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Testing of Screed Materials

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MATERIALS AND ENGINEERING
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1. Objectives

Evaluate the relative performance of Oscrete brand floor screed material (Oscreed QD) against a leading competitor brand floor screed material (*k* screed). Investigate the following three compositions:

- Screed material containing 500g per tonne of *k* screed
- Screed material containing 250 g per tonne of Oscreed QD
- Screed material containing 500g per tonne of Oscreed QD

Determine the following properties to evaluate the relative performance of the screed materials: rate of drying, compressive strength, flexural strength.

2. Materials and test samples

Materials used for the screed compositions were as follows: Cement - CEM 1(52.5 N) supplied by Hanson at Ribblesdale. Calcium Carbonate - Betocarb from Omya, Melton Lound. Sand (washed) from Astley Moss, of grain size 0-4 mm.

The following three compositions of screed materials were prepared:

- *k* screed material (symbol K) a 1:4 sand/cement screed which included 500 g/tonne of *k* screed admixture, resulting in a w/c ratio of 0.42.
- Oscreed QD Low Dosage material (symbol OL) containing 250 g/tonne of Oscreed QD instead of the *k* screed admixture. The mix design used was a 1:4 sand/cement screed - as per the *k* screed. This mix resulted in a reduced w/c ratio of 0.40.
- Oscreed QD High Dosage material (symbol OH) with the same composition as OL but containing 500 g/tonne of Oscreed QD (instead of 250 g/tonne) resulting in a reduced w/c of 0.38.

Each of the three compositions of the screed materials were mixed in a pan mixer. Sufficient water was added to each mix to give a constant workability (compressibility) which was determined visually followed by squeezing a handful of the mix with a constant pressure of the fist. The consistency of the material was deemed as similar to that which would be delivered to site.

The following samples were made for each mix: three 50x50x50 mm cubes, three 40x40x160 mm prisms, one 500x500x25 mm thick panel, one 500x500x50 mm thick panel and one 500x500x75 mm thick panel.

The cubes and prisms were cast in steel moulds. The panels were cast in timber moulds which were lined with polythene sheeting as shown in Photo 1. Compaction was provided by tamping with the wooden levelling float, without any vibration or rod tamping.

All samples were cured in the laboratory air. The panel samples of all the three screed compositions (K, OL and OH) were made together at the same time and cured in the same environment (laboratory air). This ensured that daily variations in relative humidity of the air affected the drying rate of all panels similarly. Relative performance of the screed materials could, therefore, be assessed.

3. Testing

A panel of thickness 25, 50 and 75 mm for each composition of screed material was tested to determine its rate of drying. Tests were carried out in accordance with BS8203:2001+A1:2009.

A Protimeter Hygromaster was used to measure the relative humidity of a pocket of air entrapped in the cavity between an impervious thermally insulated housing and the surface of the panel.

A Protimeter Foam Humidity Box (Photo 1) was firmly sealed to the panel surface and sufficient time (over 4 hours) was allowed for the entrapped air to reach moisture equilibrium with the panel. The relative humidity of the entrapped air was then measured with the Protimeter Hygromaster by inserting the humidity probe into the entrapped air cavity through the hole shown plugged in Photo 1.

The panel samples were exposed to the laboratory air after casting. Relative humidity of the air was measured at 1,2,3,4 and 7 days age.

The cubes and prisms were tested at 28 days age to determine the compressive strength and modulus of rupture respectively. The tests were carried out according to EN 13892-2. The 40x40x160 mm prisms were tested in flexure over a span of 100 mm with a concentrated load applied at mid span.

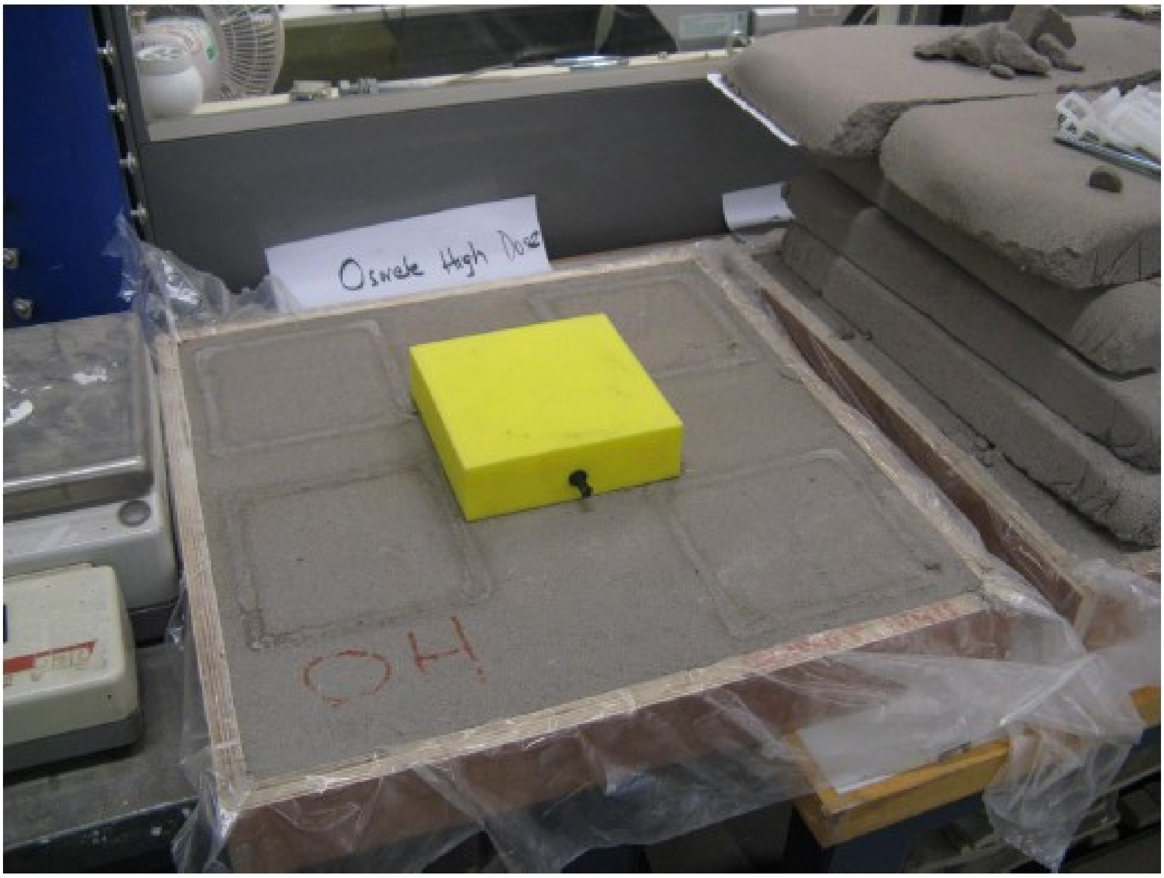

Photo 1: Foam humidity box entrapping a cavity of air on the panel surface, showing the plugged hole where the humidity probe is inserted.

4. Results and Discussion

4.1 Rate of Drying

The relative humidity data at the ages of 1 to 7 days for the 25 mm thick panel are given in Table 1. The drying rates of the three screed materials are quite similar but with panel OH showing some improvement. For example, at day 1, the relative humidity for panels K, OL and OH was 80%. 80.7% and 78.2% respectively. The corresponding values at 4 days were 46.5%, 45.4% and 42% respectively.

The data for the 50mm thick panels are given in Table 2. The drying rate is similar for all the materials (K, OL and OH) for the first 3 days. The relative humidity for each material is about 80% on day 1 and decreases to about 66% - 67% on day 3. Subsequently the drying rate remains similar up to 7 days age for materials K and OL dropping to a relative humidity about 58% at day 7. The relative humidity of material OH is up to 4% lower at days 4 and 7 compared with the other materials.

The data for the 75 mm thick panels are given in Table 3. The drying rate is similar for all materials (K, OL and OH). The relative humidity at day 1 is about 77% for each material and decreases in similar increments to about 60.5% at 7 days.

The overall observation is that the drying rate of the 50 mm and 75 mm thick panels is not significantly affected by the screed material. The drying rate of the 25 mm thick panels of the OH material, however, is significantly faster than the other materials.

4.2 Strength

The 28 day flexural strength (modulus of rupture) data are given in Table 4. The mean modulus of rupture of materials K and OL is similar (3.28 and 3.15 N/mm² respectively). The value for material OH is higher at 3.36 N/mm².

The 28 day compressive strength data are given in Table 5. The mean compressive strength for K and OL is similar (23.3 and 22.9 N/mm² respectively). The mean strength of the OH material is higher at 27.3 N/mm².

4.3 Density

The results in Table 4 show that the density of all materials is similar with values ranging between 2044 to 2064 kg/m³.

5. Conclusions

The following conclusions apply to the screed materials investigated, namely k screed, Oscreed QD low dosage (OL), Oscreed QD high dosage (OH).

- The high dosage Oscreed QD screed panels (OH) of 25 mm thickness have a faster rate of drying than all the other screed materials
- All materials have similar drying rates at higher thicknesses (50 mm and 75 mm)
- The density of all the materials (K, OL and OH) is similar
- The modulus of rupture of materials K and OL is similar. It is higher for material OH
- The compressive strength of materials K and OL is similar. It is higher for material OH
- The performance of Oscreed QD (OL) dosed at 250g / tonne is equivalent to *k* screed dosed at 500g / tonne

Panel	Age Days	Panel RH %	Panel Temp Deg. C	Lab. air RH %	Lab. air Temperature Deg C	Test Location
K screed	1	80	20.3	30.3	21	Middle
	2	75.6	21	41.5	20	Middle
	3	56.7	20.2	36	22	Corner 1
	4	46.5	20.1	30	20.5	Corner 2
	7	38.6	20.8	32.5	21	Corner 3
O - Low	1	80.7	20.8	30	21	Middle
	2	75.2	20.3	41.5	20	Middle
	3	51.5	20.8	36	22	Corner 1
	4	45.4	20.3	30	20.5	Corner 2
	7	38.6	20.8	32.5	21	Corner 3
O - High	1	78.2	20.5	32.6	21	Middle
	2	73.1	20.3	32.6	21	Middle
	3	50.1	20.2	36	22	Corner 1
	4	42	20.3	30	20.5	Corner 2
	7	37.4	20.8	32.5	21	Corner 3

Table 1: Drying Rate of 500x500 x **25mm thick panels of screed**

Panel	Age Days	Panel RH %	Panel Temp Deg. C	Lab. air RH %	Lab. air Temperature Deg C	Test Location
K screed	1	80.6	21	29.7	21	Corner 1
	2	70.0	20.5	37.5	20	Corner 2
	3	66.7	20.5	43.7	20.3	Corner 3
	4	64.7	20.2	32	20.2	Corner 4
	7	58.6	20.4	41.4	20.4	Middle
O - Low	1	81.7	21	29.7	21	Corner 1
	2	71.3	20	37.5	20	Corner 2
	3	67.2	20.2	43.7	20.3	Corner 3
	4	63.1	20.8	32	20.2	Corner 4
	7	58.0	21.5	41.4	20.4	Middle
O - High	1	80.3	21	29.7	21	Corner 1
	2	69.8	20	37.5	20	Corner 2
	3	67.1	20.2	43.7	20.3	Corner 3
	4	59.1	21.2	32	20.2	Corner 4
	7	55	21	41.4	20.4	Middle

Table 2: Drying Rate of 500x500 x **50mm thick panels of screed**

Panel	Age Days	Panel RH %	Panel Temp Deg. C	Lab. air RH %	Lab. air Temperature Deg C	Test Location
K screed	1	77.2	20.2	43.6	19.7	Corner 1
	2	72.2	21	44	21	Corner 2
	3	65.4	20.5	34	20.4	Corner 3
	4	61.4	20.8	30.3	20.3	Corner 4
	7	60.2	21.1	41.6	21.2	Middle
O - Low	1	77.4	41.6	21.2	21	Corner 1
	2	72.2	21	44	21	Corner 2
	3	65.8	20.6	34	20.4	Corner 3
	4	61.4	20.3	30.3	20.3	Corner 4
	7	60.6	21.5	41.6	21.2	Middle
O - High	1	77.6	20.1	43.6	19.7	Corner 1
	2	68.5	21.5	44	21	Corner 2
	3	61.4	22	34	20.4	Corner 3
	4	60.5	20.3	30.3	20.3	Corner 4
	7	59.9	21.0	41.6	21.2	Middle

Table 3: Drying Rate of 500x500 x **75mm thick panels of screed**

Screed material	Cube weight, g	Density, kg/m³	Flexure load, N	Modulus of rupture, N/mm²
K	524	2046	1326	3.11
	531	2075	1443	3.38
	530	2071	1435	3.36
		Mean = 2064		*Mean = (3.28)*
OL	527	2059	1340	3.14
	525	2050	1348	3.16
	529	2065	1346	3.15
		Mean = 2058		*Mean = (3.15)*
OH	523	2044	1375	3.22
	525	2052	1463	3.43
	521	2036	1470	3.44
		Mean = 2044		*Mean = (3.36)*

Table 4: Density and Modulus of Rupture at 28 days

Screed material	Weight, g	Density, kg/m³	Crushing load, kN	Compressive strength, N/mm²
K	252	2016	56.50	22.6
	254	2032	60.00	24.0
	254	2023	57.90	23.1
		Mean = 2024		*Mean = (23.3)*
OL	256	2048	56.75	22.7
	252	2016	57.75	23.1
	254	2031	56.90	22.8
		Mean = 2032		*Mean = (22.9)*
OH	256	2048	67.25	26.9
	254	2032	69.25	27.7
	255	2041	68.50	27.4
		Mean = 2040		*Mean = (27.3)*

Table 5: Compressive Strength and Density at 28 days