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Research on ZWR Concrete Energy Saving Synergist

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Abstract. ZWR concrete energy saving synergist used in commodity concrete, were carried out experimental research and engineering application. The results show that the energy-boosters, in ensuring the overall performance of the concrete situation, as its content is 0.6% to 1% in cementitious material can reduce the amount of cement by 10% to 15%, significantly reduces production costs. Without changing the working properties and structural performance of the concrete，this energy saving synergist can reduce the risk of cracking and total alkali content in concrete.

1 Introduction

Concrete is the largest amount of construction materials, scholars from various countries has researched on the energy conservation of concrete industry from different academic perspectives [1-3].

ZWR concrete energy saving synergist is a new concrete performance tuning admixtures, its content is 0.6% to 1% in cementitious material can reduce the amount of cement by 10% to 15%, significantly reduces production costs. Since the product use case in Inner Mongolia region is relatively small, its performance in the commodity concrete was studied.

2 Test material

2.1 Cement

This test uses a certain brand named PO42.5. key performance indicators are listed in Table 1.

Table 1. technical indicators of testing cement.

After 3 days	Flexural strength (Mpa)	5.3
	Compressive strength (Mpa)	24.7
After 28 days	Flexural strength (Mpa)	7.8
	Compressive strength (Mpa)	50.5
Standard consistency Water (%)		27.4
Initial condensation time (min)		165
Final condensation time (min)		244
Stability		Accepted

2.2 Sand

Experimental sand comes from the local factories, it's main technical indicators as shown in Table 2.

Table 2. technical indicators of testing sand.

Fineness modulus	Clay content (%)	Mud content(%)	Apparent density(kg/m^3)
2.5	1.2	0.2	2.62

2.3 Gravel

This test uses local 5-25mm continuous graded gravel; its main technical indicators are shown in Table 3.

Table 3. Technical indicators of testing gravel.

Clay content (%)	Mud content (%)	Flakiness content(%)	Crushing index value (%)	Apparent density (kg/m^3)
0.2	0.2	6	4.5	2.73

2.4 Fly ash

This test uses level I fly ash,it's technical parameters are listed in Table 4.

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Table 4. Technical indicators of testing fly ash.

Level	0.045mm square hole sieve (%)	Water requirement ratio (%)	Loss on ignition (%)
Ⅰ	7.8	94	2.9

2.5 Mineral Powder

Test uses S95 mineral powder, technical parameters as shown in Table 5.

Table 5. Technical indicators of testing mineral powder.

Grade	Specific surface area (kg/m^2)	Activity index (%)		Liquidity ratio (%)
		7d	28d	
S95	424	82		102

2.6 Superplasticizer

Test uses aliphatic efficient pumping admixture content of 1.5% superplasticizer. It's technical parameters are listed in Table 6.

Table 6. Technical indicators of testing pumping.

Density (g/cm^3)	PH	Solid content (%)	Water reduction (%)
1.20	11	35	22

2.7 Synergists

Test uses ZWR concrete synergists, it's technical performance as shown in Table 7.

Table 7. Technical indicators of testing pumping.

Density (g/cm^3)	PH	Solid content(%)	Water reduction (%)
1.005	10.5	10	5

3 Figures and tables

3.1 Concrete benchmark sample test

According to the current commercial concrete mixing ratio, Benchmark tests were completed, when wet sand contains 5% water.C30 proportion data is shown in table 8.

Table 8. C30 grade concrete products (Unit: kg).

NO.		1	2	3	4
volume		$1m^3$	25L	$1m^3$	25L
Cement		300	7.5	200	5
Mineral powder		/	/	100	2.5
Fly Ash		60	1.5	60	1.5
Pumping agent		5.4	0.135	5.4	0.135
Water		135	3.375	135	3.375
Sand		800	20	800	20
Gravel		1000	25	1000	25
Compressive strength(MPa)	3d	/	/	/	/
	7d	/	19.8	/	21.8
	28d	/	34.6	/	35.6

The results are shown in Table 9.

Table 9. Technical indicators of C30 grade concrete products.

NO.		1	2	3	4
Concrete slump	(SL_O,mm)	195		185	
	(SL_{1h},mm)	185		175	
Extended degree (mm)		480		430	
Workability of concrete		good		good	

3.2 Concrete added energy saving synergist WZR test

According to the table 3.1, we adjust the concrete mix and reduce 10% to 15% of the amount of cement, WZR's content is 0.6% to 1% in cementitious material incorporated in concrete. Other raw material used in the concrete does not change. C30 proportion data is adjusted in table 10.

Table 10. adjusted C30 grade concrete products (Unit: kg).

NO.	5	6	7	8
volume	1m3	25L	1m3	25L

Cement		264	6.6	171	4.28
Mineral powder		/	/	86	2.1
Fly Ash		66	1.65	63	1.58
Pumping agent		4.9	0.124	4.9	0.124
Water		120	3	120	3
Sand		802	20	802	20
Gravel		1064	26.6	1064	26.6
WZR		2	0.05	2	0.05
Compressive strength(MPa)	3d	/	/	/	/
	7d	/	21.5	/	22.5
	28d	/	34.9	/	35.9

The results are shown in Table 11.

Table 11. Technical indicators of adjusted C30 grade concrete products.

NO.		5	6	7	8
Concrete slump	(SL_O,mm)	200		195	
	(SL_{1h},mm)	190		185	
Extended degree (mm)		490		450	
Workability of concrete		good		good	

3.3 Result Analysis

(1) in this test, WZR concrete Energy Savingsynergists can reduce the amount of cement from 12 to 15 percent, making the same performance concrete(including concrete strength at 7 and 28 days).

(2) under the conditions of using synergists, cement concrete reduces 36 kg/m^3, pumping agent reduces 0.5kg / t, Energy Saving synergists increases 2.0 kg/m3, gravel increase 60kg /m3. Profits increases 4.18 RMB yuan/m^3.

4 Synergist mechanisms

ZWR concrete Energy Saving Synergist are mixed by a number of organic chemical compound formed, it's key component enhanced by organic chemical synthesis alone and without any inorganic salts and alkali activator. Some studies[4-6] have shown that about 15% -20% cement in concrete are not fully hydrated, just filling the role, cannot be effectively dispersed react, actually belong to the surplus cement.

ZWR concrete Energy Saving synergists can emulsify the cement, it's molecules adsorbed on the surface of cement particles, forming a hydrophilic membrane layer, Hindering the cement particles agglomerate and resulting in a suspension stabilizing effect.[7-8]

Dissolved in water, ZWR molecules lowers the surface tension of solution, so that the cement particles are better contacted with the water, accelerating wetting and penetration, reducing the number of bladders, thereby improving the impermeability, dense concrete and strength of concrete.

5 Conclusions

(1) ZWR synergists concrete can be significantly improved cohesiveness and pumpable of concrete, and it has good adaptability to different concrete materials. ZWR synergists content is 0.6% to 1% in cementitious material can reduce the amount of cement by 10% to 15%, significantly reduces production costs.

(2) Without changing the premise of concrete work performance and structural properties, reducing the amount of cement that can indirectly improve due to the early strength of high-strength cement-induced early concrete cracking and reduce total alkali content of concrete structures, also indirectly improve the durability of concrete.

References

1. Kazuhiro Yoshioka, Ei-ichi Tazawa, Kenji Kawai, etal. Adsorption characteristics of superplasticizers on cement component minerals. Cement and Concrete Composites . 2002.
2. Michel Pigeon, Jacques Marchand, Richard Pleau. Frost Resistant Concrete. Constructionand Building Materials . 1996.
3. Tarun R Naik, S. Singh. Influence of fly ash on setting and hardening characteristics of concrete system. ACI Materials Journal . 1997.
4. Sun Zhiqiang, Yuan Haidong. Application of synergists in concrete [J]. Concrete, 2010 (9).
5. Li Qingchuan, Chen Hongtao, Chen Xiangrong, etc., Affect of CTF synergists concrete impermeability on concrete [J], commercial concrete, 2011.03, pp37-39.
6. Wang Guodong. Effect of synergists in properties of concrete Study on [D]. Beijing University of Architecture 2013.
7. Yan Xijiao. CTF test and application of concrete with a synergist [J]. Concrete, 2010 (10)
8. Zhou Xingwang. Application of CTF synergists concrete in self-compacting concrete [J]. Concrete, 2011 (8).