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(54) **METHOD FOR PRE-TREATING A FENCE PANEL FOR GALVANIZATION AND PRE-TREATED FENCE PANEL**

(57) The present invention concerns a method for pre-treating a fence panel to be galvanized, comprising the sequential steps of: i. pickling, ii. rinsing, iii. fluxing and iv. drying a fence panel to be galvanized, wherein during pickling the fence panel is immersed three times in a pickling bath comprising a pickling solution, wherein the pickling solution comprises water, in an amount between 90 and 96 m%, and hydrogen chloride (HCl), in an amount between 2 and 5 m%, wherein the method does not comprise the step of degreasing the fence panel.

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Description

TECHNICAL FIELD

[0001] The invention relates to a method for pre-treating a fence panel to be galvanized.

PRIOR ART

[0002] Metal components often require effective protection against corrosion due to the application. In particular, steel fence panels for indoor and outdoor fencing require efficient corrosion protection that can withstand long-term loads.

[0003] The main method of protecting steel from corrosion with metallic zinc coatings is hot-dip galvanizing. Steel is immersed continuously or piece by piece at temperatures of approximately 450 °C to 600 °C in a heated vat with liquid zinc (melting point of zinc: 419.5 °C), so that a resistant alloy layer of iron and zinc is formed on the steel surface and above it a very firmly adhering pure zinc layer.

[0004] To ensure the adhesion, integrity and uniformity of the zinc layer, thorough preparation or pre-treatment of the surface of the parts to be galvanized is generally required in advance, which usually involves degreasing with subsequent rinsing, subsequent acid pickling with subsequent rinsing and finally includes a fluxing treatment (i.e. a so-called fluxing) with subsequent drying process.

[0005] Known procedures for conventional pre-treatment of surfaces prior to hot-dip galvanizing, as described for example in EP3663429 and WO2010081905, usually proceed as follows:

- First, the surfaces of the affected parts are degreased to remove residues of fats and oils, it being possible to use aqueous alkaline or acidic degreasing agents as degreasing agents. Cleaning in the degreasing bath is usually followed by a rinsing process, usually by immersion in a water bath, to prevent the degreasing agents and the galvanized material from being transferred to the next process step of pickling, especially when the transition from alkaline degreasing to acid pickling of is of great importance.

- This is followed by a pickling treatment (pickling), which is mainly intended for removing specific contaminants, such as rust and scale, from the steel surface. Pickling is usually carried out in dilute hydrochloric acid, where the duration of the pickling process depends, among other things, on the contamination status (e.g. degree of rust formation) of the galvanized material and the acid concentration and temperature of the pickling bath. To prevent or minimize the entrainment of acid and/or salt residues with the galvanized material, a rinsing process (rinsing step) is usually carried out after the pickling treatment.

- This is followed by so-called fluxing (flux treatment), the previously degreased and pickled steel surface using a so-called flux, which is typically an aqueous solution of inorganic chlorides, usually with a mixture of zinc chloride ($ZnCl_2$) and ammonium chloride (NH_4Cl). On the one hand, it is the task of the flux to perform a final intensive fine cleaning of the steel surface before the reaction of the steel surface with the molten zinc and to dissolve the oxide film of the zinc surface and prevent renewed oxidation of the steel surface until the galvanization process. On the other hand, the flux is said to increase the wettability between the steel surface and the molten zinc. After the flux treatment, drying is usually carried out to produce a solid flux film on the steel surface and to remove adhering water, so that unwanted reactions (particularly the formation of water vapor) in the liquid zinc immersion bath are subsequently avoided.

- The parts pretreated in the aforementioned manner are then hot-dip galvanized by immersion in the molten zinc melt.

[0006] However, there are several disadvantages associated with the currently known pre-treatments in the prior art, especially if they are applied to complete fence panels. The immersion baths in which the pre-treatment steps take place are made of polypropylene. The problem with known pre-treatments is that these baths are affected by the degreasing chemicals during degreasing. This means that the baths require frequent replacement.

[0007] During pickling, a 10-20 m% aqueous hydrogen chloride (HCl) solution is generally used in a pickling bath. However, this releases environmentally unfriendly acidic fumes that also carry a strong odor that is unpleasant for the operators. In addition, the pickling solution produces very acidic rinse water if a rinse takes place after pickling.

[0008] Another problem occurs with fluxing, which usually uses complex compositions of so-called flux salts.

[0009] EP2725115 describes a flux composition for the treatment of a metal surface, consisting of (a) more than 40 and less than 70 wt.% zinc chloride, (b) 10 to 30 wt.% ammonium chloride, (c) more than 6 and less than 30 wt.% of a group of at least two alkali metal chlorides including sodium chloride and potassium chloride, d) 0 to 2 percent by weight lead chloride, and e) 0 to 15 percent by weight tin chloride, provided that the KCl/NaCl weight ratio of said group of at least two alkali metal chlorides is between 2.0 and is 8.0.

[0010] WO2010081905 discloses a flux for hot-dip galvanizing consisting of: 36 to 80 percent by weight zinc chloride ($ZnCl_2$); 8 to 62 percent by weight ammonium chloride (NH_4Cl); 2.0 to 10 percent by weight of at least one of the following compounds: $NiCl_2$, $MnCl_2$ or a mixture thereof. The invention further relates to a flux bath, a process for hot-dip galvanizing of an iron or steel object

as well as to the use of this flux.

[0011] GB2480913 describes a panel consisting of woven wires of low carbon steel with various components incorporated into the panel to provide greater resistance to cutting.

[0012] There is therefore a need for an improved method for pre-treating steel components prior to hot-dip galvanizing. More specifically, for the specific pre-treatment of steel fence panels.

[0013] The present invention aims to find a solution for at least some of the above problems.

SUMMARY OF THE INVENTION

[0014] The invention concerns a method for pre-treating a fence panel to be galvanized according to claim 1.

[0015] The current method is advantageous because the method is focused on the pre-treatment of large fence panels. Pickling takes place in a pickling bath with a reduced concentration of HCl. This reduces the release of environmentally unfriendly acid fumes. This means there is less strong odor nuisance that is unpleasant for the operators. The fence panel is immersed three times in a pickling bath, making degreasing of the fence panel unnecessary. This means that the highly corrosive degreasing chemicals can be avoided. In addition, highly corrosive degreasing chemicals can be avoided.

[0016] Preferred forms of the invention are shown in claims 2-12.

[0017] A specific preferred form is shown in claim 2. The flux composition is less complex than conventional flux compositions known in the art. The flux composition is also advantageous for use in pre-treating fence panels.

[0018] In a second aspect, the invention concerns a fence panel obtained according to a method according to the first aspect.

[0019] The fence panel has improved galvanization through hot-dip galvanizing, whereby a thinner zinc layer can be obtained on the fence panel.

[0020] It is an objective of the invention to efficiently (in the shortest possible time) pre-treat double-wire fence panels with 51 longitudinal bars that need to be galvanized.

[0021] It is also an object of the invention to increase the durability of the pre-treatment, by increasing the lifespan (i.e. the time that it can be in operation) of the immersion baths. Consequently, it is also an objective of the invention to optimize the pre-treatment of fence panels by reducing or even avoiding production downtime due to the replacement of the baths.

[0022] It is an aim of the invention to reduce or even avoid the release of environmentally unfriendly acid fumes during this pretreatment. Furthermore, the invention aims to reduce or even prevent acidification of the rinse water.

DETAILED DESCRIPTION

[0023] The invention concerns a method for pre-treating a double-wire fence panel to be galvanized.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] Quoting numeric intervals by the endpoints includes all integers, fractions, and/or real numbers between the endpoints, including those endpoints.

[0030] In a first aspect, the method concerns a method for pre-treating a fence panel to be galvanized, comprising the sequential steps of: (i) pickling, (ii) rinsing, (iii) fluxing and (iv) drying a fence panel to be galvanized, wherein during pickling the fence panel (i) is immersed three times in a pickling bath comprising a pickling solution, wherein the pickling solution comprises water, in an amount between 90 and 96 m%, and hydrogen chloride (HCl), in an amount between 2 and 5 m%.

[0031] The current method is advantageous because pickling takes place in a pickling bath with a reduced concentration of HCl. This reduces the release of environmentally unfriendly acid fumes. This means there is less strong odor nuisance that is unpleasant for the operators. The fence panel is immersed three times in a pickling bath, making degreasing of the fence panel unnecessary. This means that the highly corrosive degreasing chemi-

cals can be avoided.

[0032] In an embodiment, the fence panels are not degreased prior to pickling in step (i). This means that the highly corrosive degreasing chemicals can be avoided. Moreover, an extra rinsing step is thus also unnecessary.

[0033] In a preferred form the method takes place continuously.

[0034] 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.

[0035] 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.

[0036] 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%.

[0037] 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%.

[0038] 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).

[0039] 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%.

[0040] In a preferred form, the fence panel is a twin-wire or double-wire fence panel. With double-wire fence panels, parallel vertical bars (also called vertical wires or transverse bars) are welded to horizontal bars (also called horizontal wires or longitudinal bars), 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.

[0041] 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: 606, 608, 630, 806, 808, 830, 1006, 1008, 1030, 1206, 1208, 1230, 1406, 1408, 1430, 1606, 1608, 1630, 1806, 1808, 1830, 2006, 2008, 2030, 2206, 2208, 2230, 2406, 2408, 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.

[0042] In an 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.

[0043] In another embodiment, the distance between the adjacent horizontal wires is 100-300 mm c.t.c., pref-

erably 150-250 mm, more preferably 180-220 mm, most preferably about 200 mm.

[0044] The term "c.t.c." (center to center) refers to a distance between the center (the heart) of a circular cross-section of a wire and the center (the heart) of a circular cross-section of another wire.

[0045] In a preferred form, the fence panel is immersed three times in a pickling bath in a first step. In an embodiment, the fence panel is immersed three times in the same pickling bath or in different pickling baths in a first step. Preferably, the fence panel is immersed three times in different pickling baths in a first step, even more preferably three different pickling baths. The pickling treatment (pickling) is aimed at removing specific contaminants, such as rust and scale, from the steel surface. Pickling is usually carried out in dilute hydrochloric acid (HCl), where the duration of the pickling process depends, among other things, on the contamination status (e.g. degree of rust formation) of the galvanized material and the acid concentration and temperature of the pickling bath. The pickling bath is filled with a pickling solution. The pickling solution comprises, in an amount between 90 and 96 m%, and hydrogen chloride (HCl), in an amount between 2 and 5 m%, preferably between 2.5 and 5 m%, more preferably between 3 and 5 m%, even more preferably between 3.1 and 4.9 m%, even more preferably between 3.2 and 4.8 m%, even more preferably between 3.3 and 4.7 m%, even more preferably between 3.4 and 4.6 m%, even more preferably between 3.5 and 4.5 m%, even more preferably between 3.6 and 4.4 m%, even more preferably between 3.7 and 4.3 m%, most preferably between 3.8 and 4.2 m%.

[0046] In an embodiment, pickling continues for a period of time between 8 and 12 minutes, preferably between 8.5 and 11.5 minutes, more preferably between 9 and 11 minutes, most preferably about 10 minutes.

[0047] In a preferred form, pickling continues in three different pickling baths, whereby the fence panel is successively immersed in a first, a second and a third pickling bath. In a further preferred form, the fence panel is immersed in the first pickling bath for between 2 and 4 minutes, in the second pickling bath for between 3 and 5 minutes and in the third pickling bath for between 2 and 4 minutes.

[0048] Preferably the pH of the pickling baths is a maximum of 3, more preferably a maximum of 2, most preferably a maximum of 1.

[0049] In an embodiment, pickling takes place at a temperature between 20 and 50°C, preferably between 25 and 45°C, more preferably between 30 and 40°C, even more preferably between 31 and 39°C, even more preferably between 32 and 38°C, even more preferably between 33 and 37°C, most preferably about 35°C.

[0050] In an embodiment, the pickling solution further comprises iron(II) chloride ($FeCl_2$). In a preferred form, the pickling solution comprises $FeCl_2$, in an amount of up to 5 m% of the pickling solution, preferably in an amount of up to 3 m% of the pickling solution, preferably in an amount of up to 2 m% of the pickling solution, preferably in an amount up to 1 m% of the pickling solution, preferably in an amount of up to 0.5 m% of the pickling solution, preferably in an amount of up to 0.1 m% of the pickling solution.

[0051] To prevent or minimize acid and/or salt residues being carried along with the fence panel, a rinsing process (rinsing step) is carried out after the pickling treatment. Rinsing preferably takes place in a rinse bath filled with water. In a preferred form, the rinse is a double rinse. In a further preferred form, the double rinse continues in two successive rinse baths with water.

[0052] After rinsing, the fence panel is fluxed in an embodiment (flux treatment). The previously pickled steel surface of the fence panel is treated using a so-called flux, which is typically an aqueous solution of inorganic chlorides, usually containing a mixture of zinc chloride ($ZnCl_2$) and ammonium chloride (NH_4Cl). On the one hand, it is the task of the flux to perform a final intensive fine cleaning of the steel surface before the reaction of the steel surface with the molten zinc and to dissolve the oxide film of the zinc surface and prevent renewed oxidation of the steel surface until the galvanization process. On the other hand, the flux is said to increase the wettability between the steel surface and the molten zinc. After the flux treatment, drying is usually carried out to produce a solid flux film on the steel surface and to remove adhering water, so that unwanted reactions (particularly the formation of water vapor) in the liquid zinc immersion bath are subsequently avoided.

[0053] In the presently described invention, fluxing takes place in a flux bath filled with a flux solution. A flux solution is an aqueous solution containing a flux composition. In an embodiment, during fluxing the fence panel is immersed in a flux bath comprising a flux solution comprising a flux composition.

[0054] Preferably the flux solution has a pH between 3 and 8, more preferably between 4 and 7, even more preferably between 5 and 6, most preferably about 5.5.

[0055] In an embodiment, the flux solution comprises water. In a preferred form, the flux solution comprises water, in an amount of up to 95 m% of the flux solution, preferably up to 90 m%, more preferably up to 85 m%, most preferably up to 82 m%. In another preferred form, the flux solution comprises water, in an amount of at least 65 m%, preferably at least 70 m%, more preferably at least 75 m%, most preferably at least 78 m%. In yet another preferred form, the flux solution comprises water, in an amount between 65 and 95 m%, preferably between 70 and 90 m%, more preferably between 75 m% and 85 m%, most preferably between 78 and 82 m%.

[0056] In an embodiment, the flux solution comprises a flux composition. In a preferred form, the flux solution comprises a flux composition, in an amount of up to 35 m% of the flux solution, preferably up to 30 m%, more preferably up to 25 m%, most preferably up to 22 m%. In another preferred form, the flux solution comprises a flux composition, in an amount of at least 5 m% of the

flux solution, preferably at least 10 m%, more preferably at least 15 m%, most preferably at least 18 m%. In yet another preferred form, the flux solution comprises a flux composition, in an amount between 5 and 35 m% of the flux solution, preferably between 10 and 30 m%, more preferably between 15 m% and 25 m%, most preferably between 18 and 22 m%.

[0057] In an embodiment, the flux composition comprises ammonium chloride (NH4Cl) and zinc chloride (ZnCl2). In a preferred form, the flux composition comprises ammonium chloride (NH4Cl) in an amount of up to 70 m% of the flux composition, preferably up to 65 m%, more preferably up to 60 m%, most preferably up to 56 m%. In another preferred form, the flux composition comprises ammonium chloride (NH4Cl), in an amount of at least 40 m% of the flux composition, preferably at least 45 m%, more preferably at least 50 m%, most preferably at least 52 m%. In yet another preferred form, the flux composition comprises ammonium chloride (NH4Cl), in an amount between 40 and 70 m% of the flux composition, preferably between 45 and 65 m%, more preferably between 50 m% and 60 m%, most preferably between 52 and 56 m%.

[0058] Ammonium chloride improves the wettability of the surface of the article by molten zinc and thereby promotes the formation of an even, continuous, void-free coating.

[0059] In a preferred form, the flux composition comprises zinc chloride (ZnCl2) in an amount of up to 60 m% of the flux composition, preferably up to 55 m%, more preferably up to 50 m%, most preferably up to 48 m%. In another preferred form, the flux composition comprises zinc chloride (ZnCl2), in an amount of at least 30 m% of the flux composition, preferably at least 35 m%, more preferably at least 40 m%, most preferably at least 44 m%. In yet another preferred form, the flux composition comprises zinc chloride (ZnCl2), in an amount between 30 and 60 m% of the flux composition, preferably between 35 and 55 m%, more preferably between 40 m% and 50 m%, most preferably between 44 and 48 m%.

[0060] In a preferred form, the flux composition comprises ammonium chloride (NH4Cl) and zinc chloride (ZnCl2), in a weight ratio of maximum 70/30, preferably maximum 65/35, more preferably maximum 60/40, even more preferably maximum 56/44, most preferably about 54/46. In another or further preferred form, the flux composition comprises ammonium chloride (NH4Cl) and zinc chloride (ZnCl2), in a weight ratio of at least 40/60, preferably at least 45/55, more preferably at least 50/50, even more preferably at least 52/48, most preferably about 54/46. In a preferred form, the flux composition comprises ammonium chloride (NH4Cl) and zinc chloride (ZnCl2), in a weight ratio between 70/30 and 40/60, preferably between 65/35 and 45/55, more preferably 60/40 and 50/50, even more preferably between 56/44 and 52/48, most preferably about 54/46.

[0061] Both zinc chloride and ammonium chloride are excellent reducing agents and clean metal very efficiently in the temperature range required for soldering.

[0062] In an embodiment, the flux composition consists of ammonium chloride (NH4Cl), in an amount between 40 and 70 m% of the flux composition, preferably between 45 and 65 m%, more preferably between 50 m% and 60 m%, most preferably between 52 and 56 m%, and zinc chloride (ZnCl2) in an amount between 30 and 60 m% of the flux composition, preferably between 35 and 55 m%, more preferably between 40 m% and 50 m%, most preferably between 44 and 48 m%.

[0063] In a preferred form the flux composition consists of:

- ammonium chloride (NH4Cl), in an amount between 40 and 70 m% of the flux composition,
- zinc chloride (ZnCl2) in an amount between 30 and 60 m% of the flux composition,
- impurities and/or additives in an amount of up to 5 m% of the flux composition, preferably in an amount of up to 3 m% of the flux composition, preferably in an amount of up to 2 m% of the flux composition, preferably in an amount of up to 1 m % of the flux composition, preferably in an amount of up to 0.5 m% of the flux composition, preferably in an amount of up to 0.1 m% of the flux composition.

[0064] In a further preferred form, the flux composition consists of:

- ammonium chloride (NH4Cl), in an amount between 45 and 65 m% of the flux composition,
- zinc chloride (ZnCl2) in an amount between 35 and 55 m% of the flux composition,
- impurities and/or additives in an amount of up to 5 m% of the flux composition, preferably in an amount of up to 3 m% of the flux composition, preferably in an amount of up to 2 m% of the flux composition, preferably in an amount of up to 1 m % of the flux composition, preferably in an amount of up to 0.5 m% of the flux composition, preferably in an amount of up to 0.1 m% of the flux composition.

[0065] In a still further preferred form, the flux composition consists of:

- ammonium chloride (NH4Cl), in an amount between 50 and 60 m% of the flux composition,
- zinc chloride (ZnCl2) in an amount between 40 and 50 m% of the flux composition,
- impurities and/or additives in an amount of up to 5 m% of the flux composition, preferably in an amount of up to 3 m% of the flux composition, preferably in an amount of up to 2 m% of the flux composition, preferably in an amount of up to 1 m % of the flux composition, preferably in an amount of up to 0.5 m% of the flux composition, preferably in an amount of up to 0.1 m% of the flux composition.

[0066] In an embodiment, the fence panel is immersed in the flux bath for 120-300 seconds, preferably 130-290 seconds, more preferably 140-280 seconds, even more preferably 150-270 seconds, even more preferably 160-260 seconds and most preferably between 170-250 seconds.

[0067] In a next step (iv) the fluxed fence panels are dried. Preferably, drying takes place in an oven. In a preferred form, the fence panels are dried in an oven at an air temperature between 120 and 140°C, preferably between 125 and 135°C. In another or further preferred form, the fence panels are dried in an oven for a period of time between 10 and 25 minutes, preferably between 15 and 20 minutes.

[0068] In an embodiment, the fence panel is then galvanized, preferably hot-dip galvanized.

[0069] In a second aspect, the invention concerns a fence panel

[0070] A pre-treated fence panel obtained by a method according to the first aspect.

[0071] The fence panel has improved galvanization through hot-dip galvanizing, whereby a thinner zinc layer can be obtained on the fence panel.

[0072] 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.

DESCRIPTION OF THE FIGURES

[0073] **Figure 1** shows a schematic representation of a specific embodiment of the method described herein for pre-treating a fence panel to be galvanized.

[0074] The method involves pre-treating a fence panel to be galvanized. The method comprises, in a first step, pickling (1) the fence panel. During pickling, the fence panel is immersed three times (1', 1", 1"') in three different pickling baths containing a 4 m% aqueous HCl solution as pickling solution. The fence panel is then rinsed in a second step (2). Rinsing (2) is done by immersing the pickled fence panel twice (2', 2") in a rinse bath filled with water.

[0075] The fence panel is then fluxed in a third step (3) by immersion in a flux bath comprising 20 m% of a flux composition dissolved in water, the flux composition comprising 46 m% ZnCl2 and 54 m% NH4Cl.

[0076] In a final step, the fence panel is dried (4) in an oven with air temperature 130°C.

[0077] **Figure 2** and **Figure 3** show a double-wire fence panel that can be pre-treated according to the method of the first aspect. **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).**

[0078] 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 a double-wire fence panel to be galvanized, comprising the sequential steps of: i. pickling, ii. rinsing, iii. fluxing and iv. drying a fence panel to be galvanized, wherein the fence panel is immersed three times during pickling in a pickling bath containing a pickling solution, wherein the pickling solution comprises water, in an amount between 90 and 96 m%, and comprises hydrogen chloride (HCl), in an amount between 2 and 5 m%, and wherein the fence panel is immersed during fluxing in a flux bath comprising a flux solution, wherein the flux solution comprises water, in an amount between 75 and 85 m%, and comprises a flux composition, in an amount between 15 and 25 m%, wherein the method does not comprise the step of degreasing the fence panel.

2. Method according to any one of the preceding claims, wherein the flux composition comprises ammonium chloride (NH4Cl), in an amount between 50 and 60 m%, and zinc chloride (ZnCl2), in an amount between 40 and 50 m%.

3. Method according to any one of the preceding claims, wherein the flux composition comprises ammonium chloride (NH4Cl) and zinc chloride (ZnCl2), in a weight ratio between 60/40 and 50/50, preferably about 55/45.

4. Method according to any one of the preceding claims, wherein the rinsing comprises a double rinse, preferably in successive rinse baths.

5. Method according to any one of the preceding claims, wherein the pickling solution further comprises iron(II) chloride (FeCl2).

6. Method according to any one of the preceding claims, wherein the fence panel is immersed in three separate pickling baths during pickling.

7. Method according to any one of the preceding claims, wherein the pickling continues for a period of time between 8 and 12 minutes.

8. Method according to any one of the preceding claims, wherein the fluxing continues for a period of time between 2 and 4 minutes.

9. Method according to any one of the preceding claims, wherein pickling takes place in three different

pickling baths, wherein the fence panel is successively immersed in a first, a second and a third pickling bath, and wherein the fence panel is immersed in the first pickling bath for between 2 and 4 minutes, between 3 and 5 minutes in the second pickling bath and between 2 and 4 minutes in the third pickling bath.

10. Method according to any one of the preceding claims, wherein the fence panels are dried in an oven at an air temperature between 120 and 140°C.

11. Method according to any one of the preceding claims, wherein the fence panels are dried in an oven for a period of time between 15 and 20 minutes.

12. Method according to any one of the preceding claims, wherein the flux composition consists of:

a. ammonium chloride (NH_4Cl), in an amount between 50 and 60 m% of the flux composition,
b. zinc chloride ($ZnCl_2$) in an amount between 40 and 50 m% of the flux composition,
c. impurities and/or additives in an amount of up to 5 m% of the flux composition, preferably in an amount of up to 3 m% of the flux composition, preferably in an amount of up to 2 m% of the flux composition, preferably in an amount of up to 1 m % of the flux composition, preferably in an amount of up to 0.5 m% of the flux composition, preferably in an amount of up to 0.1 m% of the flux composition.

13. A pre-treated fence panel obtained by means of a method according to any one of the claims 1-12.

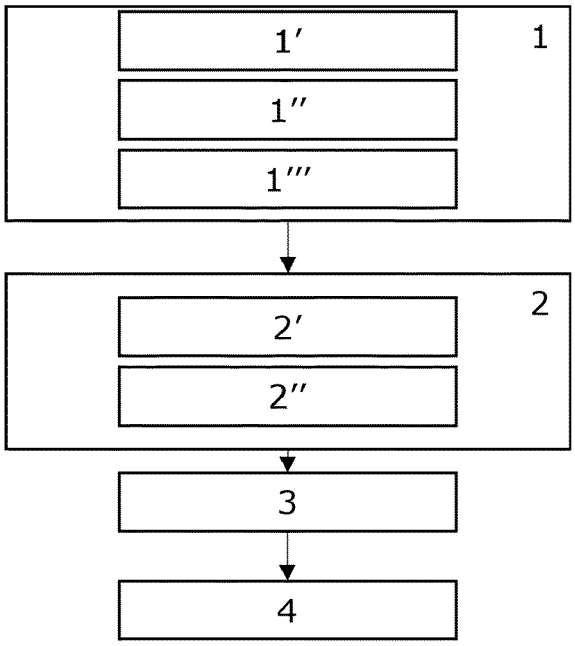

FIG. 1

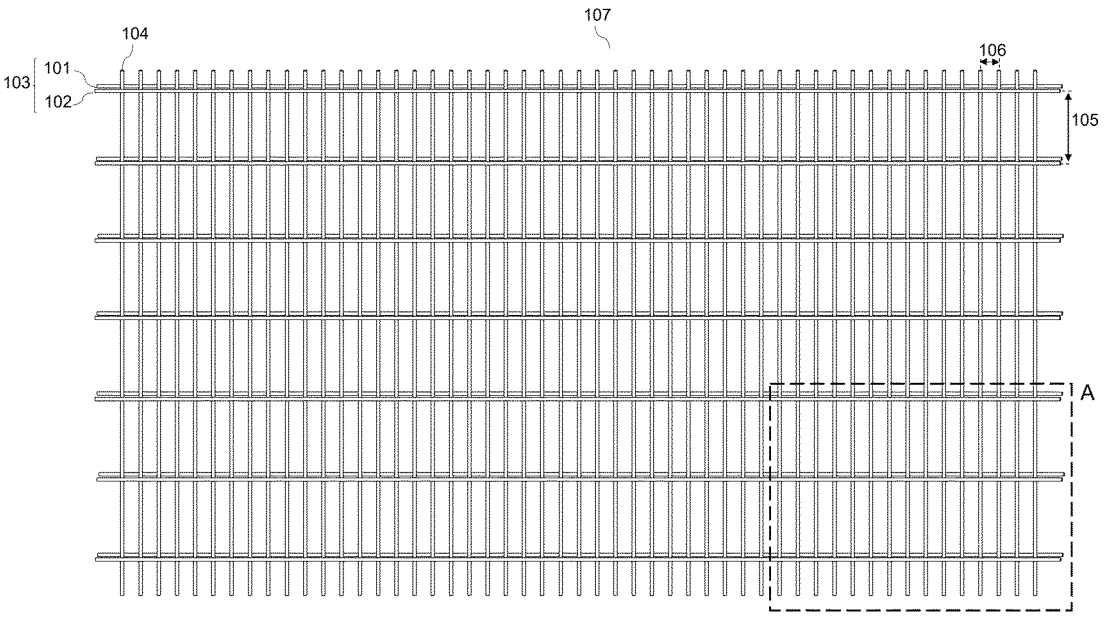

FIG. 2

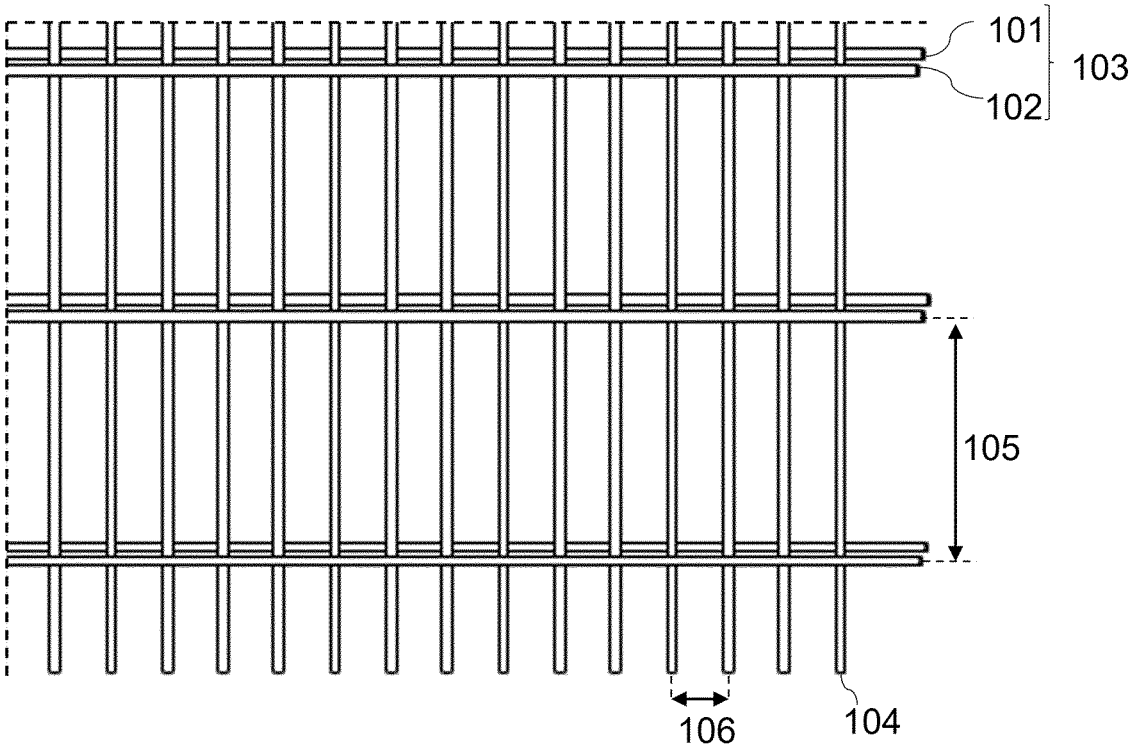

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 23 19 2614

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C23C
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C23G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 October 2023	Chalaftris, Georgios

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