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Cathodic Electrodeposition Coatings

阴极电泳涂料

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Foreword

The Appendix A and Appendix B of this Standard are normative.

This Standard was proposed by China Petroleum and Chemical Industry Federation.

This Standard shall be under the jurisdiction of National Technical Committee of Paints & Pigments for Standardization.

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Chief drafting staffs of this Standard: Tang Ying, Song Hua, Wang Hua, Li Jian, Fang Jixiang, Liang Yabin, Fang Liming, Liu Jing, Peng Songhe, Wang Songxian, Shi Yilei, and Yu Bin.

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Cathodic Electrodeposition Coatings

1 Scope

This Standard specifies the classification requirements, test methods, inspection rules, marking, package and storage, etc. of the cathodic electrodeposition coatings.

This Standard is applicable to the cathodic electrodeposition coatings with epoxy resin as the main film former.

2 Normative References

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 1250 Rules for Expression and Judgement of Limiting Values

GB/T 1724 Methods of Test for Fineness of Grind of Paints

GB/T 1731-1993 Determination of Flexibility of Films

GB/T 1732-1993 Determination of Impact Resistance of Film

GB/T 1740 Determination of Resistance to Heat and Humidity of Paint Films

GB/T 1766 Paints and Varnishes – Rating Schemes of Degradation of Coats

GB/T 1771 Paints and Varnishes – Determination of Resistance to Neutral Salt Spray (GB/T 1771-1991, eqv ISO 7253:1984)

GB/T 6751 Paints and Varnishes – Determination of Volatile and Non-Volatile Matter (GB/T 6751-1986, eqv ISO 1515:1973)

GB/T 9271 Paints and Varnishes – Standard Panels for Testing (GB/T 9271-1988, eqv ISO 1514:1984)

GB/T 9274-1988 Paints and Varnishes – Determination of Resistance to Liquids (eqv ISO 2812:1974)

GB 9278 Temperature and Humidity for Conditioning and Testing of Paint Specimens (GB 9278-1988, eqv ISO 3270:1984, Paints and Varnishes and Their Raw Materials – Temperature and humidity for Conditioning and Testing)

GB/T 9286-1998 Paints and Varnishes – Cross Cut Test for Films (eqv ISO 2409:1992)

GB/T 9750 Marks for Package of Coating Products

GB/T 9753 Paints and Varnishes – Cupping Test (GB/T 9753-1988, eqv ISO 1520:1973)

GB/T 13452.1-1992 Paints and Varnishes - Determination of Total Lead - Flame Atomic Absorption Spectrometric Method (eqv ISO 6503:1984)

GB/T 13491 General Rule for Packing of Coatings

GB 17930 Unleaded Petrol (Gasoline) for Motor Vehicles

HG/T 3792-2005 Crosslinking Fluorocarbon Resin Coatings

ISO 15184:1998 Paints and Varnishes – Determination of Film Hardness by Pencil Test

ISO 15528:2000 Paints, Varnishes and Raw Materials for Paints and Varnishes – Sampling

ISO 15580:2000 Paints, Varnishes and Binders – Determination of MEQ Value of Water-Based Coating Materials and Binders

ASTM D1654-2005 Standard Test Method for Evaluation of Painted and Coated Specimens Subjected to Corrosive Environments

3 Product Classification

The cathodic electrodeposition coatings can be divided into 4 classes according to the main application areas in this Standard: Class-A is the cathodic electrodeposition coatings for commercial vehicles (buses, trucks); Class-B is the cathodic electrodeposition coatings for passenger cars (small cars with less than 9 seats); Class-C is cathodic electrodeposition coatings for automotive parts; Class-D is cathodic electrodeposition coatings for motorcycle, household appliances hardware and light industrial products, etc. The cathodic electrodeposition coatings for agricultural vehicles, construction machinery and the like vehicles can refer to Class-A.

requirements.

5.2 Test environment

The test board conditioning and test temperature shall conform to the provisions of GB 9278.

5.3 Preparation of test template

5.3.1 Substrate and substrate treatment

The items of flexibility and impact resistance use tin plate; the remaining items use steel plate. The tin plate and steel plate shall conform to the provisions of GB/T 9271; substrate treatment: use 200# water sandpaper to dip into water and polish the tin plate, so that to remove the tin layer; the steel plate used for throwing power, breakdown voltage, coulomb efficiency, salt spray resistance, cycle corrosion alternating test must be phosphating; the phosphating solution and other pre-treatment reagents shall be agreed by both parties; cupping item shall not be phosphating; the steel plate used for the remaining items without special provisions shall not be phosphating; use 200# water sandpaper to dip into water to polish, and remove the oxide layer. After the tin plate is polished or steel plate is phosphate, it shall be electroplated as soon as possible, so that prevent the template rusted or phosphating film damaged.

NOTE: the substrate material and treatment mode can be agreed. The arbitration test phosphating plate is recommended to adopt BONDER plate (cold-rolled steel plate) with brand of RB₀ 26S/NL60/0 or the standard phosphating plate agreed by both parties (during the test, it shall be noted that generally the standard phosphating plate has positive side and negative side).

5.3.2 Specimen preparation

Prepare as per the product provisions; prepare the plate after curing.

5.3.3 Requirements for preparing-plate

5.3.3.1 Equipment and material requirements

- a) DC power supply: 0V~350V, the voltage ripple rate is less than 5%; the current reading can be displayed.
- b) Stainless steel plate: long strip shape, the area of each block (single-side) shall be 1/5~1/3 of the coated template; the stainless-steel plate with brand of 316 is recommended to be used.
- c) Electrophoresis groove: volume is about 10L, material is plastic.
- d) Adjustable speed electric mixer: mixing head is made of stainless steel or glass.

5.4.1.2 Fineness

It shall be performed as per the provisions of GB/T 1724. The double-component paint only checks the color paste; while if the single-component paint is too viscous and difficult to test, then diluent can be added according to the product provisions to adjust.

5.4.1.3 Storage stability

Place about 1L of sample (the double-component paint shall check each component) into the appropriate plastic or glass container; 10% space shall be left in the container; after sealing, place it into $(50\pm 2)^{\circ}\text{C}$ constant temperature drying oven; take it out after 10d, place for 3h at $(23\pm 2)^{\circ}\text{C}$; check the "state in the container" according to the method in 5.4.1.1, if stirring, it can be mixed evenly; prepare the plate as per 5.3; check the coating film appearance (5.4.3.1); if the appearance is normal, then it is considered "no abnormality".

5.4.1.4 Solid content

It shall be performed as per GB/T 6751. The emulsion and color paste of double-component paint shall be tested respectively.

5.4.2 Working fluid performance operation method

5.4.2.1 pH value

The accuracy of pH meter to determine the pH value shall be at least ± 0.01 . The total amount of test solution is 100mL; adjust the temperature into the range of $(25\pm 1)^{\circ}\text{C}$, then test as per the instrument requirement. Repeat for twice, take the average value. The difference between the parallel determinations shall be no greater than 0.3; otherwise repeat the determination.

5.4.2.2 Conductivity

The accuracy of conductivity meter to determine the conductivity shall be at least $\pm 1\%$. The total amount of test solution is 100mL; adjust the temperature into the range of $(25\pm 1)^{\circ}\text{C}$, then test as per the instrument requirement. Repeat for twice, take the average value. The difference between each measurement value and the average value shall be no greater than 3%; otherwise repeat the determination.

5.4.2.3 Solid content

It shall be performed as per the provisions of GB/T 6751.

5.4.2.4 Ash content

5.4.2.4.1 Instrument and material

a) Analytical balance: sensitivity of 0.0001g.

tests.

5.4.2.9 Re-solubility

Electrophoresis plate as per the requirements in 5.3.3; after washing with water, immediately immerse 1/2 template into the working fluid; the stirring speed and working fluid temperature shall be the same as the plate preparation; take out the template after 10min; dry it as per the requirements in 5.3.3. The immersed coating film shall be even and flat, free of pinhole, shrinkage, pits and other paint film defects; the part contacting with the liquid surface is allowed to have slight line mark.

5.4.2.10 Breakdown voltage

5.4.2.10.1 Material

a) Phosphating steel plate.

b) 2000 mL beaker.

5.4.2.10.2 Operation procedures

This item shall be performed after the completion of other performances (after the completion of this item, the working fluid may be damaged). Prepare the template, working fluid and device, etc. as per the 5.3.2; electrophoresis according to the product specified voltage plus 50V (do not need gradual-voltage-rise process); if the current value decreases as the electrophoresis time is increased, then improve 30V; repeat such operation; when reaching such voltage, the current value shall increase rather than decrease as the time goes on, immediately cut off the power supply; reduce the above voltage by 20V; increase-decrease 10V according to the current decline or rise as time goes on, until reaching the maximum voltage when the current does not rise any more, which is called breakdown voltage.

NOTE: each electrophoresis shall be finished within 30s; if the coating film is found breakdown during the test process (no evaluation shall be performed within 5cm on the upper part of coating film), immediately cut off the power supply; if necessary, stir the working fluid for 20min, then filter it.

5.4.2.11 Coulomb efficiency

5.4.2.11.1 Instrument and material

a) Coulometer.

b) Analytical balance: sensitivity of 0.0001g.

c) Electric hot blower oven: accuracy of $\pm 2^{\circ}\text{C}$.

d) Phosphating steel plate.

Continuously stir the working fluid at a suitable speed (just at all working fluid can be stirred up) for 1 month (20°C~30°C environment); supplement the evaporation amount of water during this period every day. After continuously stirring for 1 month, measure the pH value, conductivity, solvent content of the working fluid; if it is out of the product range, it can be adjusted (add assistant, etc. rather than the original lacquer) as per the product requirements. Then prepare the plate again, measure the items that are tested before continuously stirring; if both the test results of two tests conform to the requirements of corresponding items in Table 1, it is evaluated "passed".

5.4.3 Coating film performance operation method

5.4.3.1 Coating film appearance

Visual examine the template under the scattting of sunlight; if the coating film is even, free of shrinkage, pinhole, pits and other coating film defects; then it is evaluated "normal".

5.4.3.2 Dry performance

Electrophorese template as per the requirements of 5.3.3; dry under the product specified curing temperature and time conditions; perform the solvent resistance wipe test as per the Appendix C in HG/T 3792-2005; the solvent is butanone; the number of tests is 10 times. The coating film is free of shedding, significant loss of gloss, significant discoloration, significant scratches, and the like destroying phenomena; the curing temperature and time shall be indicated in the report.

5.4.3.3 Heating reduction

5.4.3.3.1 Instrument and material

- a) Analytical balance: sensitivity of 0.0001g.
- b) Electric hot blower oven: accuracy of $\pm 2^{\circ}\text{C}$.

5.4.3.3.2 Operation procedures

Dry the phosphating steel plate for 15min under the conditions of $(105\pm 2)^{\circ}\text{C}$; after cooling off, weigh it (m_1); electrophorese the plate as per the requirements of 5.3.3; dry the wet film template for 3h under the conditions of $(105\pm 2)^{\circ}\text{C}$; after cooling off, weigh it (m_2); dry the template under the product specified curing conditions; after cooling off, weigh it (m_3).

5.4.3.3.3 Calculation

The heating reduction shall be calculated as per the Formula (4):

It shall be performed as per the immersing method specified in GB/T 9274-1988; the test solution is 50g/L NaOH. After the specified test time, take it out using water to wash and wipe; after standing for 1h, visually examine under the scattering sunlight; if two of the three test plates are free of blistering, cracking, peeling, powder-falling, significant discoloration, significant loss of gloss, and other coating film defects; then it is evaluated "no abnormality". If the above coating film defects appear, then describe as per the provisions of GB/T 1766.

5.4.3.11 Gasoline resistance

It shall be performed as per the immersing method specified in GB/T 9274-1988; the test solution is No.93 gasoline (meet the requirements of GB 17930). After the specified test time, take it out using water to wash and wipe; after standing for 1h, visually examine under the scattering sunlight; if two of the three test plates are free of blistering, cracking, peeling, powder-falling, significant discoloration, significant loss of gloss, and other coating film defects; then it is evaluated "no abnormality". If the above coating film defects appear, then describe as per the provisions of GB/T 1766.

5.4.3.12 Gel fraction

5.4.3.12.1 Definition

Gel fraction – the electrophoresis coating film through the curing, which is immersed into the mixed solvent for certain period; it indicates the mass ratio between the mass of electrophoresis coating film and that before immersing into the solvent.

Gel fraction is a method to express the degree of crosslinking and curing of electrophoresis coating film.

5.4.3.12.2 Instrument and material

- a) Analytical balance: sensitivity of 0.0001g.
- b) Electric hot blower oven: accuracy of $\pm 2^{\circ}\text{C}$.
- c) Phosphating steel plate.
- d) Methanol : acetone = 1:1 (volume ratio) (chemically pure).

5.4.3.12.3 Operation procedures

Dry the phosphating steel plate for 15min under the conditions of $(105\pm 2)^{\circ}\text{C}$, after cooling off, weigh it (m_1); electrophorese the plate as per the requirements of 5.3.3; dry the template under the product specified curing condition; after cooling off, weigh it (m_2); then immerse the template into the mixed solution of methanol and acetone for 24h; take the template out, wipe with filter paper; the paint film shall be free of blistering, peeling, sticky, significant discoloration, significant loss of gloss, and the like

marking line, and within 5mm around the template. After the test, check the blistering on the marking part of the template, the degree of corrosion of substrate, and damage of coating film in the unmarking area; if there is blistering, rusting, peeling and other coating film defects, it shall be described as per GB/T 1766.

NOTE: When examining the spread condition of the substrate corrosion, it can treat the painting film on the marking place by the appropriate method specified in ASTM D 1654-2005 or method agreed by the two sides; remove the coating that has been corrosive on the substrate or lost the adhesion; evaluate the substrate corrosion spread from the marking line and the coating loss.

6 Inspection Rules

6.1 Inspection classification

6.1.1 The product inspection can be divided into exit-factory inspection and type inspection.

6.1.2 The exit-factory inspection items include the state in the container (original lacquer), fineness (original lacquer), solid content (original lacquer), pH value (working fluid), conductivity (working fluid), coating film appearance, bending resistance, pencil hardness, adhesion, and impact resistance.

6.1.3 The type inspection items include the whole technical requirements listed in this Standard. Under normal conditions, the open mixing stability of working fluid and corrosion alternating test can be inspected as per the requirements; the rest items shall be inspected once every year.

6.2 Judgment of test results

6.2.1 The judgment of inspection results shall be performed as per the rounding-off using value comparison method specified in GB/T 1250.

6.2.2 When the inspection results of all items meet the requirements of this Standard; the sample for this test shall meet the requirements of this Standard.

7 Marking, Package and Storage

7.1 Marking

It shall be performed as per the provisions of GB/T 9750. For the paint with double-component, each group matching shall be indicated on the package marking.

7.2 Package

Appendix A

(Normative)

Determination of the Throwing Power (Ford Box Method)

A.1 Scope

This Standard is applicable to the determination of throwing power for the working fluid of electrodeposition coatings.

A.2 Definition

Throwing power – during the coating process of electrodeposition coatings, the ability of paint that can be electrophoresed on the part that is shielded in the electric field.

A.3 Material

A.3.1 Test plate: phosphating steel plate with dimension of (300mm ~ 350mm) × 105mm × 0.75mm.

A.3.2 Isolation bar: material of PVC plastic with dimension of (300mm~350mm) × 4mm × 10mm.

A.3.3 Waterproof tape: two types with width of 20mm and 38mm.

A.3.4 Electrophoresis groove: material of PVC plastic with inner wall dimension of 120mm × 200mm × 350mm.

A.3.5 Polar plate: material of stainless steel (the stainless-steel plate with Grade 316 is recommended to be used) with dimension 1/4 ~ 1/2 of the covered cathode area.

A.3.6 Adjustable speed electric mixer: the mixing head is made of stainless steel or glass (appropriate magnetic force can also be used for stirring).

A.4 Operation process

A.4.1 Preparation of throwing power box (Ford Box) (test device can refer to Figure A.1).

Appendix B

(Normative)

Determination of the Solvent Content

B.1 Scope

This Method is applicable to measure the glycol ether solvent content in the working fluid and original lacquer of electrodeposition coating.

B.2 Principle

Use gas chromatograph, in the capillary column with coatings of 6% nitrile phenylpropyl / 94% dimethylpolysiloxane, to ideally separate the common organic solvent in the cathodic electrodeposition coatings. Use internal standard method to quantify.

B.3 Reagents

B.3.1 Calibration chemical compounds

B.3.1.1 2-methoxyethanol, the purity is at least 99.5% above (mass percentage) or contains the known purity.

B.3.1.2 2-ethoxyethanol, the purity is at least 99.5% above (mass percentage) or contains the known purity.

B.3.1.3 2-Butoxyethanol, the purity is at least 99.5% above (mass percentage) or contains the known purity.

B.3.1.4 Propylene glycol monomethyl ether, the purity is at least 99.5% above (mass percentage) or contains the known purity.

B.3.1.5 Isopropanol, the purity is at least 99.5% above (mass percentage) or contains the known purity.

B.3.1.6 N-butyl alcohol, the purity is at least 99.5% above (mass percentage) or contains the known purity.

B.3.1.7 Isooctanol, the purity is at least 99.5% above (mass percentage) or contains the known purity.

B.3.1.8 Propylene glycol phenyl ether, the purity is at least 99.5% above (mass percentage) or contains the known purity.

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