METHOD OF APPLYING PHOSPHATE COATINGS TO OBJECT-SURFACES

A method of applying a phosphate coating to a surface of a metallic object immediately after phosphating in a zinc phosphating solution, wherein the metallic object is still therein the solution vessel, the method comprising the steps of: (a) taking the metallic object out of the zinc phosphating solution vessel, leaving surface of the metallic object completely covered with a wet layer of the zinc phosphating solution, the phosphating solution having a density of a first density value; (b) desiccating the wet layer, the desiccating transforms the wet layer into an adhesive layer by increasing the density from the first density value to a second density value; (c) disposing at least one layer of powdered materials onto said adhesive layer, powdered materials adhere to adhesive layer forming a completely covered layer; and (d) drying the completely covered layer, the drying creating an insoluble crystalline phosphate layer.
Method of Applying Phosphate Coatings to Object-Surfaces

This PCT patent application draws priority from U.S. Provisional Patent Application Serial No. 60/983,958.

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to methods of depositing powdered materials, such as paints, glues, metals, etc., on surfaces of metallic and non-metallic objects, transforming them into a solid crystalline phosphate layer in the process of drying.

It is known that phosphate conversion crystalline coatings are widely used for corrosion protection of metallic objects. Thus, for example, they protect iron-based materials during neutral salt spray tests (according to ASTM B117 standard) for 12-24 hrs until the base material corrosion begins. These coatings improve the corrosion protection when they are impregnated with oils, which usually contain inhibitors. In these cases, the iron-based materials start to corrode after approximately 80-100 hrs.

Moreover, since these powdered phosphate conversion crystalline coatings have excellent adhesion abilities, they are also widely used in the prior art as excellent bases for many organic paints, coatings, glues, soldering and brazing materials etc.

It should be noted that when compared to liquid organic and inorganic
materials used for coating metallic objects, powdered materials have some very important advantages of convenience, as well as safety, in transportation and storage as a result of their reduced volume and the absence of dangerous evaporating solvents.

Generally, the main technological operation in using powdered materials is a uniform deposition of the powdered components on the surface to be coated.

The most popular prior art methods are electrostatic powder deposition, and thermal powder grains fixation, where powder grains are blasted or pulverized on preliminarily heated objects, melted and fixed. The first method usually provides a coating layer having the thickness of about 40\(\mu m\) to 100\(\mu m\), while the second method provides a coating layer of about 150\(\mu m\) to 1500\(\mu m\).

In U.S. Patent Application No. 20030082391 Goodreau et al. teach a method of applying a multilayered coating to a metal substrate that include the steps of: applying a zinc phosphating solution to a portion of the substrate, which converts the surface to a zone of an insoluble crystalline phosphate, rinsing the zone, and auto-depositing a layer of a polymer resin thereupon.

It should be noted that it is very difficult to produce a thin uniform covering layer of about 25\(\mu m\), but, there is no known prior art method of production thinner powdered material layers. In addition, the above-mentioned powdered materials deposition methods are only suitable for relatively big objects, whilst no practical industrial solution is known for coating small objects with powdered materials.
There is therefore a recognized need for, and it would be highly advantageous to have a method of applying a phosphate coating to metallic and non-metallic object surfaces, by deposing powdered materials using adhesive phosphate solutions layers. The method is suitable for the treatment of relatively small objects and for the production of thin coating layers.

**SUMMARY OF THE INVENTION**

The present invention is a method of applying phosphate coatings to metallic and non-metallic object surfaces, by deposing powdered materials using adhesive phosphate solutions layers, which are transformed into a solid crystalline phosphate layer in the process of drying.

It is an object of the present invention to provide a method of applying a phosphate coating to a surface of a metallic object immediately after phosphating in a zinc phosphating solution.

It is also an object of the present invention to provide a method of applying a phosphate coating to a surface of a metallic object.

It is a further object of the present invention to provide a method of applying a phosphate coating to a surface of a non-metallic object.

According to the teachings of the present invention there is provided a method of applying a phosphate coating to a surface of a metallic object immediately after phosphating in a zinc phosphating solution, wherein the metallic object is still therein the solution vessel. The method comprises the steps of: (a) taking the metallic object out of the zinc phosphating solution
vessel, leaving the surface of the metallic object completely covered with a wet
layer of the zinc phosphating solution having a density of a first density value;
(b) desiccating the wet layer, the desiccating transforms the wet layer into an
adhesive layer by increasing the density from the first density value to a second
density value; (c) disposing at least one layer of powdered materials onto the
adhesive layer, the powdered materials adhere to the adhesive layer forming a
completely covered layer; and (d) drying the completely covered layer, creating
an insoluble crystalline phosphate layer.

According to yet another aspect of the present invention there is
provided a method of applying a phosphate coating to a surface of a metallic
object, the method comprising the steps of: (a) applying a zinc phosphating
solution to at least a portion of the surface of the metallic object. The zinc
phosphating solution completely covers the surface with a wet layer of the
solution. The phosphating solution has a density of a first density value; (b)
desiccating the wet layer, the desiccating transforms the wet layer into an
adhesive layer by increasing the density from the first density value to a second
density value; (c) disposing at least one layer of powdered materials onto the
adhesive layer, the powdered materials adhere to the adhesive layer forming a
completely covered layer; and (d) drying the completely covered layer, creating
an insoluble crystalline phosphate layer.

According to still another aspect of the present invention there is
provided a method applying a phosphate coating to a surface of a non-metallic
object, the method comprising the steps of: (a) applying a zinc phosphating
solution to at least a portion of the surface of the non-metallic object, the zinc phosphating solution completely covers the surface with a wet layer of the solution, the phosphating solution having a density of a first density value; (b) desiccating the wet layer, thus transforming the wet layer into an adhesive layer by increasing the density from the first density value to a second density value; (c) disposing at least one layer of powdered materials onto the adhesive layer. The powdered materials adhere to the adhesive layer forming a completely covered layer; and (d) drying the completely covered layer, creating an insoluble crystalline phosphate layer.

According to a further feature in the described preferred embodiments, the method further comprises the step of: (e) curing the completely covered layer.

According to still another feature described in the preferred embodiments, the first density value is between 1.00 kg/1 and 1.20 kg/1.

According to yet another feature of the present invention, the first density value is between 1.03 kg/1 and 1.15 kg/1.

According to yet another feature described in the preferred embodiments of the present invention, the first density value is between 1.03 kg/1 and 1.10 kg/1.

According to still another feature of the present invention, the second density value is larger than 1.25 kg/1.

According to still another feature of the present invention, the second density value is between 1.25 kg/1 and 1.50 kg/1.
According to yet another feature of the present invention, the second density value is larger than 1.25 kg/l.

According to still another feature described in the preferred embodiments, the second density value is between 1.25 kg/l and 1.50 kg/l.

According to yet another feature described in the preferred embodiments, the desiccating means reducing the volume of said wet layer 4 to 5 times.

According to yet another feature of the present invention, the desiccating is selected from a list of means including: heating with infrared radiation, air drying, sublimation, vacuum drying, microwave drying and ultrasonic drying,

According to still another feature of the present invention, the powdered materials include additives for acquiring required attributes. These additives are selected from a listing including: paints, sealers, glues, coatings materials, dry lubricants, and pigments.

According to still another feature described in the preferred embodiments, the powdered materials include materials selected from a list of metallic powders. These metallic powders include zinc, zinc oxide, calcium, salts, iron, iron oxide, iron salts, and manganese salts.

According to yet another feature of the present invention, the amount of the metallic materials at least neutralizes excessive acidity contained in the covered layer, and the pH value of an aqueous extract after the drying is at least 7.
According to yet another feature described in the preferred embodiments of the present invention, the drying of the completely covered layer is accomplished above 40°C.

According to still another feature of the present invention, the curing is done above 150°C.

According to still another feature described in the preferred embodiments, the curing is done between 150°C and 225°C. According to yet another feature of the present invention, the curing is done between 180°C and 200°C and

Finally, according to another feature of the described in the preferred embodiments of the present invention, the non-metallic object is a wooden object.

The present invention successfully addresses the shortcomings of the existing technologies by providing a method of applying a phosphate coating to a surface of a metallic object immediately after phosphating in a zinc phosphating solution, without any intermediate washing. This method is also method of applying a phosphate coating to a surface of a metallic, as well as a non-metallic object. The present invention, is simple, reliable and inexpensive, and provides thin and homogeneous coating to the treated object.
DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a method of applying phosphate coatings to metallic and non-metallic object surfaces, by deposing powdered materials using adhesive phosphate solutions layers, which are transformed into a solid crystalline phosphate layer in the process of drying.

The principles and operation of the method according to the present invention may be better understood with reference to the accompanying description.

Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of the method set forth in the following description. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

It is known that concentrated phosphate solutions of divalent and trivalent metals are adhesive. However, they are very unstable and easily crystallize at a density equal to, or greater than 1.25 kg/l. Therefore, phosphate solutions with the density of 1.03 kg/l to 1.10 kg/l are usually used in industry. These solutions are stable enough, but have no adhesive properties, because their molecules in this density-range are mainly in the monomolecular form.
layer, which remains on the treated surface, is usually removed by repeated rinsing in water or neutralization solutions. After rinsing, the objects are dried, and finally a solid crystalline layer of phosphates covers the surface of the treated objects. Generally, the divalent and trivalent metals applied for the phosphating process are phosphates of zinc, iron, calcium, manganese as well as their combinations.

According to one preferred embodiment of the present innovative method, the surface of objects to be treated is phosphatized with non-adhesive phosphate solutions, having the density of 1.00 kg/l to 1.20 kg/l, preferably 1.03 kg/l to 1.15 kg/l, and more preferably 1.03 kg/l to 1.10 kg/l. Usually, but not necessarily, these objects are small metallic parts, which are very frequent in the machinery and vehicle industries.

In sharp contradiction to the prior art methods, when the phosphating process is completed, the treated objects are desiccated instead of being rinsed. Consequently, the density of the thin phosphate solution layer, which remains on the treated surface, is increased to, or above 1.25 kg/l and thus becomes adhesive. At this stage, the powdered materials are deposited onto this adhesive phosphate solution layer, and adhere thereon it. If desired the process may be repeated to produce a multilayer coating on the surface of the treated objects. After getting the desired coating thickness, the coating is dried, and, if needed, cured.

Actually, the innovative coating structure includes three combined layers: a crystalline phosphate conversion layer produced in the process of
phosphalmg, an intermediate crystalline phosphate layer produced at the crystallization of the adhesive phosphate layer during the desiccations stage, layer of paint, glue coating, etc. produced from the powdered materials, which include suitable additives, during the drying and curing stages.

According to another embodiment of the present invention, preliminarily phosphated dry objects and objects that cannot be phosphatized are wetted by a phosphating solution, and then the treatment continues in the above-described method: desiccating the treated objects and depositing powdered materials, drying and curing. As can be appreciated by those skilled in the art, the main important requirement of the method is the formation of an adhesive layer of phosphate solution on the objects surfaces by desiccation. It should be stressed that this particular embodiment is suitable to treat non-metallic objects such as wood or plastic.

As already mentioned hereinabove, in U.S. Patent Application No. 20030082391, Goodreau et al. describe a process for applying a multilayered coating to a metal substrate that includes applying a zinc phosphating solution to a substrate, which converts the surface to a zone of an insoluble crystalline phosphate, rinsing the zone, and auto-depositing a layer of a polymer resin on the substrate. Although these process operations seem similar to the present invention, in the present invention, in a sharp contradiction to Goodreau, the phosphating liquid layer on the surface of treated objects is used, after the phosphating process is finished, as a base for the adhesive layer formation. In addition, in Goodreau's process the phosphating liquid should be completely
removed after the phosphating process by rinsing with water, while in the present invention the remaining phosphating solution is turned into an adhesive solution by desiccating to a density of at least 1.25 kg/l.

It should be emphasized that the present innovative method may be used for all types of phosphate solutions without any limitations regarding their chemical composition. To illustrate the present invention, we have used zinc phosphate solutions in the Experiments, described in details hereinbelow, which are the most popular used solutions in many different industries.

Referring now to a more detailed description of the invention, when, for example, a zinc phosphate solution typically having the density of 1.06 kg/l is used for the phosphating process the same solution can also be used as an initial solution for attaining adhesion.

Immediately after phosphatizing, the surface of the treated objects remains covered with solution of phosphate salts. In sharp contradiction to the prior art, in general, and to Goodreau, in particular, it is possible to proceed to the next steps of attaining adhesiveness immediately after phosphatizing, without any need to rinse this solution of phosphate salts.

Then, in the following stage, the water content of the phosphate salts solution on the surface of the treated objects is reduced so as to obtain a density larger than 1.25 kg/l, and preferably of 1.25 kg/l to 1.5 kg/l, at which the phosphate salts solution acquires adhesive properties. To achieve this density range, the water content of the initial phosphating liquid is reduced 4 to 5 times.
This effect may be attained by controlled desiccation of the initial solution using any known industrial method such as heating the surface of the treated objects with infrared radiation, air drying, sublimation, vacuum drying, microwave drying, ultrasonic drying, etc. Obviously, the desiccation method chosen for any specific case is the most suitable and most economical one for the case.

After turning the surface of the treated objects into an adhesive surface, powdered materials, such as paints, sealers, glues, coatings materials, dry lubricants, pigments, etc. are dispersed on the surface.

After sticking the powdered materials to the surface of the objects, the liquid adsorption layer should be crystallized into a water-insoluble phosphate salt, usually \( \text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O} \). The phosphating solution contains excessive amount of phosphoric acid, which should be bound into a solid insoluble salt. It should be reminded that only phosphates of bivalent and trivalent metals are water-insoluble. Obviously, it is expedient to use the same compounds of metals (zinc, calcium, iron, etc.) as those used in the process of phosphation in the capacity of neutralizing agents. From the practical point of view, zinc oxide is the most acceptable, since it reacts well with phosphoric acid with the formation of colorless compounds. It is proposed in the present invention to add zinc oxide or metal zinc, calcium, iron, etc., or their oxides to the powder applied to the object surface. The amount of these metallic materials, usually between 0.1% and 5%, should be sufficient for neutralizing the excessive phosphoric acid contained in the liquid layer. The exact amount is determined
by the pH value of an aqueous extract after thermal treatment of the coated objects. This pH value should be equal to, or higher than, 7.

It should be reminded that the powdered materials also include additives for acquiring required functional attributes to the final coating. These additives are paints, sealers, glues, coatings materials, dry lubricants, pigments etc.

To accelerate the process of phosphate layer crystallization, it is practical to heat up the objects up to between 50°C and 100°C. In this case, a useful side effect is the removal of excessive water still remaining after the crystallization. If needed, the present innovative method may be combined with processes of powder materials melting or powder materials curing above 150°C, preferably between 150°C and 225°C and most preferably between 180°C and 200°C.

EXAMPLES

Reference is now made to the following examples, which together with the above descriptions, illustrate the invention in a non-limiting fashion. In these experiments, Zinc phosphate was chosen as a base material for the solutions that were used for zinc-phosphating of steel objects as well as steel objects after sherardizing process, which is a diffusion coating of steel with zinc.

To prepare 1 liter of a phosphating solution concentrate (PSC) the following components were used:
• 130 g ZnO, pigment grade, produced by Numinor Ltd;

• 510 g $H_3PO_4$, technical grade, density 1.65 g/cm$^3$, supplied by Chimicol Ltd;

• 42 g NaOH, technical grade, produced by INEOS Chlor and supplied by Chimicol Ltd; and

• 270 ml tap water.

Different phosphating solutions, having the densities of 1.03 kg/l, 1.09 kg/l and 1.2 kg/l were prepared by diluting the PSC with tap water.

The main process equipment used in carrying the experiments was:

• A drying box, Thermoplus, manufactured by Dahan Technologies Ltd;

• A plastic drum having a volume of 1 liter, and a diameter of 70 mm;

• A helical degreaser, model 300/70/2, produced by Ultrasonik, Turkey;

• A digital vacuum drying furnace, 1495D; and

• A mixer, Phillips, Holland / China.

The control and measuring equipment used in the experiments include:

• An hydrometer measuring from 1.000 g/cm$^3$ to 1.200 g/cm$^3$, supplied by Bein Z.M. General Laboratory Equipment;

• A pH-meter, CyberScan 50OpH, produced by Eutech Instruments, Singapore and supplied by M.R.C. Ltd;

• An analytical balance, GF-200, produced by A&D Co., Ltd., Japan, supplied by Prisma Ltd; and
• A metallographic microscope, Optiphot-1005, manufactured by Nikon, Japan, and supplied by Eastronics Ltd.

The processed samples used in experiments 1 to 8 were sherardized steel plates of 40x40x3 mm made of low carbon steel SAE 1020. The thickness of the sherardizing coating layer, in these experiments, was 40 ± 5µm. In experiment 9, the same steel plates without coating were tested, while in experiment 10, 40x40X6 mm oak-wood plates were used.

In the experiments, the following steps and parameters were taken:

1. Sherardized samples for experiments 1 to 8 were initially phosphated, according to the conventional process, in a laboratory plastic beaker having the volume of 0.5 liter. The temperature of the phosphating liquid was 35°±2°C, and the duration of the phosphating step was 10 minutes.

2. After phosphating, the samples were rinsed, thoroughly dried and weighed.

3. The phosphated samples were immersed in phosphating solutions with different initial densities and weighed again.

4. The samples were desiccated in the vacuum drying furnace during various periods of times, and weighed again.

5. Immediately after desiccation, the samples were covered with a homogenized powdered mixture, including a black polyester powdered paint, produced by DuPont Company, France, and 5% of zinc oxide powder. This was performed in a regular fluidized-bed chamber, where the powder grains adhere to the sticky high-density desiccated phosphating liquid layer on the surface of
the samples. The samples were cured in the drying box at a temperature of 180°C to 200°C for 10 minutes. The pH value of an aqueous extract after the thermal treatment of these coated samples was 7 to 8.

6. The density $p$, in g/cm$^3$, and the thickness $d$, in µm, of the coating paint layer of the treated samples were calculated after the desiccation by the following formulas:

\[
I. \quad p = \frac{m}{(m_0 - \Delta m)/p_{H_2O}}
\]

and

\[
II. \quad d = \frac{m}{s*P}
\]

where:

$m_0$ is the initial mass of the layer in g;

$m$ is the mass of the same layer after desiccation in g;

$\Delta m$ is equal to $(m_0 - m)$ in g;

$p_0$ is the density of the initial phosphating solution in g/cm$^3$;

$p_{H_2O}$ is the density of water in g/cm$^3$; and

$s$ is the area of the sample in cm$^2$.

7. In addition, the paint coating uniformity, and the corrosion resistance of each sample were checked. The corrosion resistance was checked by the Neutral Salt Spray Test (SST) according to ASTM 117B. The corrosion resistance criterion was the time period, in hours, before white zinc corrosion products were observed. The results were averaged over at least three samples.

The experimental results were summarized in Table 1:
Due to the porosity of wood, the missing calculations of experiment #10 are inapplicable.

From the experimental results, it will be apparent to those skilled in art that:

1. An increase in the density of the phosphating solution of the phosphating salts increases the final thickness of the paint layer; and

2. The uniformity of paint thickness is improved with the decrease in the initial density of the solution.

In addition, the experiments demonstrated the possibility of painting by the method of the present method low-carbon steel objects, sherardized objects, and, surprisingly, even non-metallic objects, such as objects made of wood.

This novel method enables to prepare an adhesive layer of aqueous solutions of phosphate salts adsorbed on the surface of processed objects, by increasing the initial density of these solutions by desiccation to more than

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**Table 1**

<table>
<thead>
<tr>
<th>#</th>
<th>Initial phosphating liquid density, kg/L</th>
<th>Deseccation data</th>
<th>Deseccated phosphating layer</th>
<th>Paint layer data</th>
<th>Notes</th>
</tr>
</thead>
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<tr>
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<td></td>
<td>Temp °C</td>
<td>Dwell time, minutes</td>
<td>Density kg/liter</td>
<td>Thickness, μm</td>
</tr>
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</table>

*Due to the porosity of wood, the missing calculations of experiment #10 are inapplicable.*

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From the experimental results, it will be apparent to those skilled in art that:

1. An increase in the density of the phosphating solution of the phosphating salts increases the final thickness of the paint layer; and

2. The uniformity of paint thickness is improved with the decrease in the initial density of the solution.

In addition, the experiments demonstrated the possibility of painting by the method of the present method low-carbon steel objects, sherardized objects, and, surprisingly, even non-metallic objects, such as objects made of wood.

This novel method enables to prepare an adhesive layer of aqueous solutions of phosphate salts adsorbed on the surface of processed objects, by increasing the initial density of these solutions by desiccation to more than
1.25kg/l, or preferably to a value between 1.25 kg/l and 1.5 kg/l. This desiccation can be performed by any known technology.

The present invention is simple, reliable, easy to perform, inexpensive and requires relatively low capital costs.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the specification.
WHAT IS CLAIMED IS:

1. A method of applying a phosphate coating to a surface of a metallic object immediately after phosphating in a zinc phosphating solution, wherein the metallic object is still therein the solution vessel, the method comprising the steps of:
   
   (a) taking the metallic object out of the zinc phosphating solution vessel, leaving surface of the metallic object completely covered with a wet layer of the zinc phosphating solution, the phosphating solution having a density of a first density value;
   
   (b) desiccating said wet layer, said desiccating transforms said wet layer into an adhesive layer by increasing said density from said first density value to a second density value;
   
   (c) disposing at least one layer of powdered materials onto said adhesive layer, said powdered materials adhere to said adhesive layer forming a completely covered layer; and
   
   (d) drying said completely covered layer, said drying creating an insoluble crystalline phosphate layer.

2. The method of applying a phosphate coating of claim 1, further comprising the step of:
   
   (e) curing said completely covered layer.

3. The method of applying a phosphate coating of claim 1, wherein said first density value is between 1.00 kg/l and 1.20 kg/l.
4. The method of applying a phosphate coating of claim 1, wherein said first density value is between 1.03 kg/1 and 1.15 kg/1.

5. The method of applying a phosphate coating of claim 1, wherein said first density value is between 1.03 kg/1 and 1.10 kg/1.

6. The method of applying a phosphate coating of claim 1, wherein said second density value is larger than 1.25 kg/1.

7. The method of applying a phosphate coating of claim 1, wherein said second density value is between 1.25 kg/1 and 1.50 kg/1.

8. The method of applying a phosphate coating of claim 1, wherein said desiccating means reducing the volume of said wet layer 4 to 5 times.

9. The method of applying a phosphate coating of claim 1, wherein said desiccating is selected from a list of means including: heating with infrared radiation, air drying, sublimation, vacuum drying, microwave drying, and ultrasonic drying.

10. The method of applying a phosphate coating of claim 1, wherein said powdered materials include additives for acquiring required attributes, said additives are selected from a listing including: paints, sealers, glues, coatings materials, dry lubricants, and pigments.

11. The method of applying a phosphate coating of claim 1, wherein said powdered materials include materials selected from a list of metallic powders, said metallic powders include zinc, zinc oxide, calcium, salts, iron, iron oxide, iron salts, and manganese salts.
12. The method of applying a phosphate coating of claim 1, wherein the amount of said metallic materials at least neutralizes excessive acidity contained in said covered layer, and wherein the pH value of an aqueous extract after said drying is at least 7.

13. The method of applying a phosphate coating of claim 1, wherein said drying of said completely covered layer is accomplished above 400°C.

14. The method of applying a phosphate coating of claim 2, wherein said curing is done above 1500°C.

15. The method of applying a phosphate coating of claim 2, wherein said curing is done between 1500°C and 2250°C.

16. The method of applying a phosphate coating of claim 2, wherein said curing is done between 1800°C and 2000°C.

17. A method of applying a phosphate coating to a surface of a metallic object, the method comprising the steps of:

(a) applying a zinc phosphating solution to at least a portion of the surface of the metallic object, said zinc phosphating solution completely covers the surface with a wet layer of said solution, said phosphating solution having a density of a first density value;

(b) desiccating said wet layer, said desiccating transforms said wet layer into an adhesive layer by increasing said density from said first density value to a second density value;

(c) disposing at least one layer of powdered materials onto said adhesive layer, said powdered materials adhere to said adhesive layer
forming a completely covered layer; and

(d) drying said completely covered layer, said drying creating an insoluble crystalline phosphate layer.

18. The method of applying a phosphate coating of claim 17, further comprising the step of:

(e) curing said completely covered layer.

19. The method of applying a phosphate coating of claim 17, wherein said first density value is between 1.03 kg/l and 1.10 kg/l.

20. The method of applying a phosphate coating of claim 17, wherein said second density value is between 1.25 kg/l and 1.50 kg/l.

21. The method of applying a phosphate coating of claim 17, wherein said desiccating means reducing the volume of said wet layer 4 to 5 times.

22. The method of applying a phosphate coating of claim 17, wherein said desiccating is selected from a list of means including: heating with infrared radiation, air drying, sublimation, vacuum drying, microwave drying, and ultrasonic drying,

23. The method of applying a phosphate coating of claim 17, wherein said powdered materials include additives for acquiring required attributes, said additives are selected from a listing including: paints, sealers, glues, coatings materials, dry lubricants, and pigments.

24. The method of applying a phosphate coating of claim 17, wherein said powdered materials include materials selected from a list of metallic powders, said metallic powders include zinc, zinc oxide, calcium, salts, iron, iron oxide,
iron salts, and manganese salts.

25. The method of applying a phosphate coating of claim 17, wherein the amount of said metallic materials at least neutralizes excessive acidity contained in said covered layer, and wherein the pH value of an aqueous extract after said drying is at least 7.

26. The method of applying a phosphate coating of claim 17, wherein said drying said completely covered layer is accomplished above 40°C.

27. The method of applying a phosphate coating of claim 18, wherein said curing is done between 180°C and 200°C.

28. A method of applying a phosphate coating to a surface of a non-metallic object, the method comprising the steps of:

(a) applying a zinc phosphating solution to at least a portion of the surface of the non-metallic object, said zinc phosphating solution completely covers the surface with a wet layer of said solution, said phosphating solution having a density of a first density value;

(b) desiccating said wet layer, said desiccating transforms said wet layer into an adhesive layer by increasing said density from said First density value to a second density value;

(c) disposing at least one layer of powdered materials onto said adhesive layer, said powdered materials adhere to said adhesive layer forming a completely covered layer; and

(d) drying said completely covered layer, said drying creating an insoluble crystalline phosphate layer.
29. The method of applying a phosphate coating of claim 28, further comprising the step of:
   
   (e) curing said completely covered layer.

30. The method of applying a phosphate coating of claim 28, wherein the non-metallic object is a wooden object.