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GRAFFITAGE

Development of a new anti-graffiti system, based on traditional concepts, preventing damage of architectural heritage materials

SSP (Policy Oriented Research) – Call 3

Priority 3.6 "The protection of cultural heritage and associated conservation strategies"

D7 – PERFORMANCE CRITERIA AND LIMITS OF THE ANTI-GRAFFITI SYSTEMS

Due date of deliverable: 15th March 2006
Actual submission date: 13th March 2006

Start date of project: **1st August 2005** Duration: **36 months**

FUNDACIÓN LABEIN

V 1.0

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)	
Dissemination Level	
PU	Public

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1. INTRODUCTION

This document is the contractual deliverable "D7 –Performance criteria and limits of the anti-graffiti systems" of the GRAFFITAGE project and belongs to "WP2 – Performance criteria and test procedures definition", where WP leader is BAM and WP participants are BAM, BBRI, CISTeC, Restauraciones Siglo XXI, Ayto-Bilbao and Labein.

Objectives for WP2 are:

1. To establish the methods for characterising relevant properties of substrates
2. To establish the performance criteria and limits of the anti-graffiti systems
3. To establish the methods for lab and field test procedures
4. To harmonise results from different labs by basic tests inter-comparison

2. PERFORMANCE CRITERIA AND LIMITS OF THE ANTI-GRAFFITI SYSTEMS

The second objective of WP2 is to establish the performance criteria and limits of the anti-graffiti systems.

In this case, performance criteria before and after application of an anti-graffiti system as well as before and after natural weathering (see Tables 1 to 8) are meant.

Besides the tests, the requirements are of special interest. In the case of hydrophobic agents the values plotted in Table 1 are used. It is useful to take the same for anti-graffiti system:

Table 1: Classification of the reduction of **capillary water absorption** and **evaporation rate**

Performance		**Capillary water absorption**	**Evaporation rate**
		Within 24 h	Mass loss within 24 h
Class	Subclass	***Reduction of***	
A	-	> 95%	< 10%
B	B1	> 95% (within 60min), later 85% - 95%	10% up to 40%
	B2	85% up to 95%	
C	-	75% up to 85%	40% up to 70%
D	-	< 75%	>70%

If the values of the determination of **liquid water transmission rate** acc. to EN 1062-3 are used, following requirements have to be taken into account (Table 2).

Table 2: Classification of the permeability rate for liquid water

Class	**Permeability rate for liquid water in kg / (m^2 x $h^{0.5}$)**
I (high)	> 0,5
II (medium)	0,1 up to 0,5
III (low)	< 0,1

The advantage of the Karsten`s pipe test is that it can be performed at the building. One can determine a kind of **water absorption rate** (Table 3).

Table 3: Classification of the reduction of initial water absorption

Class	**Reduction of the initial water absorption**
A	< 95%
B	Between 85% and 95%
C	Between 75% and 85%
D	> 75%

If one wants to have a report about the durability of the surface treatment, the test has to be prolonged and the number of classes has to be increased (Table 4).

Table 4: Reduction of the initial water absorption after a longer test procedure

Class	**Reduction of the initial water absorption**
A	<95%
B	between 85% and 95%
C	between 75% and 85%
D	>75%

The **water vapour permeability** (water vapour transmission rate) before and after application of an anti-graffiti system will be determined acc. to EN ISO 7783-2. Also the s_d-value can be estimated (see Table 5).

Table 5: Classification of water vapour transmission rate

Class	Water vapour permeability		s_d value
	g/(m² * d)	g/(m² * h)	m
I (high)	>150	>6	<0,14
II (medium)	15 to 150	0,6 to 6	0,14 to 1,4
III (low)	<15	<0,6	>1,4

For the assessment the **colour** of the anti-graffiti system, the spherical colour space L* a* b* is used. The colour space is defined by reflectance L* and the colour coordinates a* und b*. With increasing a*, b* values (rising distance of the chromaticity coordinates from the central point of the colour space) the colourfulness is getting greater**.** But differences in colour can also be described using only the value (ΔE^*_{ab}), in which only the amount of the colour difference is incorporated but not their direction (only for cleaned surfaces in relation to the original).

The requirements for concrete surfaces after application and weathering of a prophylaxis system in relation to the untreated concrete surface, immediately before application the anti-graffiti system are:

- brightness $\Delta L^* < |10|$
- red-green colourfulness ? $a^* < |1|$
- yellow-blue colourfulness ? $b^* < |5|$

For natural stones ΔE^*_{ab} is used (in the case of hydrophobic agents). In Table 6 the classification is plotted.

Table 6: Classification of colour changes using ΔE^*_{ab}

Class	Deviation
A	ΔE^*_{ab} <4 units
B	ΔE^*_{ab} >4 units

The determination of the **gloss** is performed acc. to EN ISO 2183; the classification is done acc. to EN 1062-1. The classification is valid for untreated material (Table 7).

Table 7: Classification of the gloss before treatment

Description	Angle of measure	Reflectometer value
High gloss finished and glossy	60°	>60
Semi-glossy	60°	up to 60
Semi-matt	85°	>10
Matt	85°	up to 10

For classification of gloss of treated stone (by hydrophobic agents) gloss differences (before and after application of the system) are used which can also be used for anti-graffiti systems (Table 8).

Table 8: Classification of gloss differences

Class	Deviation
A	<3 units
B	>3 units

The evaluation of a test sample's resistance to **salt crystallisation** is done by measuring the mass loss of the sample after the test. The relative mass loss after the test (compared to the initial mass of the sample, expressed in %) is considered to indicate the salt crystallisation resistance.

Three classes are distinguished:

- A: a very small increase in salt crystallisation damage (due to a statistical spread on the test results), which means that the sensitivity to salt crystallisation is almost not affected by the treatment.
- B: a moderate increase in salt crystallisation damage due to salt crystallisation.
- C: severe and visually unacceptable increase in damage due to salt crystallisation.

Class	Difference in percentage mass loss
A	Between 0 and 2,5 %
B	Between 2,5 and 5 %
C	More than 5%

For classification of **algae growth**, a number ranging from 1 to 5 is attributed to a sample, where 1 is no growth at all, and 5 is completely overgrown. Evaluation is done visually, including a comparison to a reference sample.

class	Algae growth
1	none
2	light
3	average
4	strong
5	very strong

The classification of the influence of a treatment on algae growth is according to the following classes:

Class	Difference in algae growth
A	0 (no influence of the treatment)
B	1 or 2 (moderate influence of the treatment on algae growth)
C	>2 (large influence of the treatment on algae growth)

Requirements for **acid rain ageing:** according to ISO 6988:1985, usually, the following specifications are considered:

a) The appearance of the sample after the test;
b) The appearance of the sample after removing superficial corrosion products;
c) The number and the distribution of corrosion defects like pitting, cracks, blisters, etc;
d) The time passed before the appearance of the first signs of corrosion.

The **accelerated UV ageing test** is intended to simulate the deterioration caused by water as rain or dew and the ultraviolet energy in sunlight. It is not intended to simulate the deterioration caused by localized weather phenomena, such as atmospheric pollution, biological attack, and salt water exposure.

The loss in mass determined shall be represented as a function of the total area exposed to corrosion, in g/m^2. The mean value shall be (125 ± 25) g/m^2, individual values not deviating from the mean by more than 20%.

There are no deviations from the project work program