

Experiment Research to Improvement the Soundness of Cementitious Material Blended with Cycled Fluidized Bed Ash

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Abstract This paper presents experimental results on the expansion by Le chatelier tester and the compressive strength. Hydraulic ash zeolite (HAZ) cementitious material was blended as the chemical activator to study the effects of the activator on the soundness. The results show that HAZ can not only deduce the expansion, but it can also make the prisms compressive strength increased obviously. FT-IR spectroscopic and X-ray diffraction analysis indicated that the main hydrated products of the sample are calcium hydroxide, ettringite, zeolite and calcite, which consisted with the results of the expansion and the strength tests.

Key words cycled fluidized bed ash (CFBA); soundness; cement clinker; free CaO; cementitious material

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The use of cycle fluidized-bed ash (CFBA) as a cement replacement in concrete is the most attractive one because of its high volume utilization and wide spread construction. A number of studies involved using different activating methods including alkali activation and sulfate activation^[1-4].

The purpose of this study was to find an effective and simple mix ratio of HAZ to keep the soundness of blend cement in which CFBA mix ratio ranged from 40 to 70 percents.

1 Experiment

1.1 Materials

The chemical compositions and main physical properties of the CFBA and cement used in this study were commercial obtained. Hydraulic ash-zeolite (HAZ) is a kind of hydraulic ash-slag cement material which was made up of some pozzolanic concrete dust, some byproduct of alkali industry, high blast furnace slag and some chemical agent. Fig.1 give the xrd of HAS mortar.

1.2 Experimental Procedure

Samples were determined using the China standard method (Publishing company for standard in China, GB1346-89).

2 Result and discussion

2.1 Expansion decrease

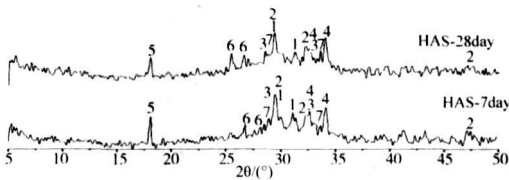


Fig.1 XRD of HAS mortar

- 1: $\text{CaMgSi}_2\text{O}_6$; 2: $\text{CaAl}_2\text{Si}_2\text{O}_8$;
3: CaAl_2SO_6 ; 4: $\text{CaAlSi}_2\text{O}_6$;
5: $\text{Ca}(\text{OH})_2$; 6: CaSO_3 ; 7: CaAl_4O_7

In Table 1, it can be seen that the pastes was broken when the CFBA replacement beyond 30%, in which there was no HAZ dosage. Table 1 shows that the maximum rate of the expansion deduce of the prism was achieved at 2% HAZ dosage. It can be concluded that the major parameter of the expansion is not the replacement of disposed CFBA but the HAZ dosage.

Tab.1 schemes and results of expansion

Cement/%	Cement clinker/%	CFBA/%	HAZ/%	Le chatelier value/mm
70	—	30	—	Broken
—	60	40	2	1.9
—	50	50	2	2.0
—	40	60	2	2.3
—	30	70	2	3.4
—	60	40	1	2.7
—	50	50	1	2.9
—	40	60	1	3.0
—	30	70	1	3.6
—	30	70	0.5	4.3

2.2 X-ray diffraction analysis

Fig 2 shows the X-ray diffraction (XRD) patterns of the samples hydrated for 3, 28 days with 2% HAZ dosage. In Fig 2 the XRD-A is the patterns of 3 days hydrated of the sample with 2% HAZ dosage. And in the patterns of XRD-B it can be seen that the main hydrated products of the sample are calcium hydroxide, ettringite, zeolite and calcite in the 28 days hydrated production. However acting as an activator with its addition in the binder, HAZ can not only deduce the expansion, but it can also make the prism compressive strength increased obviously.

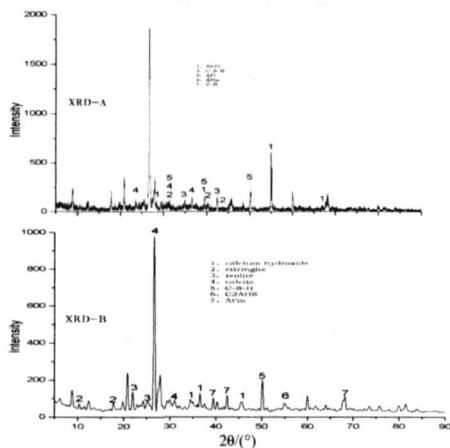


Fig 2 X-ray diffraction patterns

2.3 FR spectroscopic analysis

The FR spectra of the samples hydrated for 3, 14, 28 days with 2% HAZ dosage was given in Fig 3. In fact, HAZ hydration products was increasing and the high pH of HAZ solution resulted in the breakdown of the covalent bonds of Ca-O, Si-O, and Al-O from the glassy surface of CFBA. This cause the dissolution of calcium, silicon and aluminum ions, and as a result calcium silicate hydrate (C-S-H) gels are formed quickly by given the crystalloid inducement,

which is responsible for the expansion reduce and the compressive strength development of the prism macroscopical.

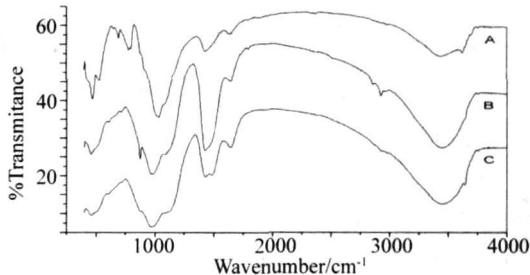


Fig 3 Infrared spectrum of specimens

3 Conclusion

The addition of HAZ compensate the expansion induced by the 70% replacement of disposed CFBA, the study results show that HAZ can not only deduce the expansion, but it can also make the prism compressive strength increased obviously. In the hydration products, there were some kinds of zeolite produced, this is consistent with the results of micro-study results.

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固硫渣安定性改良试验研究

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摘要: 通过测定雷氏值和无侧限抗压强度来研究沸石灰渣激发剂 (HAZ) 掺量对安定性的影响。结果表明 HAZ 不但可以提高改善固硫渣复合水泥的安定性而且可以很好的提高其强度。最好通过扫描电镜和 X 射线衍射分析实验试件的水化产物验证了安定性和强度实验得出的结论。

关键词: 固硫渣; 安定性; 水泥熟料; 活性氧化钙; 胶凝材料

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