Comparative tests between products with UV powder paint and products with standard powder paint

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1 PURPOSE

In the **first part** will be verified the different characteristics in terms of mechanical resistance and the different properties between a standard polyester painting and a crosslinking painting induced by UV irradiation, applied on steel sheets.

In the **second part**, will be carried out tests to verify the corrosion resistance in neutral salt spray chamber (as described by **UNI EN ISO 9227:2006**) and resistance to moisture (as described by the **UNI EN ISO 6270-1:2001**) of the same components painted with two different technologies: traditional powder paint and UV paint.

2 TESTS CARRIED OUT

2.1 MECHANICAL TESTS

The samples consist of two steel sheets, each painted with one of the two products analyzed. Below are summarized the specs:

Reference	Material	Kind of paint	Color	Notes
A	Steel	Polyester	RAL 7035	Silap Standard Paint
B	Steel	UV paint	Light Grey	V 0,9

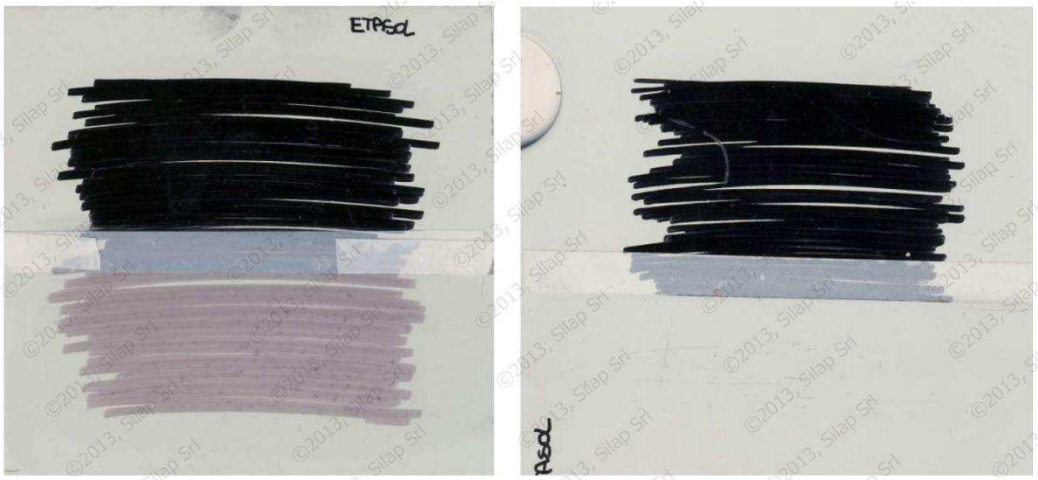
2.1.1 GRAFFITI-PROOF TEST

The surface was scrawled with a marker PEN PENTEL N50 and was briefly cleaned by wiping with a cloth soaked in solvent. Here are the results of that test.

Cleaning Solvent	Time spent	Sample A (standard paint)	Sample B (UV paint)
Etasol*	24 hours	Clear residue of the marker	No residue
Etasol/MEK 1/1		Clear residue of the marker	No residue
Etasol*	1 week	Clear residue of the marker	No residue
Etasol/MEK 1/1		Clear residue of the marker	No residue

* Ethyl alcohol / isopropanol 70/30

GRAFFITI-PROOF TEST AFTER 24 HOURS



Picture 1 – On the left: A sample cleaned with solvent after 24 hour; On the right: sample B cleaned with solvent after 24 hour

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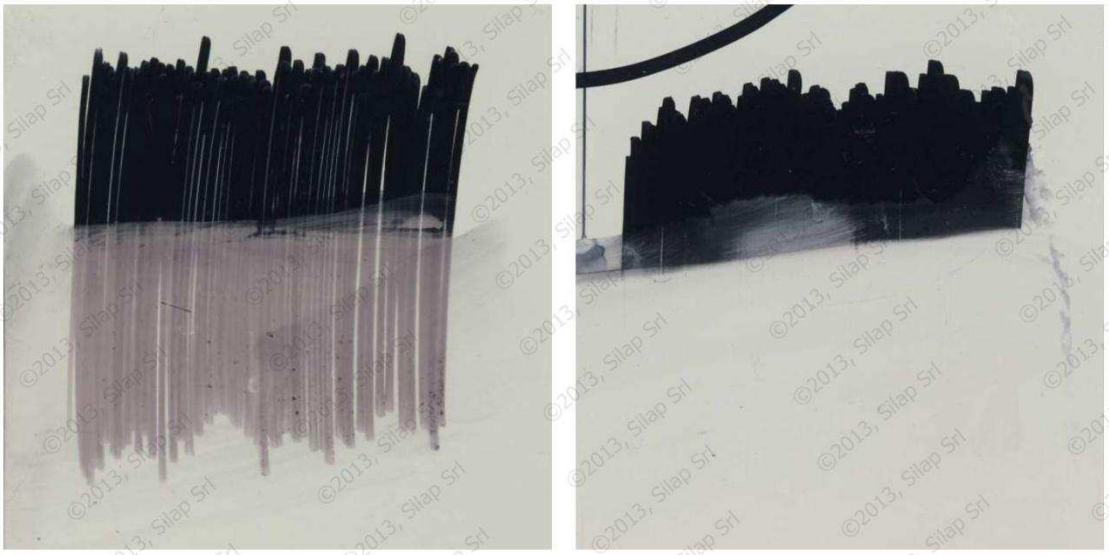
GRAFFITI-PROOF TEST AFTER 1 WEEK



Picture 2 - On the left: A sample cleaned with solvent after 1 week; On the right: sample B cleaned with solvent after 1 week

Remarks
Sample B (UV paint) has no marker residues, so has better water resistance than conventional paint, thanks to the UV curing which makes the piece less permeable.

2.1.2 SOLVENTS TEST

The test was performed by subjecting the samples to continuous passages of a swab soaked in solvent maintained in contact with the surface by a mass of 1 kg.

Picture 3 - Equipment for solvents test

Below are the results:

Solvent	Sample	Thickness	Nr. Of passes	Result	Notes
Ethyl alcohol	A (standard paint)	No residue	1000	No change	-
	B (UV paint)	No residue	1000	No change	-

2.1.3 CROSS-CUT TEST

The test was performed according to **EN ISO 2409:1996**. The results obtained after the cross-cut test are reported in the table.

Reference	Thickness	Result	Notes
Sample A (standard paint)	80 µm	0 (no separation)	-
Sample B (UV paint)	85 µm	0 (no separation)	-

Picture 4 – Cross-cut test results, on the left the sample A, on the right the sample B

Remarks
This test gave the same result for both samples, but the realization of the incisions was more difficult on the sample B because the UV coating is much more resistant than standard paint of the sample A.

2.1.4 BUCHHOLZ HARDNESS

The test was performed according to ISO 2815. Both samples gave the same value as hardness index, equal to 111.

Picture 5 – Buchholz hardness test machine

2.2 CORROSION TESTS

The results are shown in the following tables as described by the standard **UNI EN ISO 4628-2-3-4-5**.

The samples were obtained from two sheets larger than those used for the mechanical tests. Below are summarized the specs:

Reference	Material	Kind of paint	Color	Notes
A	Steel	Polyester	RAL 7035	Silap standard paint
B	Steel	UV Paint	Light Grey	V 0,9

2.2.1 RESISTANCE TO NEUTRAL SALT SPRAY FOG

The samples were tested for a total of 400 hours and were monitored periodically throughout the duration of the test.

Type of degradation	Sample A		Sample B	
	Dimension	Density	Dimension	Density
Blistering (ISO 4628-2)	**3**	**1**	**0**	**0**
Rusting (ISO 4628-3)	**0**		**0**	
Cracking (ISO 4628-4)	**0**		**0**	
Flaking (ISO 4628-5)	**0**		**0**	

N.B. The evaluations reported in the table above refer to the surface not engraved.

Legend:
0 = excellent, no defects.
1 = not relevant, the defect is less than 5% of the total.
2 = the defect comprises between 5% and 15% of the total area.
3 = the defect comprises between 15% and 35% of the total area.
4 = the defect comprises between 35% and 65% of the total area.
5 = it is not possible to classify the defect as they are not visible areas not attacked

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RESULT OF NEUTRAL SALT SPRAY FOG TEST AFTER 200 HOURS

Picture 6 - result of neutral salt spray fog test after 200 hours; on the left the sample B, on the right the sample A

Remarks
The sample A has some slight blistering principle that the B sample coated with UV paint hasn't.

2.2.2 RESISTANCE TO CONDITIONING MOISTURE

The samples were tested for a total of 1300 hours and were monitored periodically throughout the duration of the test.

Type of degradation	Sample A		Sample B	
	Dimension	Density	Dimension	Density
Blistering (ISO 4628-2)	**0**	**0**	**0**	**0**
Rusting (ISO 4628-3)	**0**		**0**	
Cracking (ISO 4628-4)	**0**		**0**	
Flaking (ISO 4628-5)	**0**		**0**	

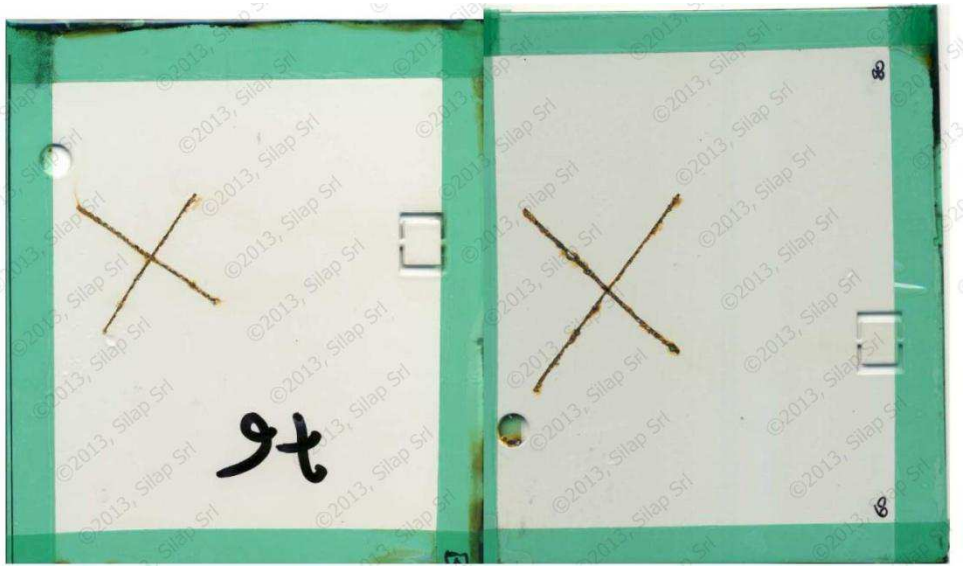
N.B. The evaluations reported in the table above refer to the surface not engraved.

Legend:
0 = excellent, no defects.
1 = not relevant, the defect is less than 5% of the total.
2 = the defect comprises between 5% and 15% of the total area.
3 = the defect comprises between 15% and 35% of the total area.
4 = the defect comprises between 35% and 65% of the total area.
5 = it is not possible to classify the defect as they are not visible areas not attacked

RESULT OF CONDITIONING MOISTURE TEST AFTER 200 HOURS

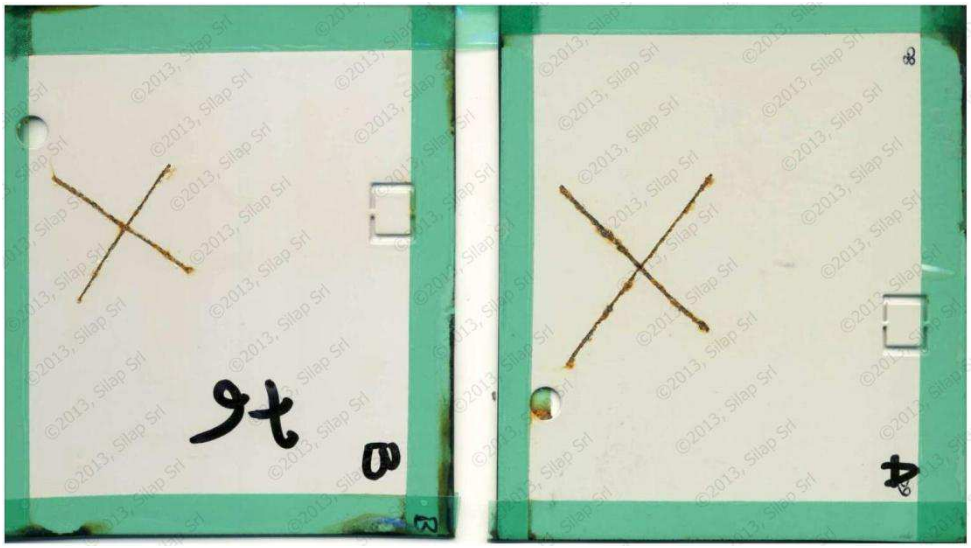
Picture 7 - result of conditioning moisture test after 200 hours; on the left the sample B, on the right the sample A

RESULT OF CONDITIONING MOISTURE TEST AFTER 400 HOURS



Picture 8 – result of conditioning moisture test after 400 hours; on the left the sample B, on the right the sample A

RESULT OF CONDITIONING MOISTURE TEST AFTER 627 HOURS



Picture 9 – result of conditioning moisture test after 627 hours; on the left the sample B, on the right the sample A

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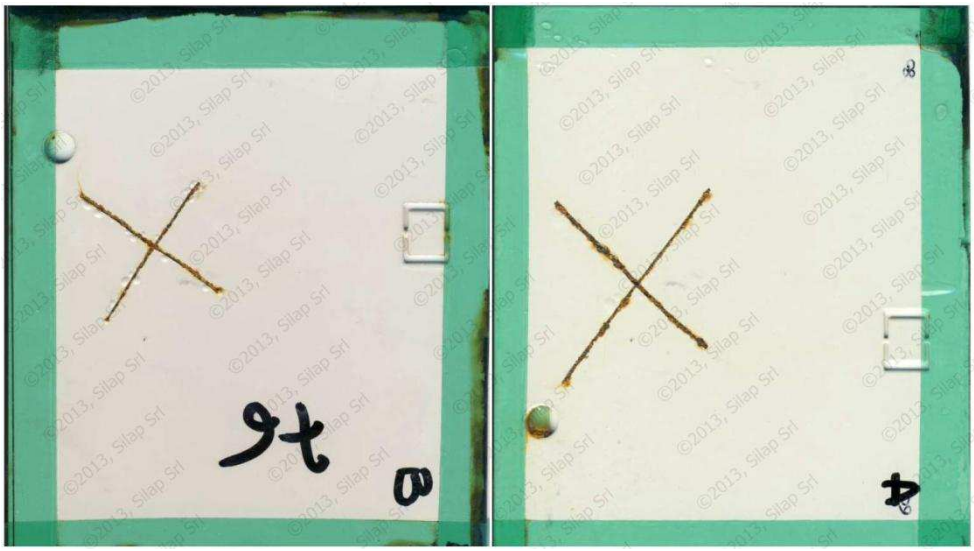
RESULT OF CONDITIONING MOISTURE TEST AFTER 1300 HOURS – END OF TEST



Picture 10 – result of conditioning moisture test after 1300 hours; on the left the sample B, on the right the sample A

Final remarks

- From the results gathered it can be seen as both samples exhibit a high degree of moisture resistance.
- In the non-engraved area doesn't appear defects in any of the 2 samples.
- Near the incision, both samples show the formation of bubbles (blistering).
- On the SAMPLE B there are many bubbles having a diameter of about 2 mm; On the SAMPLE A there are fewer than the SAMPLE B but any of these has a diameter of about 5 mm.
- We observe very little rust limited to the incision, which exposes the substrate.

From this test the samples haven't significant defects, thus showing a good resistance to humid atmospheres.