

Hygienic and Antimicrobial Paint Testing

For

Vechro S.A.

Final Report

Work Carried Out By

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Global Surface Coatings Covered



Final Report

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Work Requested Hygienic and Antimicrobial Paint
Testing

Samples Submitted 1 Liquid Paint

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I Materials Submitted For Testing

One litre Smaltoplast Silk White was received in September 2007 and was tested for application properties, appearance, chip resistance, adhesion, hiding power, gloss/sheen, drying and recoatability times, fungal resistance testing to BS 3900:G6 and anti microbial activity against *Staphylococcus aureus* and *Escherichia coli*

1 litre of Smaltoplast Silk White was received in December 2007 and was tested for wet scrub resistance, cleanability and spreading rate .and antimicrobial activity against *Pseudomonas aeruginosa*

A reference hygienic wall coating supplied by PRA for comparison.

2 Test Procedure

2.1 General Paint Properties

Application Properties

This was assessed on plasterboard sealed with thinned emulsion paint. Both roller and brush application were assessed. Several aspects of application were considered.

Roller Application. (Area applied 1200mm x 900mm)

Ease of roller loading - Rated as easy, acceptable or difficult.

Ease of application - Rated as easy, acceptable or difficult.

Degree of foaming - Rated as none, slight , moderate or severe.

Amount of spatter - Rated as none, slight, moderate or severe.

Brush Application. (Area applied 1200mm x 300mm)

Ease of brush loading - Rated as easy, acceptable or difficult.

Ease of application - Rated as easy, acceptable or difficult.

The coverage in m²/litre of the paints was calculated for both roller and brush application.

Appearance

The paints were applied to sealed plasterboard by brush and roller. Black and white charts were attached to the board to aid in the assessment of hiding power. The appearance was assessed as follows;

Roller.

Quality of surface - Rated as good, acceptable or poor. In the case of an acceptable or poor finish the rating also included reasons why the paint was considered so, such as the presence of burst bubbles, patchy appearance etc.

Hiding power over the attached black and white card - Rated as good, acceptable or poor.

Brush.

Quality of surface - Rated as good, acceptable or poor. In the case of an acceptable or poor finish the rating will also include reasons why the paint was considered so, such as patchy appearance.

Hiding power over the attached black and white card - Rated as good, acceptable or poor.

Spreading Rate

The spreading rates were determined in accordance with ISO 6504/3 (Determination of contrast ratio (opacity) of light-coloured paints at a fixed spreading rate). Paint films were applied to clear polyester film using k bars of appropriate value, and allowed to dry in a controlled environment of 23°C and 50% RH.

Reflectance measurements were performed on all samples on both black and white substrates using a Gretag Macbeth Color Eye 7000A spectrophotometer with d/8° geometry. In order to calculate the thickness of the wet paint film the wet density in accordance with ISO 2811 and non-volatile content in accordance with ISO 3251 were also determined. These results were then used to determine the spreading rate of the paints.

Adhesion

The samples were applied to a masonry substrate by brush and aged for 7 days before testing for pull off adhesion in accordance with in accordance with ISO 4624.

Chip Resistance

The samples were applied to a masonry substrate by brush and aged for 7 days before testing in accordance with BS AU 148 Part 15 where 100 hexagonal steel nuts were dropped through a 50mm diameter pipe onto the surface of the coating from a height of 5 metres. The resulting damage was assessed by reference to the pictorial rating standards from BS AU 148 part 15, the categories being, very slight, slight, moderate, considerable, severe and very severe.

Drying and Recoatability Time

The samples were drawn down onto glass panels using a 100µm bar spreader. The hard drying time was determined in accordance with ISO 9117. When the coatings were hard dry they were overcoated with themselves by brush, and any drag on the brush or rivelling when dry was noted.

The tests were carried out at 23°C and 50% RH.

Gloss/ Sheen

BS 3900: D5 60° angle. The gloss was measured on panels applied to glass with a 150µm bar spreader. A Rhopoint Statistical Novo-gloss instrument was used.

Scrub Resistance and Cleanability

The scrub resistance and cleanability were assessed in accordance with ISO 11998. The films were aged for 28 days before testing. The test result was used to classify the paint for scrub resistance in accordance with BS EN 13300.

The soiling agents used for the cleanability test were Wax crayon, Charcoal HB pencil, Tea, and Coffee. After the cleanability test the soiled area was compared with an unsoiled reference area and given a rating from 1 - 5, where

1 = No stain/complete removal of the soiling agent.

2 = Very light stain remaining

3 = Light stain remaining

4. =Moderately dark stain remaining

5 = Dark stain remaining

2.2 Fungal Resistance Testing

Test samples were prepared by applying 2 full brush coats of the 2 test paints to each of 2 calcium silicate Masterboard panels. In addition PRA control paint, known to be susceptible to fungal growth was similarly applied to 2 further panels. All coated panels were allowed to air dry for 7 days prior to testing.

Fungal testing was carried out according to the procedure described in BS 3900: G6, in which the paint films are inoculated with a spore suspension containing the following mixture of mould and yeast fungi:

<i>Alternaria alternata</i>	IMI	342924
<i>Aspergillus versicolor</i>	IMI	45554
<i>Aureobasidium pullulans</i>	IMI	45533
<i>Cladosporium cladosporioides</i>	IMI	178517
<i>Penicillium purpurogenum</i>	IMI	178519
<i>Phoma violacea</i>	IMI	49948ii
<i>Rhodotorula rubra</i>	NCYC	1695
<i>Sporobolomyces roseus</i>	NCYC	717
<i>Stachybotrys chartarum</i>	IMI	82021
<i>Ulocladium atrum</i>	IMI	79906
<i>Cladosporium herbarum</i>	IMI	378363
<i>Cladosporium sphaerospermum</i>	IMI	170353
<i>Paecilomyces variotii</i>	IMI	114930

Note 1: The IMI Number is a strain prefix used by the International Mycological Institute (now CABI-Bioscience)

Note 2: The NCYC Number is the catalogue number of the National Collection of Yeast Cultures.

Each species was present in the spore suspension at a level of not less than 10^4 spores per ml.

The 4 test panels and 2 control panels were spray inoculated with the spore suspension and placed in fungal test cabinets (i.e. humidity chambers operating on a time cycle to give 2 hours in every 12 hours at 4°C above ambient). After 7 days incubation, the panels were re-inoculated as above and incubation was continued for a total of 56 days.

Growth of fungi on the panels was monitored after 28 and 42 days, with a final growth assessment being made 56 days after inoculation.

2.3 Antimicrobial Activity

Test samples were prepared by applying 2 full brush coats of the test paints to each of 2 aluminium panels which were allowed to air dry for 7 days prior to testing.

The samples were tested for antibacterial activity using the procedure described in ISO 22196:2007 (formerly Japanese Standard, JIS Z 2801 2000).

The test was carried out using 3 different test organisms - *Staphylococcus aureus* ATCC6538P, *Escherichia coli* ATCC8739, and *Pseudomonas aeruginosa* ATCC9027. For the *Pseudomonas aeruginosa* only Smaltoplast Silk was tested

For each paint test pieces, approx 3 cm by 3 cm, were cut from the coated aluminium panels to provide three replicates for each test.

0.1 ml of a suspension of the test organism (containing approx. 5×10^5 bacterial cells) was placed on the coated surface of triplicate samples of the test pieces, and on triplicate samples of polypropylene film (used as the PRA control and known to have no antibacterial activity). The suspension was held in intimate contact with the test surface using a polyethylene film rectangle, 20 mm x 20 mm in size.

To provide a time zero inoculation level, an additional triplicate set of PRA control samples (polypropylene film) were inoculated and washed off immediately, each into 10 ml of sterile neutralizer solution, shaken with glass beads, and bacterial counts determined to give a time zero count.

The remaining replicates were incubated at 21°C and relative humidity of not less than 90%. After 24 hours incubation the test pieces were washed off as described previously, and bacterial counts determined.

3 Results and Observations

3.1 General Paint Properties

Test	Smaltoplast Silk	Reference Sample
Application Properties	<p>Roller</p> <p>Ease of Roller Loading -Easy</p> <p>Ease of Application - Easy</p> <p>Foam - None</p> <p>Spatter -None</p> <p>Brush</p> <p>Ease of Brush Loading - Easy</p> <p>Ease of Application - Easy</p>	<p>Roller</p> <p>Ease of Roller Loading - Easy</p> <p>Ease of Application - Easy</p> <p>Foam - None</p> <p>Spatter - Slight</p> <p>Brush</p> <p>Ease of Brush Loading - Easy</p> <p>Ease of Application - Easy</p>
Coverage	<p>Roller – 10.0 m²/litre</p> <p>Brush – 10.7 m²/litre</p>	<p>Roller – 9.6 m²/litre</p> <p>Brush – 11.6 m²/litre</p>
Appearance	<p>Roller</p> <p>Quality of Surface - Good</p> <p>Hiding - Good</p> <p>Brush</p> <p>Quality of Surface - Good</p> <p>Hiding - Good</p>	<p>Roller</p> <p>Quality of Surface - Good</p> <p>Hiding – Acceptable</p> <p>Brush</p> <p>Quality of Surface – Acceptable (slightly patchy, needs second coat)</p> <p>Hiding - Acceptable</p>
Comments and Comparative Appearance	The appearance of the Smaltoplast sample was superior to that of the reference sample especially when brush applied. Both samples dripped slightly while loading the brush and the reference sample had a higher viscosity which made brushing the sample out slightly more difficult.	
Spreading Rate	8.42m ² /l	8.40m ² /l

Test	Smaltoplast Silk	Reference Sample
Adhesion	Average adhesion strength 5.62MPa Failure mode - mixed - adhesive to masonry surface and cohesively in the masonry substrate	Average adhesion strength 3.89MPa Failure mode - mixed - adhesive to masonry surface and cohesively in the masonry substrate
Chip Resistance	Slight/moderate	Slight/moderate
Drying and Recoatability Times	Hard Drying Time - 25 mins Recoating Time – No obvious defects when overcoated 3 hours after application.	Hard Drying Time - 25 mins Recoating Time - No obvious defects when overcoated 3 hours after application.
Scrub Resistance	Film thickness loss – 3.66µm BS EN 13300 Classification 1	Film thickness loss – 2.5 µm BS EN 13300 Classification 1
Cleanability (Degree of Cleaning)	Wax Crayon – Very light stain. (2) Charcoal – No stain (1) HB Pencil - No stain (1) Tea – Moderately dark stain (4) Coffee – Light stain (3)	Wax Crayon – Very light stain. (2) Charcoal – No stain (1) HB Pencil – Very light stain (2) Tea – Very light stain (2) Coffee – Very light stain (2)
Gloss/Sheen	4 units	19 units

3.2 Fungal Resistance

Fungal growth assessments on the test and control systems are given in Table 1. Sample condition was rated according to the following numerical scale:

- 0 = no growth
- 1 = trace of growth
- 2 = growth on 1-10% of test face
- 3 = growth on 10-30% of test face
- 4 = growth on 30-70% of test face
- 5 = growth on 70-100% of test face

Table 1: Fungal Resistance Testing

Test Sample	Fungal Growth Rating*		
	28 days	42 days	56 days
PRA Control	5, 5	5, 5	5, 5
Smaltoplast Silk	1, 1	1, 1	1, 1
Comparison Paint	1, 1	1, 1	1,1



Plate 1: Fungal Resistance Test – PRA Control at 56 days



Plate 2: Fungal Resistance Test – Smaltoplast Silk at 56 days



Plate 3: Fungal Resistance Test – Comparison Paint at 56 days

3.3 Antimicrobial Activity

The bacterial counts obtained (shown as a geometric mean), together with the antibacterial activity (shown as a Log10 reduction) and the kill rate (shown as a percentage), are given in Table 2 (*Staphylococcus aureus*), Table 3 (*Escherichia coli*), and Table 4 (*Pseudomonas aeruginosa*). The antibacterial activity was calculated as follows:

$$R = [\log (B/A) - \log (C/A)] = [\log (B/C)]$$

where, R = antibacterial activity

A = mean bacterial count on PRA control sample at time zero

B = mean bacterial count on PRA control sample after 24 hours

C = mean bacterial count on test piece after 24 hours

Table 2: Antimicrobial Activity against *S. aureus*

Test Sample	Mean Bacterial Count		Antibacterial Activity	
	Initial Count	24 Hour Count	Log10 Reduction	% Kill
PRA Control	3.2×10^5	2.3×10^5	-	
Smaltoplast Silk	-	< 10	> 4.36	>99.99
Comparison Paint	-	< 10	> 4.36	>99.99

Table 3: Antimicrobial Activity against *E. coli*

Test Sample	Mean Bacterial Count		Antibacterial Activity	
	Initial Count	24 Hour Count	Log10 Reduction	% Kill
PRA Control	6.5×10^5	3.9×10^5	-	
Smaltoplast Silk	-	< 10	> 4.59	>99.99
Comparison Paint	-	< 10	> 4.59	>99.99

Table 4 : Antimicrobial Activity against *Pseudomonas aeruginosa*

Test Sample	Mean Bacterial Count		Antibacterial Activity	
	Initial Count	24 Hour Count	Log10 Reduction	% Kill
PRA Control	2.8×10^5	1.7×10^5	-	
Smaltoplast Silk	-	< 10	> 4.23	>99.99

4 Conclusions

4.1 General Paint Properties

The Smaltoplast Silk sample has better application properties, appearance and adhesion to masonry surfaces than the reference sample. The instrumental spreading rates of the two samples are virtually identical, although in practise the hiding power of the Smaltoplast Silk is slightly superior.

The Smaltoplast Silk and reference sample have good scrub resistance with both conforming to EN 13300 class 1.

There is no difference between the samples in the chip resistance test.

The reference sample has slightly better cleaning properties. This is probably related to its higher gloss level.

4.2 Fungal Resistance

Using the BS 3900: G6 test, ratings 0, 1 and 2 are considered by PRA to represent 'pass' levels since, at most, only very slight growth will have occurred on the test face (up to a maximum of 10%). The higher ratings of 3, 4 and 5 are considered by PRA to represent 'fail' levels since a noticeable increase in biomass from the initial level will have occurred, usually accompanied by darkening and spreading of hyphal strands across the surface.

Referring to Table 1, after 56 days the PRA control paint had developed extensive fungal growth (rated 5, 5), whereas only a trace of growth had developed on the films prepared from the two test paints

Both Smaltoplast Silk and the comparison paint showed excellent resistance to growth of the fungi used in this test.

4.3 Antimicrobial Activity

The ISO standard 22196:2007 specifies a method of evaluating the antimicrobial activity of antimicrobial treated (non porous) materials which includes paint films. The predecessor of this standard, JIS Z 2801:2000, states that for a coating to demonstrate antimicrobial efficacy the value of the antibacterial activity shall not be less than 2.0. The new ISO standard provides a means of quantifying the antimicrobial effectiveness of a surface in terms of antimicrobial activity, but no longer specifies a value for determining antimicrobial efficacy

Referring to Tables 2, 3 and 4 the antibacterial activity of all paint films tested was shown to exceed a level of 4. It is concluded therefore that both the Smaltoplast Silk and the comparison paint demonstrated excellent antimicrobial efficacy against *Staphylococcus aureus* and *Escherichia coli* and that Smaltoplast Silk demonstrated excellent antimicrobial efficacy against *Pseudomonas aeruginosa*

End of Report



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