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(54) Title : ANTI-CORROSION PIGMENTS MADE OF ALUMINIUM POLYPHOSPHATE AND RARE EARTH

(54) Titre : PIGMENTS ANTI-CORROSION A BASE DE POLYPHOSPHATE D'ALUMINIUM ET DE TERRE RARE

(57) Abstract : The invention relates to an anti-corrosion pigment including an aluminium polyphosphate, characterised in that it also includes at least one cerium compound and/or a lanthanum compound and/or a praseodymium compound. The invention also relates to anti-corrosion paint including said pigment of the invention.

(57) Abrégé : L'invention a pour objet un pigment anti-corrosion comprenant un polyphosphate d'aluminium caractérisé en ce qu'il comprend en outre au moins un composé à base de cérium et/ou un composé à base de lanthane et/ou un composé à base de praséo - dyme. L'invention a aussi pour objet une peinture anti-corrosion incorporant ledit pigment de l'invention.

Anti-corrosion pigments made of aluminium polyphosphate and rare earth

The field of the invention is that of anticorrosive pigments intended to be incorporated in compositions for the preparation of a coating on a metal surface which is capable of ensuring in particular good protection of the metal surface.

Advantageously, the composition can be used as paint primer, finding highly diverse applications for which the drive is to provide coatings ensuring good protection against corrosion phenomena.

In this field, anticorrosive pigments, such as chromates, are currently used due to their effectiveness in protecting metal surfaces in the presence of water, of oxygen or of any other component liable to detrimentally affect metal surfaces, in organic formulations (paints).

The surfaces of interest are generally metal surfaces which it is desired to protect, in different types of industry, and can be of iron or of steel (coated or not coated with zinc or alloy based on zinc, aluminum, silicon, magnesium, and the like).

Nevertheless, chromates are harmful due to their high oxidizing power and must be replaced by other substances which are as effective but which are devoid of toxicity.

For substrates made of galvanized steel, alternative solutions to chromates have already been provided, such as, for example: calcium-exchanged silica pigments, pigments comprising zinc aluminum polyphosphates and/or magnesium aluminum polyphosphates and/or calcium aluminum polyphosphates and/or strontium aluminum polyphosphates, and the like.

In parallel with steels covered with zinc, there exist on the world market other types of steel coating based on zinc and on other elements, such as aluminum, silicon or magnesium, such as, for example, Galvalume® (Al: 55%, Zn: 43.5%, Si: 1.5%) or Galfan (Zn: 95%, Al: 5%).

Nevertheless, to address steels covered with Galvalume®, few specific solutions are currently provided for ensuring the replacement of chromates as anticorrosive pigments. Nevertheless, mention may be made of anticorrosive pigments which are devoid of toxicity, such as Novinox XCA02 (calcium-exchanged silica) or Novinox PAM (pigment comprising magnesium aluminum tripolyphosphate) of the Applicant, but which, in terms of anticorrosive performances, do not equal those of chromates.

This is why, in this context, the Applicant is providing a novel family of anticorrosive pigments which are particularly well-suited to the anticorrosive protection of steels covered with Galvalume® and which are also suitable for steels covered with zinc (galvanized steel, also known as HDG (hot dipped galvanized)).

More specifically, a subject matter of the present invention is an anticorrosive pigment comprising an aluminum polyphosphate, characterized in that it additionally comprises at least one cerium-based compound and/or one lanthanum-based compound and/or one praseodymium-based compound.

The anticorrosive pigment of the present invention is an anticorrosive pigment particularly suited to iron or steel substrates coated or not coated with another metal.

According to an alternative form of the invention, the aluminum polyphosphate is an aluminum tripolyphosphate.

According to an alternative form of the invention, the compound is an oxide.

According to an alternative form of the invention, the compound is a carbonate.

According to an alternative form of the invention, the compound is a cerium oxide.

According to an alternative form of the invention, the compound is cerium oxide CeO_2.

According to an alternative form of the invention, the compound is a lanthanum oxide.

According to an alternative form of the invention, the compound is lanthanum oxide La_2O_3.

According to an alternative form of the invention, the compound is a praseodymium oxide.

According to an alternative form of the invention, the compound is praseodymium oxide Pr_6O_{11}.

According to an alternative form of the invention, the pigment comprises:

- a mixture of cerium-based compound and of lanthanum-based compound; or
- a mixture of cerium-based compound and of praseodymium-based compound; or
- a mixture of lanthanum-based compound and of praseodymium-based compound.

According to an alternative form of the invention, the pigment comprises a mixture of cerium-based compound and of lanthanum-based compound and of praseodymium-based compound.

According to an alternative form of the invention, said pigment comprises a percentage by weight of rare earth metal compound(s) of between 1% and 30%.

Another subject matter of the invention is an anticorrosive paint intended to cover a metal surface, comprising an anticorrosive pigment according to the invention.

According to an alternative form of the invention, said paint is based on polyester-melamine.

According to an alternative form of the invention, said paint is based on polyurethane.

According to an alternative form of the invention, said paint is epoxy-based.

According to an alternative form of the invention, said paint comprises a percentage by weight of anticorrosive pigment of between 1% and 15%.

A better understanding of the invention will be obtained and other advantages will become apparent on reading the description which will follow, given without limitation.

Generally, the anticorrosive pigment of the present invention comprises an aluminum polyphosphate and at least one cerium-based compound and/or one lanthanum-based compound and/or one praseodymium-based compound.

The Applicant has carried out a series of tests proving the advantage of the anticorrosive pigments of the present invention, using a steel substrate covered with Galvalume®, to which a non-chromate surface treatment according to the present invention is applied.

First series of comparative tests carried out with a primer based on polyester-melamine (PE) resin incorporating an anticorrosive pigment of the known art or a pigment according to the invention:

The Applicant has carried out crosslinking tests in order to confirm the good stability over time of primer based on polyester-melamine (PE) resin and on the pigments provided in the present invention based on cerium or on lanthanum or on praseodymium, due to the presence of a catalyst, Nacure 2500, sensitive to alkaline entities.

In order to carry these tests through to a successful conclusion, an anticorrosive primer is prepared which incorporates pigment compounds (7% by weight) in a resin of polyester-melamine type with a thickness of 7 µm, having the following detailed composition:

Starting Materials	**% By Weight**	**Description**	**Suppliers**
Cymel 303	5.4	HMMM	Allnex
Desmophen 1665	47.6	Polyester Resin	Bayer
Solvesso 150	10.7	Aromatic Solvent	Exxon Chemical
Dowanol PMA	15.4	Glycol Ester Solvent	Dow
Mixing is carried out until a homogeneous preparation is obtained			
	7.0	**Anticorrosive pigment**	
TiO_2 RTC90	6.5	Filler	Huntsman
Talc HAR T84	6.5	Filler	Imerys
Aerosil R972	0.4	Silica	Evonik
Bead grinding			
Nacure 2500	0.5	Catalyst	King Industries
Total Weight	**100**		

Properties of the primer obtained:

The primer exhibits:

- a pigment volume concentration (PVC) of 19.70%;
- a Pigment/Binder ratio (by volume) of 0.25;
- a dry film thickness of 7 µm.

The anticorrosive primer thus obtained is applied to the treated steel covered with Galvalume® using a screw rod in order to carry out tests of stability over time.

Crosslinking tests:

The Applicant has carried out comparative tests on the crosslinking and on the stability of the primer over time according to the MEK crosslinking test, the result of the test of which is a number of to-and-fro movements at the end of which the application of a cloth impregnated with MEK (methyl ethyl ketone) destroys the primer, the test being repeated over time, the results being provided at the end of D days in the table given below.

The pigments of the known art:

- L203E (strontium chromate), Novinox PAM, Novinox XCA02 (calcium-exchanged silica), Novinox ACE110 (silica-based) and Novinox PAZ (pigment comprising zinc aluminum polyphosphate);

are thus compared with pigments of the present invention:

- ATP 94%/CeO_2 6%, ATP 94%/$Ce(CO_3)_2$ 6%, ATP 94%/La_2O_3 6% and ATP 94%/Pr_6O_{11} 6%.

T and F MEK	D = 0	D = 45
L203E	52	50
Novinox PAM	2	1
Novinox XCA02	>100	>100
Novinox ACE110	>100	>100
Novinox PAZ	>100	>100
ATP 94%/CeO_2 6%	>100	90
ATP 94%/$Ce(CO_3)_2$ 6%	>100	>100
ATP 94%/La_2O_3 6%	94	93
ATP 94%/Pr_6O_{11} 6%	>100	>100

The results of these tests show a good performance obtained and a good stability over time obtained with the pigments provided in the present invention based on cerium or on lanthanum or on praseodymium.

This is because the anticorrosive compounds of the present invention: ATP 94%/CeO_2 6%, ATP 94%/$Ce(CO_3)_2$ 6%, ATP 94%/La_2O_3 6% and ATP 94%/Pr_6O_{11} 6% show much more satisfactory performances than with the pigment Novinox PAM in a “PE/melamine” primer and similar performances to those obtained with silica-based chromate-free pigments, such as Novinox XCA02 and Novinox ACE110, or with pigments based on aluminum polyphosphate, such as Novinox PAZ.

Anticorrosive tests:

In order to carry out anticorrosive tests, the primers are covered with a layer of paint based on polyester-melamine with a thickness of 20 µm, also commonly known as finishing layer.

Two scratches are made in the surface:

- right-hand scratch of Clemens type, with an exerted pressure of 27 psi (pounds per square inch);
- left-hand scratch of Knife type, with an exerted pressure of 5 psi (pounds per square inch).

The combination is subjected to exposure to a salt spray (ASTM B117 standard) for 500 hours.

Grading of the scratches and edge faces:

The Leica EZ4HD stereomicroscope and the associated image analysis software are used.

The two scratches and the two edge faces are photographed in low-angled light using the stereomicroscope.

There exists a very marked contrast between the paint surface and the degraded surface. This difference in contrast is located by the software. By virtue of a function of the software, it is possible to characterize the degraded zone. The surface area of this degraded zone is subsequently calculated using a function of the software. It is expressed in mm^2 of degradation.

Grading of the full plate:

The degraded surface area is estimated by calculating the surface area of each blister formed on the plate. As the blisters are not very numerous and relatively small in size, it takes very little time to add up all the blisters in mm^2.

General grading:

In order to obtain the total degraded surface area in mm^2, the different degraded surface areas: clemens scratch + knife scratch + left-hand edge face + right-hand edge face + full plate, are subsequently added up.

The total surface area of each plate is subsequently measured.

The nondegraded surface area in mm^2 is obtained by subtraction: total surface area - degraded surface area.

The anticorrosive performance as percentage is determined by the following formula: (nondegraded surface area/total surface area)*100.

The lengths of scratches and edge faces are the same from one plate to another. It is thus possible to compare the anticorrosive performance between each plate.

	Left-hand scratch mm²	Right-hand scratch mm²	Left-hand edge face mm²	Right-hand edge face mm²	Full plate mm²	Total degradation mm²	Anticorrosive performance %
ATP 100%	294	193	1061	1145	20	2713	**72.6**
ATP 97%/CeO_2 3%	91	113	803	706	0	1713	**82.7**
ATP 94%/CeO_2 6%	97	77	785	739	0	1698	**82.8**
ATP 75%/CeO_2 25%	83	128	776	725	0	1712	**82.7**
ATP 50%/CeO_2 50%	90	77	845	1343	40	2395	**75.8**
ATP 25%/CeO_2 75%	263	236	917	1304	0	2720	**72.5**
CeO_2 100%	452	389	1865	1436	0	4142	**58.2**
ATP 94%/La_2O_3 6%	116	111	862	646	0	1735	**81.6**
ATP 75%/La_2O_3 25%	123	104	851	854	0	1932	**80.5**
ATP 50%/La_2O_3 50%	127	96	846	841	20	1930	**80.5**
ATP 25%/La_2O_3 75%	124	118	850	836	20	1948	**80.3**
La_2O_3 100%	133	129	821	829	40	1952	**80.3**
ATP 94%/Pr_6O_{11} 6%	109	91	879	636	0	1715	**82.6**
ATP 75%/Pr_6O_{11} 25%	95	91	864	670	20	1740	**82.4**
ATP 50%/Pr_6O_{11} 50%	88	86	792	756	20	1742	**82.4**
ATP 25%/Pr_6O_{11} 75%	86	97	812	763	0	1758	**82.2**
Pr_6O_{11} 100%	98	92	823	722	40	1775	**82.1**
ATP 94%/$Ce(CO_3)_2$ 6%	268	283	820	1231	60	2662	**73.0**
L203E	171	123	870	777	0	1941	**80.3**
Novinox PAM	196	108	815	759	0	1878	**80.9**
Novinox XCA02	185	118	955	1246	20	2524	**74.4**
Novinox ACE110	235	97	837	1123	15	2307	**76.6**
Novinox PAZ	182	112	1358	837	15	2504	**74.6**

It emerges from these combined tests that:

- the mixtures of ATP and of cerium-based or lanthanum-based or praseodymium-based compounds provide better results in terms of anticorrosive performances on Galvalume® than those obtained with ATP alone or with a cerium-based or lanthanum-based or praseodymium-based compound alone;
- the compositions comprising 94% of ATP and 6% of cerium or lanthanum or praseodymium oxide lead to very good results, which may even be better than those obtained with strontium chromate.

It is possible that the cerium or the lanthanum or the praseodymium can block the cathode sites by forming insoluble hydroxides and oxides at the surface of the zinc, resulting in a decrease in the current density and thus in a reduction in the corrosion process.

In conclusion, very good combined performances in terms of tests of crosslinking and of anticorrosive performance validate the advantage of the pigments of the present invention in the context of primer based on polyester-melamine.

<u>Second series of comparative tests carried out with a primer based on polyurethane (PU) resin incorporating an anticorrosive pigment of the known art or a pigment according to the invention:</u>

It should be noted that the Applicant has not had to carry out tests of crosslinking and of control of stability over time, due to the neutrality with regard to the pH of the catalyst employed: DBTL.

In order to carry these tests through to a successful conclusion, an anticorrosive primer is prepared which incorporates pigment compounds (7% by weight) in a resin of polyurethane type with a thickness of 7 µm, having the following detailed composition:

Starting Materials	% by Weight	Description	Suppliers
Mixing is carried out in the following order:			
Desmophen 1665	38.70	Polyester Resin	Bayer
Solvesso 150	11.8	Aromatic hydrocarbon, solvent	Exxon Chemical
Dowanol PMA	11.8	Glycol ester, solvent	Dow
Mixing is carried out until a homogeneous composition is obtained			
Anticorrosive pigment	**7.0**	**Corrosion inhibitor**	
TiO_2 RTC90	7.4	Titanium oxide, rutile	Huntsman
Talc HAR T84	7.4	Talc, inorganic filler	Imerys Talc
Aerosil R972	1.0	Fumed silica	Degussa
Grinding is carried out until a Hegman fineness of 8 is obtained			
Desmodur BL 3175	14.30	Blocked polyisocyanate	Bayer
DBTL	0.5	Catalyst	
Total weight	100.0		

Properties of the primer obtained:

The primer exhibits:

- a pigment volume concentration (PVC) of 22.11%;
- a Pigment/Binder ratio (by volume) of 0.28;
- a dry film thickness of 7 µm.

The anticorrosive primer thus obtained is applied to the treated steel covered with Galvalume® using a screw rod.

In order to carry out anticorrosive tests, the primers are covered with a layer of paint based on polyester-melamine with a thickness of 20 µm, also commonly known as finishing layer.

Two scratches are made in the surface:

- right-hand scratch of Clemens type, with an exerted pressure of 27 psi (pounds per square inch);
- left-hand scratch of Knife type, with an exerted pressure of 5 psi (pounds per square inch).

The combination is subjected to exposure to a salt spray (ASTM B117 standard) for 500 hours.

The grading process is identical to that deployed in the preceding case of PE-melamine resin.

The comparative tests were carried out on pigments of the known art:

- L203E (strontium chromate), Novinox PAM and Novinox PAT 15 (magnesium phosphate);

and are thus compared with pigments of the present invention:

- ATP 94%/CeO_2 6%, ATP 94%/La_2O_3 6% and ATP 89.3%/CeO_2 5.7%/La_2O_3 5%.

	Left-hand scratch mm²	Right-hand scratch mm²	Left-hand edge face mm²	Right-hand edge face mm²	Full plate mm²	Total degradation mm²	**Anticorrosive performance %**
L203E	82	46	633	226	4	992	**89.9**
Novinox PAM	176	245	856	774	36	2087	**78.8**
Novinox PAT 15	167	160	795	797	100	2020	**79.5**
ATP 94%/CeO_2 6%	172	133	809	911	54	2080	**78.9**
ATP 94%/La_2O_3 6%	438	113	693	810	49	2103	**78.7**
ATP 89.3%/CeO_2 5.7%/La_2O_3 5%	191	149	739	731	9	1819	**81.6**

These test results also show performances which are entirely satisfactory and at a level comparable to those obtained with L203E (toxic strontium chromate) during anticorrosive tests for anticorrosive pigments of the invention which are devoid of toxicity in the context of polyurethane primer, this being the case particularly with the use of compositions including different rare earth metal entities.

<u>Third series of comparative tests carried out with a primer based on epoxy resin incorporating an anticorrosive pigment of the known art or a pigment according to the invention:</u>

In order to carry these tests through to a successful conclusion, an anticorrosive primer is prepared which incorporates pigment compounds (7%

by weight) in a resin of epoxy type with a thickness of 7 µm, having the following detailed composition:

Starting Materials	% by Weight	Description	Suppliers
Epikote 1007	25.1	Epoxy resin	Hexion
Dowanol PMA	19.1	Glycol ester, solvent	Dow
Solvesso 150	14.4	Aromatic hydrocarbon, solvent	Exxon Chemical
DIAL	1.8	Diacetone alcohol	
IBA	5.4	Isobutyl alcohol	
Mixing is carried out until a homogeneous composition is obtained			
Cymel 1123	10.75	Modified benzoguanamine resin	Allnex
Coatosil MP200	1	Silane additive	Momentive
Mixing is carried out for 30 minutes until a homogeneous preparation is obtained			
Anticorrosive pigment	**7**	**Anticorrosive pigment**	**SNCZ**
TiO_2 RTC90	7	Titanium oxide, rutile	Huntsman
Talc HAR T84	8	Talc, inorganic filler	Rio Tinto Minerals
Grinding is carried out until a Hegman fineness of 7.5 is obtained			
Nacure 2500	0.5	Catalyst	King Industries
TOTAL WEIGHT	100.0	**PVC: 17.74 "Volumic solids": 46.14 P/B vol: 0.22**	

Properties of the primer obtained:

The primer exhibits:

- a pigment volume concentration (PVC) of 17.74%;
- a Pigment/Binder ratio (by volume) of 0.22;
- a dry film thickness of 7 µm.

The anticorrosive primer thus obtained is applied to the treated steel covered with Galvalume® using a screw rod.

In order to carry out anticorrosive tests, the primers are covered with a layer of paint based on polyester-melamine with a thickness of 20 µm, also commonly known as finishing layer.

Two scratches are made in the surface:

- right-hand scratch of Clemens type, with an exerted pressure of 27 psi (pounds per square inch);
- left-hand scratch of Knife type, with an exerted pressure of 5 psi (pounds per square inch).

The combination is subjected to exposure to a salt spray (ASTM B117 standard) for 500 hours.

The grading process is identical to that deployed in the preceding case of PE-melamine resin.

The comparative tests were carried out on pigments of the known art:

- L203E (strontium chromate), Novinox XCA02, Novinox PAM and Novinox PAT 15 (magnesium phosphate);

and are thus compared with a pigment of the present invention:

- ATP 94%/CeO_2 6%.

	Left-hand scratch mm²	Right-hand scratch mm²	Left-hand edge face mm²	Right-hand edge face mm²	Full plate mm²	Total degradation mm²	**Anticorrosive performance %**
ATP 94%/CeO_2 6%	88	81	297	339	8	814	**90.4**
Novinox XCA02	93	112	263	345	0	814	**90.4**
Novinox PAT 15	121	136	281	345	0	884	**89.6**
L203E	95	136	422	245	0	899	**89.4**
Novinox PAM	128	121	305	345	0	899	**89.4**

These test results also show performances which are entirely satisfactory and at a level comparable to those obtained with L203E (toxic strontium chromate) during anticorrosive tests for anticorrosive pigments of the invention which are devoid of toxicity in the context of epoxy primer applied to Galvalume®, this being the case particularly with the use of compositions including different rare earth metal entities.

Fourth series of comparative tests carried out with a primer based on epoxy resin incorporating an anticorrosive pigment of the known art or a pigment according to the invention:

In order to carry these tests through to a successful conclusion, an anticorrosive primer is prepared which incorporates pigment compounds (7% by weight) in a resin of epoxy type with a thickness of 7 µm, having a composition identical to that of the third series of tests.

Properties of the primer obtained:

The primer exhibits:

- a pigment volume concentration (PVC) of 17.74%;
- a Pigment/Binder ratio (by volume) of 0.22;
- a dry film thickness of 7 µm.

The anticorrosive primer thus obtained is applied to the treated galvanized (HDG) steel using a screw rod.

In order to carry out anticorrosive tests, the primers are covered with a layer of paint based on polyester-melamine with a thickness of 20 µm, also commonly known as finishing layer.

Two scratches are made in the surface:

- right-hand scratch of Clemens type, with an exerted pressure of 25 psi (pounds per square inch);
- left-hand scratch of Knife type, with an exerted pressure of 5 psi (pounds per square inch).

The combination is subjected to exposure to a salt spray (ASTM B117 standard) for 500 hours.

The grading process is identical to that deployed in the preceding case of PE-melamine resin.

The comparative tests were carried out on pigments of the known art:

- L203E (strontium chromate), Novinox XCA02 and Novinox ACE110;

and are thus compared with a pigment of the present invention:

- ATP 94%/CeO_2 6%.

	Left-hand scratch mm^2	Right-hand scratch mm^2	Left-hand edge face mm^2	Right-hand edge face mm^2	Full plate mm^2	Total degradation mm^2	**Anticorrosive performance %**
L203E	69	68	165	255	0	557	**94.3**
ATP 94%/CeO_2 6%	202	455	228	211	0	1096	**89.4**
Novinox ACE110	236	375	242	218	0	1071	**89.0**
Novinox XCA02	500	447	250	218	0	1417	**85.5**

These test results also show performances which are entirely satisfactory and at a level comparable to those obtained with L203E (toxic strontium chromate) during anticorrosive tests for anticorrosive pigments of the invention which are devoid of toxicity in the context of epoxy primer applied to galvanized (HDG) steel, this being the case particularly with the use of compositions including different rare earth metal entities.

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In the present specification and claims, the word ‘comprising’ and its derivatives including ‘comprises’ and ‘comprise’ include each of the stated integers but does not exclude the inclusion of one or more further integers.

Definitions of the specific embodiments of the invention as claimed herein follow.

According to a first embodiment of the invention, there is provided an anticorrosive pigment comprising an aluminum tripolyphosphate, and at least one cerium-based compound and/or one lanthanum-based compound and/or one praseodymium-based compound, wherein the at least one cerium-, lanthanum- and/or praseodymium-based compound is an oxide or a carbonate.

According to a second embodiment of the invention, there is provided an anticorrosive paint for covering a metal surface, comprising an anticorrosive pigment according to the first embodiment.

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CLAIMS

1. An anticorrosive pigment comprising an aluminum tripolyphosphate, and at least one cerium-based compound and/or one lanthanum-based compound and/or one praseodymium-based compound, wherein the at least one cerium-, lanthanum- and/or praseodymium-based compound is an oxide or a carbonate.

2. The anticorrosive pigment as claimed in claim 1, wherein the at least one cerium-based compound comprises a cerium oxide.

3. The anticorrosive pigment as claimed in claim 2, wherein the at least one cerium-based compound comprises cerium oxide (CeO_2).

4. The anticorrosive pigment as claimed in claim 1, wherein the at least one lanthanum-based compound comprises a lanthanum oxide.

5. The anticorrosive pigment as claimed in claim 4, wherein the at least one lanthanum-based compound comprises lanthanum oxide (La_2O_3).

6. The anticorrosive pigment as claimed in claim 1, wherein the at least one praseodymium-based compound comprises a praseodymium oxide.

7. The anticorrosive pigment as claimed in claim 6, wherein the at least one praseodymium-based compound comprises praseodymium oxide (Pr_6O_{11}).

8. The anticorrosive pigment as claimed in any one of claims 1 to 5, comprising a mixture of cerium-based compound and of lanthanum-based compound.

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9. The anticorrosive pigment as claimed in any one of claims 1 to 3 and 6 to 7, comprising a mixture of cerium-based compound and of praseodymium-based compound.

10. The anticorrosive pigment as claimed in any one of claims 1 and 4 to 7, comprising a mixture of lanthanum-based compound and of praseodymium-based compound.

11. The anticorrosive pigment as claimed in any one of claims 1 to 7, comprising a mixture of cerium-based compound and of lanthanum-based compound and of praseodymium-based compound.

12. The anticorrosive pigment as claimed in any one of claims 1 to 11, comprising a percentage by weight of the at least one cerium-based compound and/or one lanthanum-based compound and/or one praseodymium-based compound of between 1% and 30%.

13. An anticorrosive paint for covering a metal surface, comprising an anticorrosive pigment as claimed in any one of the preceding claims.

14. The anticorrosive paint as claimed in claim 13, wherein the anticorrosive paint is based on polyester-melamine.

15. The anticorrosive paint as claimed in claim 13, wherein the anticorrosive paint is based on polyurethane.

16. The anticorrosive paint as claimed in claim 13, wherein the anticorrosive paint is epoxy-based.

17. The anticorrosive paint as claimed in any one of claims 13 to 16, comprising a percentage by weight of anticorrosive pigment of between 1% and 15%.

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