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(71) Applicant: **Balak Coatings nv**
3900 Pelt (BE)

(72) Inventors:
- **van Bakel, Frans**
  3900 Pelt (BE)
- **Riepen, Vicky**
  3900 Pelt (BE)
- **van Hoeij, Marcel**
  3900 Pelt (BE)

(74) Representative: **Brantsandpatents bv**
Pauline Van Pottelsberghelaan 24
9051 Ghent (BE)

(54) **METHOD FOR PRE-TREATING A GALVANIZED FENCE PANEL FOR COATING**

(57) The present invention relates to a method for pre-treating one or more galvanized fence panels to be coated, wherein the one or more galvanized fence panels are sequentially immersed in baths in a suspended state, wherein the method comprises the following sequential steps: degreasing, whereby the fence panels are immersed in a degreasing bath containing a degreasing agent; rinsing, wherein the fence panels are immersed in a first rinse bath comprising water; pickling, whereby the fence panels are immersed in two successive pickling baths containing pickling agents; rinsing, wherein the fence panels are immersed in a second rinse bath comprising water; demi-rinsing, whereby the fence panels are immersed in a demi-rinse bath containing demineralized water; applying an adhesion layer, wherein the fence panels are immersed in a polymer bath; and wherein the fence panels are subsequently dried in an oven, and wherein the pickling agents comprise hydrogen fluoride and phosphoric acid, in a ratio between 1/320 and 1/80.

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Description

TECHNICAL FIELD

[0001] The invention relates to a method for pre-treating a galvanized fence panel to be coated. In a second aspect, the invention relates to a pre-treated galvanized fence panel.

PRIOR ART

[0002] Fence panels, and more specifically fence panels for outdoor use, must have sufficient anti-corrosion properties. In addition, fences often need to have an aesthetic and attractive appearance.

[0003] Applying a powder coating can provide a solution to both problems. By applying a powder coating to a galvanized fence panel, not only a more aesthetic and attractive result is achieved, the corrosion resistance of this so-called duplex system is also considerably better. However, zinc is one of the most difficult surfaces to apply a paint system to. The reason for this is that the quality of the hot-dip galvanized material can vary greatly. In addition, many contaminants can occur on the zinc surface, such as corrosion products, passivation layers, rolling oil, etc.

[0004] A problem with the known pre-treatment methods is that they are not aimed at treating complete galvanized fence panels. Known methods fall short in providing an adhesion layer on the fence panel that provides sufficient adhesion of the coating and has sufficient anti-corrosion properties.

[0005] US2014120369 discloses a continuous galvanization process for a long steel product consisting of a single immersion step, wherein prior to this single immersion step the long steel product has undergone one or more treatment steps, selected from the group consisting of alkaline cleaning, rinsing, pickling and drying, and furthermore a fluxing step, consisting of immersing in a fluxing agent composition consisting of a) more than 40 and less than 70 wt% zinc chloride, (b) 10 to 30% by weight ammonium chloride, (c) more than 6% and less than 30% by weight of a group of at least two alkali metal chlorides, including sodium chloride and potassium chloride, d) 0 to 2% by weight lead chloride, and e) 0 to 15 percent by weight tin chloride, provided that the KCl/NaCl weight ratio of this group of at least two alkali metal chlorides is between 2.0 and 8.0.

[0006] The present invention aims to find a solution for at least some of the above problems.

[0007] There is a need for an improved method for pre-treating galvanized fence panels.

SUMMARY OF THE INVENTION

[0008] The invention concerns a method for pre-treating a galvanized fence panel to be coated according to claim 1. Preferred forms of the method are set out in claims 2-13. In a second aspect, the invention concerns a pre-treated galvanized fence panel according to claim 14.

[0009] It is an aim of the invention to optimize the pre-treatment of galvanized fence panels that require coating.

[0010] It is also an object of the invention to increase the pickling speed and the pickling transfer on the metal surfaces of the fence panels. Moreover, it is an aim of the invention to achieve a faster deposition kinetics of the thin adhesion layer consisting of elements of the metal ions and to obtain a more homogeneous coating of the metal surface.

[0011] By applying a powder coating to the galvanized steel, not only an aesthetic and attractive result is achieved, the corrosion resistance of the fence panels is also significantly better. However, zinc is one of the most difficult surfaces to apply a paint system to. The reason for this is that the quality of the hot-dip galvanized material can vary greatly. In addition, many contaminants can occur on the zinc surface, such as corrosion products, passivation layers on sendzimir galvanized steel, rolling oil, etc. The addition of fluoride is particularly advantageous when hot-dip galvanized steel surfaces are treated in a method according to the invention.

[0012] The adhesion layer on the fence panel over which a coating is applied in a next step improves both the adhesion of the coating and the anti-corrosion properties of the fence panel.

DETAILED DESCRIPTION

[0013] The invention concerns a method for pre-treating one or more galvanized fence panels.

[0014] Unless otherwise defined, all terms used in the description of the invention, including technical and scientific terms, have the meaning as commonly understood by a person skilled in the art to which the invention pertains. For a better understanding of the description of the invention, the following terms are explained explicitly.

[0015] In this document, "a" and "the" refer to both the singular and the plural, unless the context presupposes otherwise. For example, "a segment" means one or more segments.

[0016] When the term "around" or "about" is used in this document with a measurable quantity, a parameter, a duration or moment, and the like, then variations are meant of approx. 20% or less, preferably approx. 10% or less, more preferably approx. 5% or less, even more preferably approx. 1% or less, and even more preferably approx. 0.1% or less than and of the quoted value, insofar as such variations are applicable in the described invention. However, it must be understood that the value of a quantity used where the term "about" or "around" is used, is itself specifically disclosed.

[0017] The terms "comprise," "comprising," "provided with," "contain," "containing," "include," "including" are synonyms and are inclusive or open-ended terms that

indicate the presence of what follows, and which do not exclude or prevent the presence of other components, characteristics, elements, members, steps, as known from or disclosed in the prior art.

[0018] The terms "consist of," "consisting of," "being composed of," "composed of", are synonyms and are exclusive or closed-ended terms indicating the presence of what follows, and excluding or precluding the presence of other components, features, elements, members, steps known or described in the art.

[0019] Quoting numeric intervals by the endpoints includes all integers, fractions, and/or real numbers between the endpoints, including those endpoints.

[0020] In a first aspect, the invention concerns a method for pre-treating one or more galvanized fence panels to be coated, wherein the one or more galvanized fence panels are sequentially immersed in baths in a suspended condition.

[0021] In a preferred embodiment, the method comprises the following sequential steps:

i. degreasing, whereby the fence panels are immersed in a degreasing bath containing degreasing agents;
ii. rinsing, wherein the fence panels are immersed in a first rinse bath comprising water;
iii. pickling, whereby the fence panels are immersed in two successive pickling baths containing pickling agents;
iv. rinsing, wherein the fence panels are immersed in a second rinse bath comprising water;
v. demi-rinsing, whereby the fence panels are immersed in a demi-rinse bath containing demineralized water;
vi. applying an adhesion layer, wherein the fence panels are immersed in a polymer bath, and wherein the fence panels are subsequently dried in an oven, and wherein the pickling agents comprise hydrogen fluoride and phosphoric acid, in a ratio between 1/320 and 1/80.

[0022] The method optimizes the pre-treatment of galvanized fence panels that need to be coated. Applying a powder coating to the galvanized steel not only results in a more aesthetically pleasing result, but also significantly improves the corrosion resistance of the fence panels. However, zinc is one of the most difficult surfaces to apply a paint system to. The reason for this is that the quality of the hot-dip galvanized material can vary greatly. In addition, many contaminants can occur on the zinc surface, such as corrosion products, passivation layers on sendzimir galvanized steel, rolling oil, etc.

[0023] In an embodiment, the pretreatment is applied to a plurality of fence panels. In a preferred form, between 2 and 100 fence panels are pre-treated at the same time, preferably between 10 and 90, more preferably between 20 and 80, even more preferably between 30 and 70, most preferably between 40 and 60. In case the method takes place continuously, it will be apparent to one skilled in the art that in each step of the method between 2 and 100 fence panels, preferably between 10 and 90, more preferably between 20 and 80, even more preferably between 30 and 70, most preferably between 40 and 60, can be treated simultaneously. In this embodiment, the fence panels are positioned parallel in a suspended state.

[0024] In an embodiment, the fence panel is made of unalloyed steel, low-alloy steel or high-alloy steel. The fence panel can be manufactured from high or low carbon steel. Unalloyed steel contains a maximum of 1.5% of alloying elements (excluding carbon (C)). Unalloyed steel has a carbon percentage of 0.5% to 2%. Low-alloy steel contains between 1.5 and 5% alloying elements (excluding carbon). High-alloy steel contains more than 5% of alloying elements. The fence panel is preferably made of unalloyed steel. The term "alloying elements" refers to the elements that are present in the alloy in addition to iron and carbon. In a preferred form, the fence panel is made of an alloy comprising iron (Fe), carbon (C) and alloying elements. Preferably, the alloy comprises a maximum of 1.5% alloying elements, more preferably a maximum of 1.4%, even more preferably a maximum of 1.3%, even more preferably a maximum of 1.2%, most preferably a maximum of 1.1%. Preferably the alloy comprises at least 0.5% alloying elements, more preferably at least 0.6%, even more preferably at least 0.7%, even more preferably at least 0.8%, even more preferably at least 0.9%, most preferably at least 1%. In another preferred embodiment, the alloy comprises between 0.5 and 1.5% alloying elements, preferably between 0.6 and 1.5%, more preferably between 0.7 and 1.4%, even more preferably between 0.8 and 1.3%, even more preferably between 0.9 and 1.2%, most preferably between 1 and 1.1%.

[0025] In an embodiment, the alloy comprises a maximum of 0.1% C, more preferably a maximum of 0.09%, even more preferably a maximum of 0.085%, even more preferably a maximum of 0.08%, most preferably a maximum of 0.075%. Preferably, the alloy comprises at least 0.025% C, more preferably at least 0.03%, even more preferably at least 0.035%, even more preferably at least 0.04%, most preferably at least 0.045%. In another preferred embodiment, the alloy comprises between 0.02 and 0.1% C, preferably between 0.025 and 0.09%, more preferably between 0.035 and 0.085%, even more preferably between 0.04 and 0.08%, most preferably between 0.045 and 0.075%.

[0026] In a preferred embodiment, the alloy comprises alloying elements selected from the list of: manganese (Mn), silicon (Si), sulfur (S), phosphorus (P), nitrogen (N), copper (Cu), chromium (Cr), nickel (Ni), niobium (Nb), tin (Sn), aluminum (Al) or any combination thereof. Preferably the alloy comprises manganese (Mn), silicon (Si), sulfur (S), phosphorus (P), nitrogen (N), copper (Cu), and optionally chromium (Cr), nickel (Ni), niobium (Nb), tin (Sn), aluminum (Al).

[0027] Preferably, the alloy comprises Mn in an amount

between 0.3 and 0.5%, more preferably between 0.35 and 0.45%, Si in an amount between 0.05 and 0.25%, more preferably between 0.1 and 0.2%, S in an amount between 0.01 and 0.045%, more preferably between 0.015 and 0.04%, P in an amount between 0.005 and 0.03%, more preferably between 0.005 and 0.025%, Cu in an amount between 0.2 and 0.4%, more preferably between 0.25 and 0.35%, N in an amount between 0.005 and 0.02%, more preferably between 0.005 and 0.015%, and Cr in an amount of up to 0.15%, more preferably up to 0.1%, Ni in an amount up to 0.15%, more preferably up to 0.1%, and Nb in an amount up to 0.005%, more preferably up to 0.002%, Sn in an amount up to 0.05%, more preferably up to 0.03%, and/or Al in an amount up to 0.005%, more preferably up to 0.003%.

[0028] In a preferred form, the fence panel is a twin-wire or double-wire fence panel. With double-wire fence panels, parallel vertical bars (wires) are welded to horizontal bars (wires), whereby the vertical bars are welded at the same height between two horizontal bars. The fence panel preferably has between 50 and 55, preferably 51, vertical bars and between 1 and 20 horizontal bars.

[0029] In an embodiment, the fence panels are galvanized prior to pre-treatment. In a preferred form, the fence panels are hot-dip galvanized, whereby a zinc layer is deposited on the fence panel. In a further preferred form, the fence panel is provided with a zinc layer with a thickness between 40 and 120 mu. In a further or other preferred form, the average thickness of the zinc layer on the wires of the fence panels is between 60 and 80 mu.

[0030] In an embodiment, the vertical wires have a length between 500 and 2500 mm, preferably the vertical wires have a length selected from the list: 630, 830, 1030, 1230, 1430, 1630, 1830, 2030, 2230, 2430 mm. It will be apparent to one skilled in the art that the length of the vertical wires corresponds to the height of a fence panel. In an embodiment, the horizontal wires have a length between 2000 and 3000 mm; preferably between 2400 and 2600, even more preferably between 2500 and 2550 mm, most preferably 2508 or 2510 mm. It will be apparent to one skilled in the art that the length of the horizontal wires corresponds to the length of a fence panel.

[0031] In a preferred embodiment, the distance between two adjacent vertical wires is 40-60 mm c.t.c., more preferably between 45 and 55 mm, even more preferably between 49 and 51, most preferably about 50 mm.

[0032] In another embodiment, the distance between the adjacent horizontal wires is 100-300 mm c.t.c., preferably 150-250 mm, more preferably 180-220 mm, most preferably about 200 mm.

[0033] The term "c.t.c." (center to center) refers to a distance between the center (the heart) of a circular cross-section of one wire and the center (the heart) of a circular cross-section of another wire.

[0034] In a preferred form the method takes place continuously. The one or more fence panels in a suspended state are sequentially immersed in the various baths. The fence panels are hung using suspension means that allow upward, downward and forward movement. In this way, the fence panels are moved and positioned forwards above the various baths by means of the suspension means, after which a downward and then upward movement makes immersion possible. Multiple suspension means can immerse one or more fence panels in different steps of the method, so that continuous operation is possible.

[0035] The first step in the method is degreasing the one or more fence panels, whereby the fence panels are immersed in a degreasing bath containing degreasing agents. The degreasing is carried out to remove an oily matter or stain adhering to the surface of the fence panel and the immersion treatment is usually carried out at a temperature between 35 and 55°C, preferably a temperature between 40 and 50°C, more preferably between 41 and 49°C, even more preferably between 42 and 48°C, even more preferably between 43 and 47°C, most preferably between 44 and 46°C.

[0036] In a preferred form, degreasing continues for 0.5-2 minutes, more preferably for 0.6-1.9 minutes, even more preferably for 0.7-1.8 minutes, even more preferably for 0.8 - 1.7 minutes, more preferably for 0.9-1.9 minutes, most preferably about 1 minute.

[0037] The degreasing agents preferably comprise sodium hydroxide. Preferably, the degreasing agents comprise at least 50 m% sodium hydroxide, more preferably at least 60 m% sodium hydroxide, even more preferably at least 70 m% sodium hydroxide, even more preferably at least 80 m% sodium hydroxide, even more preferably at least 90 m% sodium hydroxide. In a further preferred form, the degreasing agents also comprise wetting agents.

[0038] In a second step (ii) of the method, the one or more fence panels are rinsed, wherein the fence panels are immersed in a first rinse bath containing water. This involves rinsing the remaining degreasing agents from the fence panel.

[0039] In a preferred form, rinsing continues for 0.5-2 minutes, more preferably for 0.6-1.9 minutes, even more preferably for 0.7-1.8 minutes, even more preferably for 0.8-1.7 minutes, even more preferably for 0.9-1.9 minutes, most preferably about 1 minute.

[0040] In an embodiment, rinsing continues between room temperature and 80°C, preferably at room temperature.

[0041] In a third step (iii) of the method, the one or more fence panels are pickled, wherein the fence panels are immersed in two successive pickling baths containing pickling agents. In an embodiment, the pickling agents are dissolved in water, so that the pickling baths comprise water and pickling agents.

[0042] The pickling agents are preferably acidic pickling agents. The hydrogen formed by the action of the acid can be absorbed in atomic form into the steel of the fence panel and cause pickling embrittlement (actually hydrogen embrittlement). In an embodiment, the pickling

baths can therefore contain a pickling inhibitor or an inhibitor, which slows down the acid-metal reaction compared to the acid-metal oxide reaction, so that hydrogen formation and thus the risk of hydrogen embrittlement can be reduced. In addition, a pickling inhibitor protects both metal and pickling acid without significantly extending the pickling time.

[0043] The pickling agents are preferably selected from the list of: hydrochloric acid, sulfuric acid, phosphoric acid, sulfamic acid, citric acid, acetic acid, acid sodium sulfate (sodium hydrogen sulfate), hydrogen fluoride, pickling pastes, or a combination of these. In an embodiment, the pickling agents are selected from the list of: hydrochloric acid, sulfuric acid, phosphoric acid, hydrogen fluoride, or a combination thereof. In a further embodiment, the pickling agents are selected from the list of phosphoric acid, hydrogen fluoride, or a combination thereof.

[0044] In a preferred form, the pickling agents comprise phosphoric acid and hydrogen fluoride.

[0045] The addition of fluoride is particularly advantageous when, in a method according to the invention, step (iii) immediately follows the rinsing in step (i), with intermediate rinsing (ii), and in particular when hot-dip galvanized steel surfaces are treated. In that case, the pickling speed on the metal surfaces increases and a faster deposition kinetics of the thin layer consisting of elements of the metal ions is achieved and a more homogeneous coating of the metal surface is the direct result.

[0046] In a preferred form, the pickling agents comprise phosphoric acid and hydrogen fluoride. In a preferred form, the pickling baths comprise hydrogen fluoride, in an amount of at least 0.001 m%, more preferably in an amount of at least 0.002 m%, even more preferably in an amount of at least 0.003 m%, even more preferably in an amount of at least 0.004 m%, most preferably in an amount of at least 0.005 m%. In a further or other preferred form, the pickling baths comprise hydrogen fluoride, in an amount of up to 5 m%, more preferably in an amount of up to 4 m%, even more preferably in an amount of up to 3 m%, even more preferably in an amount of up to 2 m%, most preferably in an amount of up to 1 m%. In another preferred form, the pickling baths comprise hydrogen fluoride, in an amount between 0.001 m% and 5 m%, more preferably in an amount between 0.002 m% and 4 m%, even more preferably in an amount between 0.003 m% and 3 m%, even more preferably in an amount between 0.004 m% and 2 m%, most preferably in an amount between 0.005 m% and 1 m%.

[0047] Below a total amount of 0.001 m% hydrogen fluoride the additional positive effect is not well developed, while above 5 m% no further increase in the deposition kinetics occurs, but the precipitation of insoluble fluorides becomes detrimental.

[0048] In a preferred form, the pickling agents comprise phosphoric acid and hydrogen fluoride. In a preferred form, the pickling baths comprise phosphoric acid, in an amount of at least 1 m%, more preferably in an amount of at least 2 m%, even more preferably in an amount of at least 3 m%, even more preferably in an amount of at least 4 m%, most preferably in an amount of at least 5 m%. In a further or other preferred form, the pickling baths comprise phosphoric acid, in an amount of up to 25 m%, more preferably in an amount of up to 24 m%, even more preferably in an amount of up to 23 m%, even more preferably in an amount of up to 22 m%, most preferably in an amount of up to 21 m%. In another preferred form, the pickling baths comprise phosphoric acid, in an amount between 1 m% and 25 m%, more preferably in an amount between 2 m% and 24 m%, even more preferably in an amount between 3 m% and 23 m%, even more preferably in an amount between 4 m% and 22 m%, most preferably in an amount between 5 m% and 21 m%.

[0049] The pickling transfer during pickling is preferably at least 1 g/m^2, more preferably at least 1.5 g/m^2, even more preferably at least 2 g/m^2.

[0050] In a preferred form, the pickling continues for 1-15 minutes, more preferably for 2-14 minutes, even more preferably for 3-13 minutes, even more preferably for 4-12 minutes, most preferably for 5-11 minutes.

[0051] In another preferred form, the fence panels are immersed for 1-5 minutes per pickling bath, more preferably for 1.5-4.5 minutes, even more preferably for 2-4 minutes, even more preferably for 2.5-3.5 minutes, most preferably about 3 minutes.

[0052] In an embodiment, pickling takes place between room temperature and 80°C, preferably at room temperature.

[0053] To prevent or minimize acid residues being carried along with the fence panel, a rinsing step (iv) is carried out after the pickling treatment. The rinsing preferably takes place in a rinse bath filled with water, whereby the fence panels are immersed in a second rinse bath containing water.

[0054] In a preferred form, rinsing continues for 0.5-2 minutes, more preferably for 0.6-1.9 minutes, even more preferably for 0.7-1.8 minutes, even more preferably for 0.8-1.7 minutes, even more preferably for 0.9-1.9 minutes, most preferably about 1 minute.

[0055] In an embodiment, rinsing continues between room temperature and 80°C, preferably at room temperature.

[0056] In a fifth step (v) of the method, the fence panels are rinsed with demineralized water, whereby the fence panels are immersed in a demi-rinse bath containing demineralized water.

[0057] In a preferred form, demi-rinsing continues for 0.5-2 minutes, more preferably for 0.6-1.9 minutes, even more preferably for 0.7-1.8 minutes, even more preferably for 0.8-1.7 minutes, even more preferably for 0.9-1.9 minutes, most preferably about 1 minute.

[0058] In an embodiment, demi-rinsing takes place between room temperature and 80°C, preferably at room temperature.

[0059] Demineralized water, or called demi water for

short, is water from which just about all the salts (minerals) usually present in water have been removed.

[0060] In a sixth step (vi) of the method, an adhesion layer is applied to the fence panels, wherein the fence panels are immersed in a polymer bath.

[0061] In a preferred form, the demi-rinsing continues for 1-3 minutes, more preferably for 1.1-2.9 minutes, even more preferably for 1.2-2.8 minutes, even more preferably for 1.3-2.7 minutes, more preferably for 1.4-2.6 minutes, most preferably about 1.5-2.5 minutes.

[0062] In an embodiment, the adhesive layer is applied between room temperature and 80°C, preferably at room temperature.

[0063] The adhesion layer is formed by a chemical reaction of the steel surface with the components in the polymer bath. This layer also has the properties of being insoluble in water. The adhesion layer over which a coating is applied improves both the adhesion of the coating and its anti-corrosion properties.

[0064] In an embodiment, the fence panels are then dried in an oven. In a preferred form, the oven operates at an air temperature between 110 and 130°C, preferably between 111 and 129°C, more preferably between 112 and 128°C, more preferably between 113 and 127°C, even more preferably between 114 and 126°C, most preferably between 115 and 125°C.

[0065] In a preferred form it continues to dry for 10-30 minutes, more preferably for 11-29 minutes, more preferably for 12-28 minutes, more preferably for 1.3-2.7 minutes, even more preferably for 14-26 minutes, most preferably about 15-25 minutes.

[0066] In an embodiment, a coating is then applied to the fence panel, whereby all wires are provided with a coating, preferably a powder coating.

[0067] In a further embodiment, the coating comprises one or more components that form a protective coating on the object when heated. Powders can, for example, be polyamides, polyolefins, epoxies, polyesters, or a combination of these, preferably the coating comprises one or more polyesters.

[0068] In a second aspect, the invention concerns a pre-treated galvanized fence panel.

[0069] In a preferred embodiment, the fence panel is provided with an adhesion layer with a thickness between 1 and 15 mu.

[0070] In a preferred form, the adhesion layer is a layer selected from: a chromate layer, phosphate layer, molybdate layer, wolframate layer, titanium layer or zirconate layer.

[0071] In what follows, the invention is described by way of non-limiting examples illustrating the invention, and which are not intended to and should not be interpreted as limiting the scope of the invention.

EXAMPLES AND DESCRIPTION OF THE FIGURES

[0072]

Figure 1 concerns a preferred embodiment of a method according to the first aspect of the invention.

Figure 2 shows a perspective view of a double-wire fence panel.

Figure 3 shows an enlarged perspective view of a double-wire fence panel (section A in **Figure 2).**

[0073] **Example 1** concerns a method for pre-treating a plurality of hot-dip galvanized fence panels to be coated as shown in **Figure 1.** Fifty or sixty parallel positioned galvanized fence panels are degreased in a first step (1) in a suspended state, by immersion in a degreasing bath for one minute at 45°C. The degreasing bath is equipped with degreasing agents. The pickling transfer is 1 g/m^2. In a second step, the fence panels are rinsed (2), by immersion in a first rinse bath for one minute. The first rinse bath is supplied with water. In a third step of the method, the fence panels are pickled (3), by immersion in two successive pickling baths (3a, 3b), whereby the fence panels are first immersed in a first pickling bath (3a) for three minutes and then immersed in a second pickling bath (3b) for three minutes. The pickling baths are provided with a pickling solution comprising water, phosphoric acid and hydrogen fluoride. In a fourth step, the fence panels are rinsed a second time (4), by immersion in a second rinse bath for one minute. The first rinse bath is supplied with water. In a fifth step, the fence panels undergo a demi-rinse (5), by immersion in a demi-rinse bath for 1 minute. The demi-rinse bath is equipped with demineralized water. The fence panels are then immersed in a polymer bath so that an adhesion layer is applied (6) to the fence panels. In a final step, the fence panels are dried (7) in an oven at 120°C for 15-20 minutes. A pre-treated hot-dip galvanized fence panel is obtained which can then be coated.

[0074] **Figure 2** and **Figure 3** show a double-wire fence panel that can be pre-treated according to the method of the first aspect.

[0075] A twin-wire fence panel (108) consists of parallel vertical wires (104) welded to horizontal wires (101, 102) with the vertical wires welded at any height between two horizontal wires (101, 102) forming a double pair (103). The distance between two adjacent vertical wires (106) is about 50 mm c.t.c. The distance between the adjacent horizontal wires (105) is about 200 mm c.t.c.

Claims

1. A method for pre-treating one or more galvanized double-wire fence panels to be coated, wherein the one or more galvanized fence panels are sequentially immersed in baths in a suspended state, wherein the method comprises the following sequential steps:

    a. degreasing, whereby the fence panels are immersed in a degreasing bath comprising a de-

greasing agent;
b. rinsing, wherein the fence panels are immersed in a first rinse bath comprising water;
c. pickling, whereby the fence panels are immersed in two successive pickling baths comprising pickling agents;
d. rinsing, wherein the fence panels are immersed in a second rinse bath comprising water;
e. demi-rinsing, whereby the fence panels are immersed in a demi-rinse bath comprising demineralized water;
f. applying an adhesion layer, wherein the fence panels are immersed in a polymer bath, and

wherein the fence panels are subsequently dried in an oven, and wherein the pickling agents comprise hydrogen fluoride and phosphoric acid, in a ratio between 1/320 and 1/80.

2. Method according to claim 1, wherein the fence panels are immersed for between 100 and 260 seconds per pickling bath during pickling.

3. Method according to any one of the preceding claims, wherein the pickling agents comprise phosphoric acid in an amount of a maximum of 5 m% of the total mass of pickling agents.

4. Method according to any one of the preceding claims, wherein the pickling agents comprise hydrogen fluoride in an amount of a maximum of 0.1 m% of the total mass of pickling agents.

5. Method according to any one of the preceding claims, wherein between 40 and 60 fence panels are pretreated simultaneously, wherein the fence panels are positioned parallel.

6. Method according to any one of the preceding claims, wherein the pickling transfer during pickling is at least $1 g/m^2$.

7. Method according to any one of the preceding claims, wherein the oven operates at an air temperature between 110 and 130°C, preferably between 115 and 125°C.

8. Method according to any one of the preceding claims, wherein the residence time in the oven is between 10 and 30 minutes, preferably between 15 and 25 minutes.

9. Method according to any one of the preceding claims, wherein degreasing takes place at a temperature between 35 and 55°C, preferably a temperature between 40 and 50°C.

10. Method according to any one of the preceding claims, wherein immersion in the polymer bath continues for 1-3 minutes, preferably for 1.5-2.5 minutes.

11. Method according to any one of the preceding claims, wherein the fence panels are immersed for between 1 and 5 minutes per pickling bath, preferably between 2 and 4 minutes.

12. Method according to any one of the preceding claims, wherein immersion in the degreasing bath continues for 0.5-2 minutes.

13. Method according to any one of the preceding claims, wherein the degreasing agents comprise sodium hydroxide.

14. A pre-treated galvanized fence panel obtained according to any one of claims 1-13.

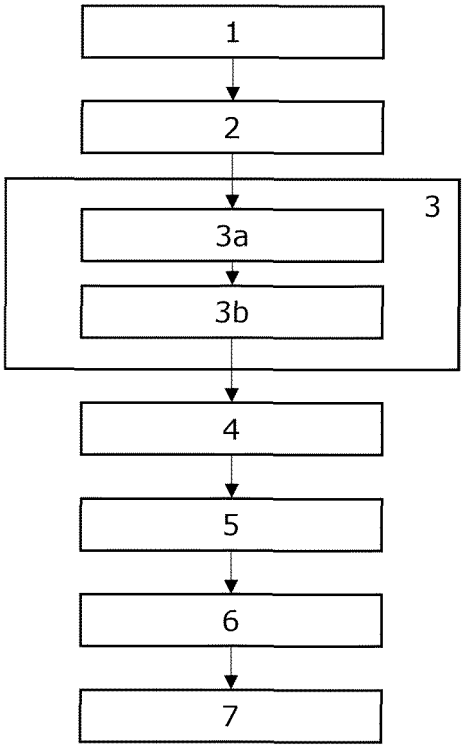

FIG. 1

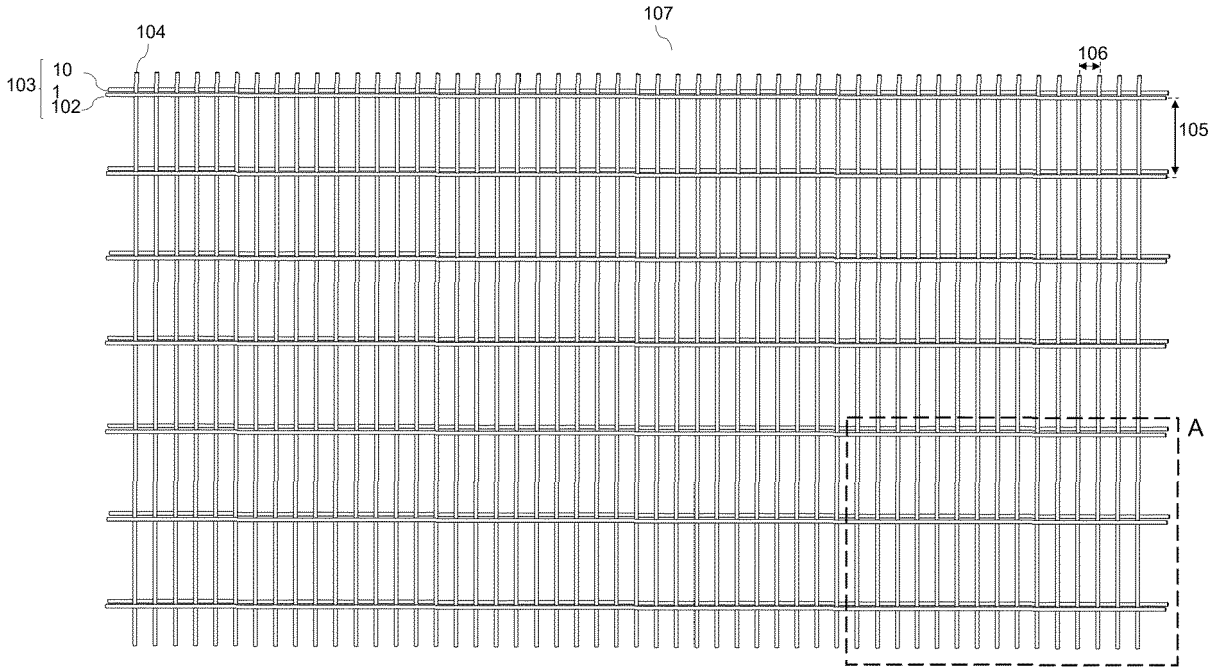

FIG.2

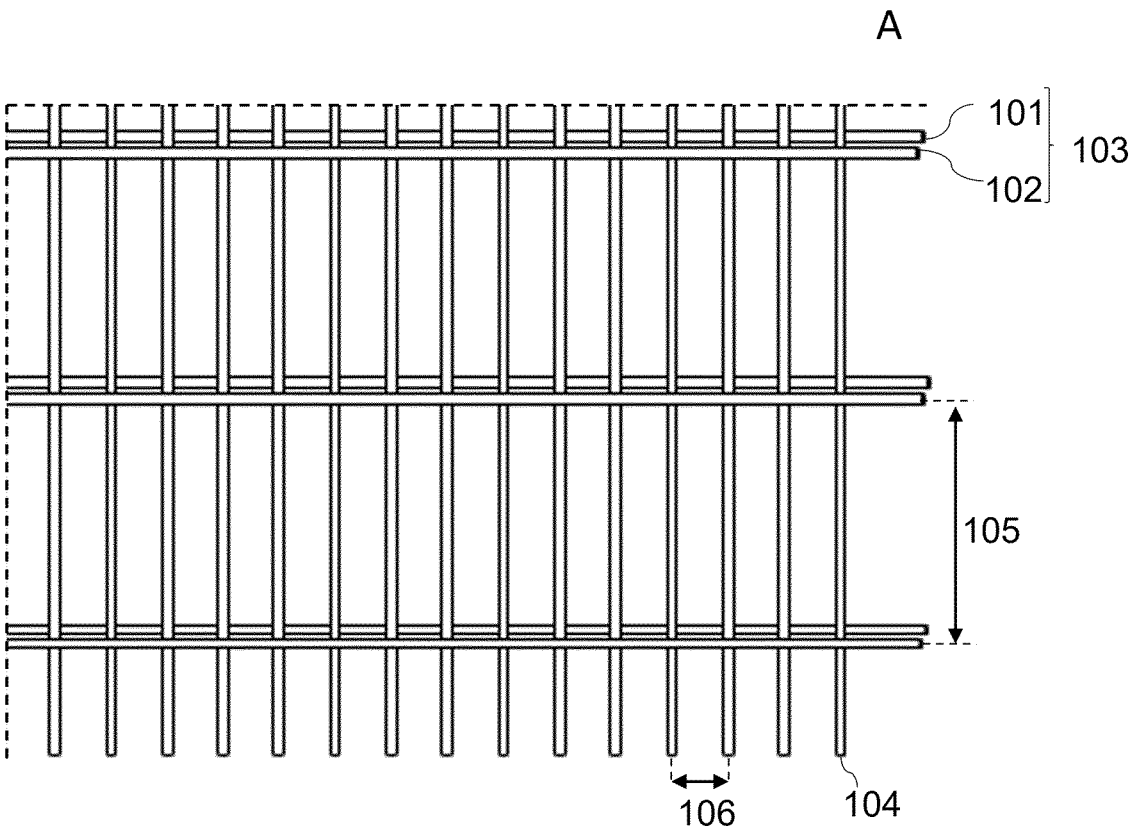

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 23 19 2618

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Place of search	Date of completion of the search	Examiner
The Hague	5 October 2023	Chalaftris, Georgios

CATEGORY OF CITED DOCUMENTS

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