TITLE
METHODS FOR MAKING COATED THREADED METALLIC

ABSTRACT
Methods for coating threaded metallic pieces which include using a threaded metallic piece as a cathode of an electrolytic cell in a bath which includes Zn ion and whereby electrodeposition of a first layer containing Zn takes place followed by deposition of a second layer of a polyester-based paint are provided. Such processes are especially useful for components of the automobile industry, such as wheel screws.
METHODS FOR MAKING COATED THREADED METALLIC

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from Italian Patent Application No. TO2010A001065, filed Dec. 27, 2010, the contents of which are incorporated herein in their entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to a process for coating threaded metallic pieces, in particular screws for use, for example, in the automobile field.

BACKGROUND OF THE INVENTION

[0008] U.S. Pat. No. 4,898,775 describes a process for coating metal sheets with paint which contains atoms of fluorine and which is applied by means of plasma.
[0009] U.S. Pat. No. 5,178,903 describes a process for coating penetration fasteners for timber (therefore not threaded), which provides for the application of a paint that must be based on aliphatic polyurethane.
[0010] U.S. Pat. No. 4,165,242 describes a process for coating metallic pieces of various kinds, which must use electro-phoretic deposition of an organic paint and special insulated cathodes.

SUMMARY OF THE INVENTION

[0011] It is an object of the present invention to provide a process which makes it possible to obtain a coating having a glossy appearance, durable over time, which also has a high resistance to repeated tightening cycles, to heat loosening, to environmental corrosion and to attack by corrosive fluids.

DETAILED DESCRIPTION

[0012] According to the invention, this object is achieved by a process for coating a threaded metallic piece, comprising in sequence the steps of:
[0013] using said piece as cathode of an electrolytic cell, wherein a bath comprising Zn ions is present, whereby the electro-deposition of a first layer containing Zn is brought about on the surface of the piece, and
[0014] applying on the piece coated by said first layer a second layer of a polyester-based paint.
[0015] In certain embodiments the electrolytic cell may be provided with membranes screening the electrodes, and the bath of the electrolytic cell further contains Ni ions, in such a way that the first layer contains Zn and Ni.
[0016] In certain embodiments before the electro-deposition, the piece may be subjected to degreasing and/or pickling treatments, and after the electro-deposition and before the application of the second layer of paint, the piece may be subjected to a passivation treatment.
[0017] In certain embodiments, the second layer of paint may be applied in two coats and the application of each coat of paint may include first the immersion of the piece in a bath of paint, then centrifuging and finally baking.
[0018] It should be noted that the process of the invention is intended exclusively for coating threaded metallic pieces, such as, for example, screws, nuts, bolts and similar parts, and it is therefore intrinsically different from and not comparable with processes for coating metal sheets or similar two-dimensional articles. It also necessarily requires that the metallic piece to be coated should be used as a cathode for the deposition of the first layer containing Zn, and that the second layer—i.e. the outer layer of the coating, exposed to the external environment—should be polyester-based.
[0019] None of the previously referenced documents, alone or in combination with the others, describes an individual embodiment incorporating all these characteristics, nor suggests to a person skilled in the art to implement it. Indeed, applicants have unexpectedly discovered that all of these benefits can be achieved by the methods described herein.
[0020] Further advantages and characteristics of the present invention will become evident from the following representative example, provided with non-limiting effect.

EXAMPLE

[0021] Wheel screws M14x48.5 were first subjected to degreasing in a bath of caustic soda of a concentration of 50 cm³/l at a temperature of 60° C. For 18 minutes, to subsequent anodic cleaning with a bath of caustic soda of a concentration of 100 cm³/l at a temperature of 40° C. and an electrical voltage of 10 V for 6 minutes, and finally to pickling in a bath of hydrochloric acid 16° Be without additives at a temperature of 20° C. for 12 minutes.
[0022] The screws thus treated were used as cathodes of an electrolytic cell provided with membranes screening the electrodes.
[0023] The cell utilized a bath containing Ni and Zn ions, supplied by the company Coventya under the commercial system name “Performa 285”. This bath furthermore contained sodium hydroxide and cleaning and brightening additives.
[0024] Keeping the screws in the electrolytic cell at a temperature of 25° C., under an electrical voltage of 8 V and for a time of 96 minutes, achieved the electro-deposition of a layer of Zn—Ni on their surfaces.
[0025] The screws thus coated were then passivated in a bath of salts of Cr(III) and Co (supplied by the company Coventya under the commercial name FINIDIP) having a concentration of 80-100 cm³/l for 6 minutes.
[0026] It should be noted that between all the various steps listed above, washing in water and neutralizations were performed.
[0027] The screws coated with the first layer and passivated were dried at a temperature of 60° C. in a centrifuge at 300 rpm for 7 minutes, and then left to settle for more than 36 hours without coming into contact with polluting agents (oils, dust etc.) of any kind.
[0028] After settling, the screws were immersed in a bath of paint having a viscosity of 38-42° for 25 seconds. During immersion the screws were rotated at 10 rpm.
The polyester-based paint containing a black pigment was supplied by the company Doerken under the commercial name Deltaprotekt VL451GZ.

The screws were then centrifuged for 13 seconds at 260 rpm to standardise the thickness of the coat of paint which had been deposited on them.

The screws were then moved into a pre-oven kept at a temperature of 100°C for a time of 20 minutes and into an oven kept at a temperature of 185°C for a time of 50 minutes, so as to bake the first coat of paint.

After coming out of the oven, the screws were cooled by exposure to a blast of air at ambient temperature.

The steps listed above—from immersion in a bath of paint onwards—were then repeated to apply a second coat of paint. In this way screws are obtained coated with a first layer of Zn—Ni and a second layer of paint. The first layer of Zn—Ni exhibited the following characteristics:

First Layer of Zn—Ni

- Thickness: 8-12 μm,
- Ni content: 12-15%,
- Wettability: 38 mN/m,
- Tightenability: 6 g.

Appearance: matt black, slightly iridescent without the presence of brightening agent.

The second layer exhibited the following characteristics:

Second Layer of Paint (Applied in Two Coats)

- Paint Quantity: 0.070-0.080 g/screw,
- Surface Area of One Screw: 34 cm²,
- Density of Dried Paint: 1.7 g/cm³,
- Thickness: 11-14 μm.

The finished screw exhibited the following characteristics:

- Total Thickness of the Two Layers of Coating: 19-26 μm (in such a way that the screw complies with a thread check using a threaded ring having a tolerance of 6 h, with a maximum torque of 2.8 Nm);
- Appearance: gloss black without accumulations of paint (in particular in the recess in the head and in the threads) and without bare patches.

Axial pull generated by tightening to 140 Nm:

- 30-60 kN over 5 consecutive tightenings;
- 20-60 kN over a further 5 consecutive tightenings.

Resistance to saline mist after 10 tightenings to 140 Nm and heating to 120°C for 24 hours:

- 120 hours without white salts, 720 hours without red salts.

Resistance to Acids:

- after 10 consecutive tightenings to 140 Nm, 5 immersions for 2 minutes each in hydrochloric acid solution 2%, brushing and remaining in a humidostatic chamber for 2 hours, no red salts appeared on the head of the screw;
- after 10 consecutive tightenings to 140 Nm, 5 immersions for 2 minutes each in phosphoric acid solution 5%, brushing and remaining in a humidostatic chamber for 2 hours, no red salts appeared on the head of the screw.

Resistance to Heat Loosening:

- after tightening to 140 Nm, heating to 160°C for 2 hours, 3 series of loosening/tightening as far as the initial angular position, minimum torques of 50 Nm were obtained on an aluminium washer and 70 Nm on a steel washer.

In sum, threaded pieces, in particular wheel screws coated by methods according to the present invention, surprisingly and completely unexpectedly exhibit a combination of properties which render them particularly suitable for their intended purposes. More specifically, threaded pieces prepared according to the present invention exhibit:

- a homogeneous gloss black appearance which is aesthetically very pleasing;
- high resistance to atmospheric agents and to salt scattered on the road, even after repeated cycles of tightening/loosening due to tire changes;
- high resistance to aggressive chemical substances, such as detergents used for cleaning wheel rims and other substances used in the automobile field such as fuels, lubricants and brake fluids with which such screws can accidentally come into contact;
- highly stable coefficient of friction, which is particularly important in view of fresh tightening which must be carried out at each tire change;
- resistance to heat loosening, up to temperatures of the order of 160°C, which can be reached because of overheating due to repeated braking;
- Naturally, without prejudice to the principle of the invention, the details of execution and the embodiments can vary widely with respect to what has been described purely by way of example, without thereby departing from the scope of the invention as defined in the attached claims.

1. A method for coating a threaded metallic piece, comprising:

- providing a bath which comprises Zn ions, introducing the metallic piece into the bath, wherein the metallic piece acts as a cathode of an electrolytic cell and wherein electro-deposition of a first layer comprising Zn is brought about on the surface of the metallic piece, and applying on the piece coated by the first layer a second layer of a polyester-based paint.

2. The method of claim 1, wherein the electrolytic cell comprises membranes screening the electrodes.

3. The method of claim 1, wherein the bath further comprises Ni ions and wherein the first layer comprises Zn and Ni.

4. The method of claim 1, wherein the metallic piece is subjected to treatments of degreasing and/or pickling prior to the electro-deposition.

5. The method of claim 1, wherein the metallic piece is subjected to a treatment of passivation after the electro-deposition and prior to the application of the second layer of paint.

6. The method of claim 1, wherein the second layer of paint is applied in two coats.

7. The method of claim 6, wherein the application of each coat of paint comprises immersing the metallic piece in a bath of paint, centrifuging and baking.

8. The method of claim 1, wherein the metallic piece is a wheel screw.

9. The method of claim 1, wherein the first layer has a thickness between about 8 and about 12 μm, and the second layer has a thickness between about 11 and about 14 μm.

10. The method of claim 1, wherein the paint comprises a black pigment.

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