Experimental Study on Durability of Recycled Concrete

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Abstract: Utilizing desert concrete to make recycle concrete can reduce the consumption of natural resources, occupancy of cultivable land and environmental pollution. In this dissertation, durability of concrete which made of simply crushed recycled aggregate (RA), particle shaped RA and normal aggregate are compared by shrinkage test, chloride penetration test, carbonation test and free-thaw test. The results show that particle shaped technique not only can be used to make high quality RA and improve the durability of recycled concrete, but also provide basic experimental data on developing the application of recycled concrete.

Key words: particle shaped; recycled aggregate; recycled concrete; simply crushed
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Abundant desert concrete will be produced when the constructions are dismantled. Through the procedure of cleanout, crushing by the jaw crusher, categorizing by the sieve, simple fine and coarse recycled aggregate (RA) are obtained by the desert concrete. After particle shaped (PS) the simple crushed (SC) RA is changed into PSRA which properties is improved[1]. Application of recycled concrete, cast with partial or all recycled aggregate, is suitable for the cosmopolitical sustainable development policy. Meanwhile, durability of concrete structures are concerned on highly now. Therefore, performance of RA concrete under the climate bad should be investigated before put it into practice.

1 Experiments

In order to investigate the difference of durability between recycled concrete and normal concrete, SCRA or PSRA is replaced the normal aggregate. The experiment scenario is shown in details in Tab. 1.

Tab. 1 Mix Proportion kg/m³

No.	Coarse aggregate		Fine aggregate		C	W	Slump	SP
TT4	Normal		Normal			170.4	100	
R′R′4	PSRA	1120	PSRA	690	400	190.0	90	1%
RR4	SCRA		SCRA			211.5	80	
TT5	Normal		Normal			172.7	100	
R′R′5	PSRA	1070	PSRA	660	500	187.9	85	1%
RR5	SCRA		SCRA			205.3	85	

2 Results and discussion

2.1 Shrinkage test

Results in Fig. 1 show that shrinkage of recycled concrete is higher than that of normal concrete. The dominant reason is a great deal of harden cement mortar adhered on the RA, make it easy to absorb water and more capillary means higher shrinkage[2-3]. After particle shaped, harden cement mortar are deleted from RA then particle angularity change to well-proportioned. Therefore, the long term shrinkage of R′R′4 & R′R′5 is lower than RR4 & RR5 respectively.

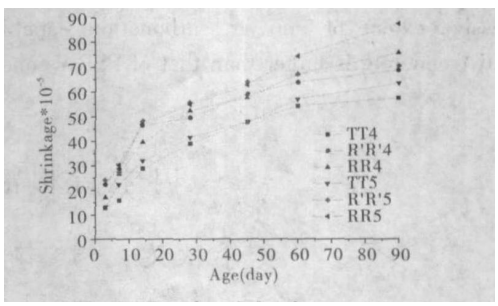

Fig. 1 Results of shrinkage test

2.2 Chloride diffusion test

Results in Tab. 2 are drawn from RBAC-Test, i.e.

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accelerated chloride iron electro-migration test. D_{RCM} of SCRA concrete is more than 3 times of normal concrete, while D_{RCM} of PSRA concrete is nearly 2 times of normal concrete. Consequently, under the Cl- corrosion circumstance, application of recycled concrete should be discreet.

Tab. 2 Chloride diffusion coefficient by RCM method

Mix No.	TT4	R′R′4	RR4	TT5	R′R′5	RR5
D_{RCM} $\times 10^{-12}$ m²/s	7.179	14.354	24.536	6.201	13.515	21.089

2.3 Freeze-thaw test

During the accelerated freeze-thaw test, the relative dynamic modulus elasticity of all specimens didn't drop to 60% and weight loss ratio didn't exceed 5%. So the test was ended until 300 cycles. Data illustrate in Fig. 2 indicate that freeze resistance of SCRA concrete is far from normal concrete, however PSRA concrete is nearly the normal concrete on freeze-thaw resistance. Accordingly, it is a good choice to use PSRA concrete in cold area.

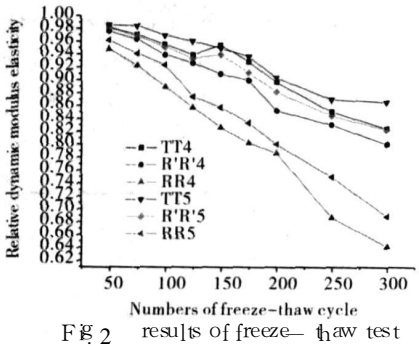

Fig. 2 results of freeze-thaw test

2.4 Carbonation Test

Carbonation depth is illustrated in Fig. 3. The degressive extent of anti-carbonation capability of SCRA concrete is larger than that of PSRA concrete and normal concrete. Along with the cement amount increase the carbonation depth decrease in the recycled concrete.

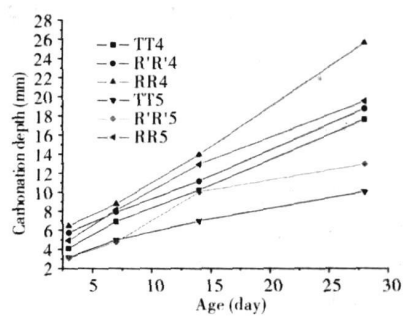

Fig. 3 relation of carbonation depth & age

3 Conclusion

Properties of shrinkage, Cl- penetration, anti-frost and carbonation are no better than normal concrete. However, anti-frost and carbonation performance is improved after particle shaped, i.e. correspond to normal concrete. The dominant reason is particle shaped make water requirement of RA concrete reduced. These characters are propitious to extend the application of recycled concrete.

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再生骨料混凝土耐久性试验研究

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摘 要: 利用废弃混凝土制备再生骨料, 可以降低天然资源损耗、减少耕地占用和降低环境污染。通过收缩试验、氯离子渗透试验、碳化试验、冻融试验等对比研究了简单破碎再生骨料、颗粒整形再生骨料、天然骨料混凝土的耐久性能。结果表明, 颗粒整形可以制备高品质再生骨料, 从而显著提高再生混凝土的耐久性能。为拓宽再生混凝土的应用领域提供了试验依据。

关键词: 再生骨料; 再生骨料混凝土; 简单破碎; 颗粒整形

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