	92.595	109.7	102.2	92.595	109. 7	102.17	92.595
mean Strength	4.91	5.5	6.07	5.5	10.17	13.37	3.5	6.5	5.83

Table 2.3 shows that the strength of aerated concrete is in direct proportion to the ratio of cement to water (C / W). The strength value of aerated is 5.5Mpa when the ratio of C / W is 1.8. The strength value of aerated concrete is 10.17Mpa when the ratio of C / W is 1.9. The strength value of aerated concrete reaches the peak (13.37Mpa) when the ratio of C / W is 2.13. The chemical reaction is analyzed that water must be added during the forming course of aerated concrete because of hydration reaction of cement or lime and the reaction of soda and Al. However, oversized water-cement ratio can affect the overall shape of aerated concrete and leads to the instability because of the bubble. The best water-cement ratio is 2.13 shown as table 2.3, and the maximum compressive strength at this time is 13.3Mpa.

Table 2.3 shows that the compressive strength of aerated concrete increases as the content of Al powder decreases. Detail illustration is as follow. Excessive Al powder that plays a role in absorbing air and decreasing the weight of aerated concrete can produce excessive and inhomogeneous bubbles due to the chemical reaction to alkali. Therefore, the strength of aerated concrete will be influenced.

Conclusions

Above all, it is feasible in technology to choose the erated concrete produced by Qidashan ore tailings of Anshan Iron and Steel Group Qidashan to produce concrete sample whose compressive strength is more than 7.5Mpa. Water-cement ratio, Al powder content and lime content have a great influence on the strength of aerated concrete.

Aerated concrete made from high-strength and lightweight iron tailings is an ideal load-bearing material to take place of the traditional clay brick. Aerated concrete with the strength is more than 7.5Mpa can be used as filling material for general and lower structure of the bearing wall and the frame structure.

The aerated concrete block produced with comprehensive utilization of mining, it can save energy and decrease pollution, in line with national policy on comprehensive utilization of resources, it has a widely market prospects, opening up a new way for the use of mine waste.

The application of mining slag to product aerated concrete has benefits in saving energy and controlling pollution. Therefore, the market prospect is favorable, and it can braze new road for application of mining slag.

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10.4028/www.scientific.net/AMR.250-253

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10.4028/www.scientific.net/AMR.250-253.853