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Investigation into the effectiveness of

abil-strength

in improving concrete strength

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Introduction

At the request of Ability Building Chemicals Co, manufacturer of "*abil-strength*", this laboratory has carried out a testing program to determine the effect on concrete strength of various dose rates of "*abil-strength*" powder. Concrete containing 5 and 10% *abil-strength* has been tested for air content, and compressive and flexural strength at 28 days with and without 7 days of curing.

Summary of results

- Compared to the control concrete (0% abil-strength), 5% abil-strength increased the compressive strength by 32% in 7-day cured concrete and by 33% in uncured concrete. 10% abil-strength delivered gains of 39% and 70% respectively.
- Flexural strengths rose by 34% (7-day curing) and 44% (no curing) with 5% abil-strength. The respective gains with 10% abil-strength were 46% and 50%.
- Air contents in the 0, 5 and 10% abil-strength concrete were about 1, 5 and 3_% respectively.

Details of the trials

Concrete mix design

The concrete used was nominally 32 MPa, and was prepared in a rotary drum mixer. Ingredients were:

Cement (Blue Circle type GP)	310 kg/m3
20 mm stone (Barro Building Supplies)	920 kg/m3
Concrete sand (Barro Building Supplies)	990 kg/m3

Both aggregates were used in an air-dry condition. Two mixes were made at each of three dose rates of *abil-strength* powder: 0, 5 and 10% by mass relative to cement content. Water was added to a slump of 80 mm for the control mixes. However for the mixes containing abil-strength I found that to achieve efficient mixing, extra water had to be added such that the slump was about 120 mm at 5% abil-strength and about 140 mm at 10%.

Mixing was continued for 10 minutes after water addition. Concrete temperature was 12 to 13 °C at the time of mixing.

Compressive strength

Four cylinders (200 X 100 mm) were cast from each mix and demoulded after 24 h. Two were cured in lime-saturated water at 23 ± 2 °C for 6 days and thereafter allowed to dry in air at the same temperature. The other two were kept in air at 23 ± 2 °C from demoulding onwards. Compressive strength was determined, by the method of AS 1012.9, at 28 days.

Flexural strength

Two beams (365 x 100 x 100 mm) were cast from each mix, demoulded after 48 h and cured and dried as above (except that water curing was for 5 days). Flexural strength, to AS 1012.11, was determined at 28 days.

Air content

On one mix at each dose rate, the air content of the concrete was determined using a concrete air meter and the method of AS 1012.4.

Test results

Compressive strength

The table below shows the strengths in MPa as the average of four cylinders. Individual cylinder strengths are shown in the appendix.

Dose rate, %	6 days curing after demoulding	No curing after demoulding
0	37.0	21.8
5	48.7	29.1
10	51.4	37.1

Flexural strength

The following results are the average of two beam strengths, in MPa. Individual beam strengths are shown in the appendix.

Dose rate, %	6 days curing after demoulding	No curing after demoulding
0	3.5	3.2
5	4.7	4.6
10	5.1	4.8

Air content and mean water / cement ratio

Dose rate, %	Air content, %	Water / cement ratio
0	1.2	0.62
5	4.9	0.52
10	3.4	0.48

Discussion

With either six days water-curing after demoulding, or none, the incorporation of abil-strength into this concrete produced large increases in compressive and flexural strength at 28 days. Much of this improvement can be attributed to the water-reducing effect of abil-strength; reductions in water / cement ratio from 0.62 to 0.52 and 0.48 would be expected to result in compressive strength gains of around 24 and 36%. The additional gains, to as much as 70%, may be at least partly as a result of slower water loss from the specimens in the presence of abil-strength; however I have no direct evidence for this.

Higher strength gains still would be expected if the abil-strength concrete had been mixed to the same slump as the control. With this mix design, and in this mixer, the slumping of the abil-strength concrete was so slow as not to occur while the mixer was turning unless so much water was added that the slump, as measured with a slump cone, was well above the 80 mm nominal target. Even so, abil-strength was still an effective water-reducer and air-entrainer.

Appendix

Individual cylinder and beam strengths

	Compressive strength, MPa		Flexural strength, MPa	
Dose rate, %	6-day water curing	No water curing	5-day water curing	No water curing
0	34.4 36.2 38.7 38.5	19.1 18.1 24.4 25.5	3.4 3.6	3.0 3.4
5	44.6 47.1 51.6 51.6	27.4 27.4 31.8 29.9	4.7 4.7	3.9 5.4
10	49.7 49.7 52.8 53.5	36.9 35.0 38.8 37.6	5.4 4.8	4.5 5.2