

TEST REPORT

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Project Title: Testing of Properties of Magnesium Oxide Board in Accordance with BS EN 12467:2004

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**TESTING OF PROPERTIES OF MAGNEISUM OXIDE BOARD
IN ACCORDANCE WITH BS EN 12467:2004**

1. INTRODUCTION

A magnesium oxide board was supplied by Enviroboards for testing for material characterisation in accordance with BS EN 12467:2004 Fibre-cement flat sheets. Product specification and test methods and for cyclic loading and tensile strength in accordance with Ceram in-house test methods

2. SAMPLE DESCRIPTION

Magnesium oxide board of nominal dimensions 800mm x 800mm x 28mm thick.

3. TEST PROGRAMME

Samples of board were tested under the following modes:

- Tensile strength
- Heat rain weathering incorporating thermal shock
- Waterproofing
- Cyclic load test

4. METHOD OF TEST

4.1 Tensile Strength

Five sections of board 600mm tall by 125mm wide were cut from larger board samples. These were shaped so as to produce a dog bone sample with a 60mm wide central waist.

A steel clamp was fixed to the top and bottom of the sample and the sample was conditioned for 48 hours at 50% relative humidity (RH) and a temperature of 20°C before immersing in water for 48 hours.

The sample was fixed down to the structures lab strong floor and a steel pyramid reaction frame was positioned so that the centre of the top clamp was in line with the sample. On top of the reaction frame, a calibrated load cell and hydraulic pull-through ram was positioned. A M12 threaded bar was guided vertically through the whole system and screwed into the spreader plate, the opposite end of the threaded bar clamped the whole system via a M12 nut and washer. A tensile load was applied to the sample at a rate such that failure occurred within 3-5 minutes. A hydraulic pump was used to apply the load via the hydraulic pull-through ram. Load was recorded via a calibrated data logger.

4.2 Water Impermeability

Three no. 400x400mm specimens were received from the client. These were conditioned at ambient laboratory temperatures for 7 days prior to sealing the sample into the test frame and filling with water to a depth of 20mm above the face of the sample.

The samples were left in controlled lab conditions at 23°C and 55%RH for 24 hours.

The underside of the sample was examined for any signs of moisture or dripping water.

4.3 Heat-Rain Incorporating Thermal Shock

800x800mm samples of the board were fixed back to a 2.4m x 3.2m vertical lightweight steel frame with studs at 800mm centres. The boards were screwed back to the studs with 4 no. 5.5x55mm self-tapping, self-drilling screws one into each corner.

The sample was placed into a large scale hygrothermal test chamber such that the face of the sample would be subjected to the test conditions.

The sample was subjected to 50 cycles of heat rain as follows:

Cycles	Duration	Conditions
Water spray	2hr 50 min	1l/m ² /min at a water temperature of 15°C
Pause	10 min	Ambient
Radiant heat	2hr 50min	60°C at a ramp rate of 15 minutes
Pause	10 min	Ambient
Total cycle Time	6hrs	-
Repeats		50

The sample was examined daily for signs of cracking, blistering or delamination.

On completion of the heat rain regime three samples were cut to 400x400mm and the samples were subject to water impermeability testing as in 4.2 above.

4.4 Cyclic Loading

Two 800X800mm panels were immersed in water for two days. One panel was subjected to a three point bending test to establish the maximum load the panel could take under flexure.

The second 800x800mm panel was fitted onto a two sided rigid steel frame such that the panel was fixed at 150mm centres to the two edges.

A Central load plate was fitted to the centreline of the panel over a 50mm strip and was connected to a 120kN tensile and compressive actuator.

The following load cycles were applied 10 times at a frequency of 2Hz:

No. of Cycles	Applied Load (kN/m ²)
100	0.9 x W _p
9600	0.4 x W _p
3600	0.6 x W _p
1240	0.5 x W _p
115	0.8 x W _p
214	0.7 x W _p

Where W_p = W_F/2= admissible load
W_F = Failure load established from three point bending test

On completion of the test the sample was examined for any signs of deterioration, cracking or warping.

5. RESULTS

5.1 Tensile Strength

The tensile strength of the board is given in the table below:

Test number	Load (kN)	Tensile strength (N/mm ²)
1	5.35	3.29
2	5.15	3.17
3	5.25	3.23
4	5.30	3.26
5	5.25	3.23
Mean	5.26	3.24

5.2 Water Impermeability

The board showed no signs of water penetration after the 24 hour test. No dampness or dripping on the undersides of the sample was noted.

5.3 Heat-Rain Incorporating Thermal Shock

The samples showed no warping, cracking, blistering or delamination after being subjected to 50 cycles of heat- rain incorporating thermal shock from the water spray.

The tested samples were subjected to a water impermeability test on completion of the cycles. These showed no signs of water penetration after the 24 hour test. No dampness or dripping on the undersides of the sample was noted.

5.4 Cyclic Loading

The sample showed no signs of cracking, distortion or delamination after being subjected to the cyclic load conditions.

6. DISCUSSION

A category A board as defined in BS EN 12467:2004 Fibre-cement flat sheets. Product specification and test methods are defined as:

“sheets which are intended for applications where they may be subjected to heat, high moisture and severe frost.”

6.1 Tensile Strength

The tensile strength tests were not included in BS EN 12467:2004 hence were carried out in accordance with a Ceram in-house test method.

All results were consistent with a calculated mean of 3.24N/mm².

6.2 Water Impermeability

According to BS EN 12467 a category A sheet is allowed to show traces of moisture on the under surface of the sheet but shall not show any formation of water drops.

The sheets showed neither traces of moisture nor water drop formation therefore would be classed as a category A sheet in accordance with the standard.

6.3 Heat-Rain Incorporating Thermal Shock

According to BS EN 12467 after 50 cycles of heat rain testing any visible cracks deformation, delamination, warping and bowing or other defects in the sheets should not affect the performance of the sheet in use.

No bowing, warping, cracking or delamination was noted. The sheets showed no deterioration in their water impermeability performance after testing showing neither traces of moisture nor water drop formation. The sheet therefore would be classed as a category A sheet in accordance with the standard.

6.4 Cyclic Loading

The cyclic load tests were not included in BS EN 12467:2004 hence were carried out in accordance with a Ceram in-house test method.

On completion of the cyclic tests the panel showed no deterioration with no signs of deformation, delamination, warping and bowing. The fixing sites showed localised minor powdering on the face of the sample.