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(54) **Process for dezincing galvanized steel**

Verfahren zum Entzinken galvanisierten Stahls

Procédé de dézincage de l'acier galvanisé

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WO-A-96/02689 **US-A- 5 779 878**

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Description**BACKGROUND OF THE INVENTION**

5 **[0001]** The present invention relates, in general, to a process for dezincing steel scrap and, in particular, to a galvanic dezincing process in which the cathode is steel or another metal or alloy which does not have a low hydrogen over-voltage.

10 **[0002]** Zinc coated (galvanized) steel is widely used in automotive, construction, and agricultural equipment and other industries. These industries and the mills producing galvanized sheet generate a considerable quantity of fresh steel scrap, at least some of which is galvanized, which can be recycled and reused as a starting material in steel and iron-making processes. The presence of zinc in the steel scrap used in steel and iron-making processes, however, increases the cost of compliance with environmental regulations due to costs associated with dust disposal and possible pretreatment of dust as a hazardous waste, treatment of waste water for removal of zinc and collection of fumes to maintain the shop floor environment and to restrict roof-vent emissions. As a result, there is great interest in develop-
15 ment of an economical method of removing zinc from steel scrap.

[0003] In one approach, the steel scrap is immersed in an acid such as hydrochloric acid or sulfuric acid. Iron, how-
ever, is co-dissolved with the zinc in the acid solution and the separation of the iron from the zinc has not been found to be economically feasible.

20 **[0004]** The use of caustic soda solution to dissolve zinc from galvanized steel scrap has also been proposed. An inherent advantage of this method is that iron is stable in caustic and thus, separation of iron from zinc in solution is not a significant problem. A disadvantage of this method, however, is the relatively slow rate at which zinc is removed from the galvanized surface which leads to low productivity or inadequate zinc removal.

25 **[0005]** Leeker et al. in U.S. Patent No. 5,106,467 disclose a process for the dissolution of zinc from galvanized steel in caustic electrolyte in which the dissolution rate is accelerated by the addition of oxidizing agents such as sodium nitrate to the electrolyte. The use of nitrates, however, increases the cost of the process. In addition, the use of nitrates has been associated with the formation of cyanides and thus this approach poses a serious risk hazard.

30 **[0006]** LeRoy et al. disclose other methods for accelerating the dissolution of zinc from galvanized steel in caustic electrolyte in U.S. Patent Nos. 5,302,260 and 5,302,261. LeRoy et al. suggest that the galvanized steel be immersed in a caustic electrolyte and electrically connected to a cathodic material which is stable in the electrolyte and which has a low hydrogen overvoltage. According to LeRoy et al., such cathodes include high-surface-area nickel-based and cobalt-based materials such as Raney nickel type and Raney Cobalt type, nickel molybdates, nickel sulfides, nickel-cobalt thiospinels and mixed sulphides, nickel aluminum alloys, and electroplated active cobalt compositions. If the scrap is clean, unpainted, or shredded, no external source of voltage is applied to the cathode material. LeRoy et al., U.S. Patent No. 5,302,261 at col. 2, lines 37-47. If bundles of scrap are to be dezincing, however, they suggest applying
35 an external source of voltage to the cathode to increase the rate of zinc stripping. LeRoy et al., U.S. Patent No. 5,302,261 at col. 2, lines 47-54. The anodic dezincing of bundles or bales, however, requires long processing times, large floor space and concomitant capital and electrical power costs, making this process relatively expensive. The cost of cathodic materials having a low hydrogen overvoltage also adds significantly to the cost of this approach.

SUMMARY OF THE INVENTION

40 **[0007]** Among the objects of the invention, therefore, is the provision of a process for dezincing steel scrap in a caustic electrolyte; the provision of such a process in which the cathode is steel or another metal having a relatively high hydrogen overvoltage; the provision of such a process in which an external source of voltage need not be applied
45 to the cathode material to increase the dissolution rate; and the provision of such a process in which the zinc removal rate is accelerated relative to the rate at which zinc would be removed from scrap which is simply immersed in caustic electrolyte.

[0008] According to the present invention there is provided a process of removing zinc from galvanized steel com-
prising

50 immersing the galvanized steel in an aqueous electrolyte containing sodium or potassium hydroxide, galvanically corroding the zinc from the surface of the galvanized steel in a reaction in which there is an anode and a cathode, wherein the zinc serves as the anode and the material serving as the cathode is principally a material having a standard electrode potential which is intermediate those of zinc and cadmium in the electro-
55 chemical series, and treating the galvanized steel to accelerate the corrosion rate of the zinc from the galvanized steel, said treatment comprising heating the galvanized steel to form an alloy of zinc on the surface of the galvanized steel.

[0009] Other objects and features of the invention will be in part apparent and in part pointed out hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view illustrating steel scrap movement and caustic electrolyte circulation through a de-zincing process of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The process of the present invention is carried out in a system in which the steel scrap is immersed in a caustic electrolyte such as caustic soda (sodium hydroxide) or caustic potash (potassium hydroxide). Caustic soda is preferred over potassium hydroxide, however, due to its relative cost advantage. While immersed in the electrolyte, the zinc-coated steel is galvanically corroded with the zinc-coated surface of the scrap serving as the anodic material and an exposed steel surface or another metal having a relatively high hydrogen overvoltage serving as the cathodic material. To enable the galvanic corrosion process to proceed at an economically practical rate, the scrap is treated in a manner to increase the surface area of the cathodic material relative to the surface area of the anodic material.

In general, the rate of dissolution of the zinc increases with increasing concentration of the caustic soda in and the temperature of the electrolyte. Preferably, the electrolyte is an aqueous solution comprising caustic soda in a concentration of at least 15% by weight. More preferably, the concentration of caustic soda in the electrolyte is between 25% and 50% by weight and most preferably it is maintained within the range of 30% to 40% by weight. At these concentrations, the electrolyte can be relatively viscous depending upon the temperature. Accordingly, the temperature of the electrolyte is preferably at least 75° C but less than the temperature at which the electrolyte boils, more preferably between 85° C and 95° C, and most preferably between 90° C and 95° C.

The cathodic material may be any metal or alloy which is more noble than zinc in the galvanic series of metals and alloys. High-surface-area nickel-based or cobalt-based materials, nickel molybdates, nickel sulfides, nickel-cobalt thiospinels and mixed sulphides, nickel aluminum alloys, and electroplated active cobalt compositions and any other such low-hydrogen overvoltage materials are too expensive and thus are preferably not used as the cathodic material. Instead, the cathodic material is principally iron, an alloy of steel, or another alloy or metal having a standard electrode potential (reduction potential) intermediate that of the standard electrode potential of zinc (-0.76 V) and cadmium (-0.4 V) in the electrochemical series which is relatively inexpensive. In a particularly preferred embodiment, pieces of galvanized scrap or regions thereof from which the zinc coating has been removed serve as the cathodic material.

In accordance with the present invention, the size of the cathodic area relative to the size of the anodic area of the steel scrap may be increased by a variety of methods. For example, (i) the steel scrap may be heated or mechanically abraded or deformed to increase the number density and total surface area of cathodic areas in the scrap, or (ii) it may be intimately mixed with a cathodic material. Except as will be noted herein, these methods may be carried out before the scrap is immersed in the electrolyte or while it is immersed in the electrolyte.

In general, heating the surface of galvanized scrap to a relatively high temperature causes zinc from the zinc coating to diffuse into the steel and iron from the steel to diffuse into the zinc coating. As a result of this diffusion, electrical contact between two dissimilar metals is increased at the surface of the steel scrap thus increasing the galvanic corrosion rate of the scrap when it is immersed in the electrolyte. Preferably, the galvanized scrap is heated to a temperature in excess of the melting point of zinc in order for this transformation to occur in a commercially acceptable time period. More preferably, the galvanized scrap is heated to a temperature of at least 470° C, still more preferably at least 500° C, and most preferably at least 600° C. The period of time at which the galvanized scrap is held at these temperatures to achieve the desired effect will be a function of temperature. In general, however, it is preferred that the holding period be between 5 and 20 minutes, with time periods of 10 to 15 minutes being particularly preferred.

In one arrangement, the steel scrap may be mechanically abraded or deformed to increase the galvanic corrosion rate. Abrading the steel scrap will remove the zinc from local areas. Deforming the steel scrap may crack or otherwise stress the zinc coating. Because these exposed and deformed areas are generally surrounded by zinc-coated regions, the number density and total surface area of cathodic areas in the scrap is increased at the surface of the steel scrap thus increasing the galvanic corrosion rate of the scrap when it is immersed in the electrolyte. The steel scrap may be mechanically abraded or deformed, for example, by shredding the scrap, by relative movement of the scrap against itself or another abrasive surface, or by hammer-milling it. Steel scrap is typically available in pieces ranging in size from 2.5 to 120 cm. with the majority of the pieces being 10 to 70 cm. If the steel scrap is shredded, therefore, the shredded pieces preferably have a size distribution of 10 to 20 cm., with the majority of shredded pieces having a size distribution of about 10 to about 15 cm. wherein size is determined by reference to the dimensions of square openings in a grate through which the pieces are passed. If the pieces of steel scrap are mechanically deformed, e.g., bent or scraped, it is preferred that the deformation sites be uniformly distributed over the galvanized surface and

that, on average, the deformed surface area exceed 10%, more preferably 15%, and most preferably at least 20% of the surface area of steel scrap.

[0017] In a further embodiment of the present invention, the size of the cathodic area may be increased relative to the size of the anodic area of the galvanized steel scrap by forming a mixture of galvanized steel scrap and uncoated material, i.e., a metal or alloy which is more noble than zinc in the galvanic series and which lacks a zinc coating. The mixture of uncoated material and galvanized steel scrap comprises at least 5% by weight uncoated material, preferably at least 10% uncoated material, more preferably at least 20% uncoated material, and optimally at least 30% uncoated material. Such mixtures may be available directly from some scrap producers or may be formed by mixing the galvanized steel scrap with uncoated material. In a preferred embodiment, the uncoated material is steel scrap from which the zinc coating has at least been partially removed.

[0018] In one embodiment of the present invention, the steel scrap is immersed in and/or carried through the electrolyte by a conveyor consisting essentially of a cathodic material which is more noble than zinc, such as a steel alloy. The conveyor may be, for example, an endless moving steel belt or a track with a carriage for holding the steel scrap suspended from the track.

[0019] In a preferred embodiment, the carriage is a rotating drum having openings in the wall thereof through which electrolyte can pass when it is immersed in the electrolyte. Rotation of the drum in the electrolyte causes movement of the steel scrap relative to itself and to drum which causes mechanical abrasion of the galvanized steel and acceleration of the galvanic corrosion rate. In addition, rotation of the drum causes the steel scrap to move relative to the electrolyte, thereby decreasing the thickness of the boundary layer and further accelerating the galvanic corrosion rate.

[0020] Referring now to Fig. 1, reference numeral 10 generally illustrates a preferred embodiment of an apparatus for carrying out the process of the present invention. Dezincing apparatus 10 comprises dezincing tank 12, rinse tanks 14, 16 and a series of endless moving belts 18, 22, 24 and 26. Steel scrap such as shredded loose clippings is fed to conveyor 18 which delivers the steel scrap to dezincing tank 12 which contains an aqueous sodium hydroxide solution containing from 150 grams/liter to 500 grams/liter NaOH at temperatures ranging from 50° C to 100° C. Within dezincing tank 14, moving belt 20 is supported by pads 21 which, in addition, electrically isolate moving belt 20 from dezincing tank 12 and from ground. Immediately upon immersion of the mixed scrap into the electrolyte, a battery effect is created which is similar to the well known Leland cell and the modern alkaline battery. The reaction proceeds rapidly (e.g., in 10 minutes or less) and vigorously when the temperature is greater than 75° C. No external voltage needs to be supplied to loose scrap; the reaction is self-sustaining until the zinc has dissolved yielding what is conventionally known as "black" or dezincing scrap. Close proximity of a clean steel surface to a zinc coated surface accelerates the process.

[0021] Moving belt 20 delivers the black scrap to moving belt 22 which carries the black scrap up and out of dezincing tank 12 and delivers it onto moving belt 24. Moving belt 24 carries the scrap through rinse tank 14 and delivers the rinsed scrap onto moving belt 26 which carries the scrap through rinse tank 16 for a second rinsing. The rinsed, black scrap is then transferred to a storage bin or directly to a customer.

[0022] Electrolyte containing dissolved zinc is continuously withdrawn from dezincing tank 12 via line 28, purified to remove aluminum, lead, copper, bismuth and iron in a tank 30, pumped by slurry pump 32, filtered in a vacuum drum or other suitable filter 34 and delivered to electrolytic zinc recovery cell 36 connected to a transformer rectifier 38. In electrolytic zinc recovery cell 36, the zinc metal is deposited on the cathode (e.g., a magnesium cathode) as a powder and/or in dendritic form and is continuously caused to be removed from the cathode to settle to the bottom of the electrolysis cell. From zinc recovery cell 36, zinc metal powder slurry is withdrawn and pumped via line 40 and slurry pump 42 to filter 44 (or centrifuge). Damp zinc cake discharged from horizontal tank filter 44 is transferred by line 46 to a briquetting unit 48 which produces zinc powder briquettes 50 which are ready for storage or sale to a customer. The electrolytic process regenerates caustic soda which is returned to the dezincing tank; the spent electrolyte with a reduced zinc content (i.e., less than 20 gm./l of zinc) is returned to the dezincing tank for further use. Preferred operating temperatures for the electrolysis solutions are 30 to 45 °C and an input range of 25 to 40 grams/liter of zinc with a free caustic level of 150 to 300 grams/liter of NaOH.

[0023] Tests on approximately 1,000 tons (approximately 1,016,047 kg) of material comprising hot dipped zinc steel, electrolytically zinc coated steel, galvaneal, galvalume, galfan, zinc iron coated, zinc nickel coated and terne (lead coated steel) plate have been carried out. Starting zinc coating weights have ranged from an average of 0.5% to 7% zinc by weight and resulting residual coatings have been reduced to as little as 0.002% zinc by weight, with the average being about 0.02% by weight zinc.

[0024] Experience to date has also demonstrated that the removal rate of zinc can be increased by deforming the surface of the scrap prior to immersion in the tank of sodium hydroxide solution with dezincing times being reduced from 80 minutes to less than 20 minutes. The dezincing effect starts at the deformed site on the steel, e.g. a bend or scratch and proceeds across the surface of the steel. It has been demonstrated that the greater the number of these deformed sites the greater the improvement in rate of effectiveness of the process, e.g., if the steel is shredded into smaller pieces in a hammer mill. This creates sites of high energy (deformation) and areas where zinc has been mechanically removed in close proximity to coated areas. In all of the above cases the galvanic dezincing effect is en-

hanced. No external current or oxidant need to be used.

[0025] Thus, improvements over prior art processes are achieved by heating the coated steel prior to feeding it into the dezincing tank. This can be achieved by passing the steel through a heated furnace on a moving grate at 400° C to 800° C and feeding the hot material into the solution. These post-heated materials assist in effectively heating the dezincing solution, achieve the temperature of the electrolyte much earlier than colder materials, and the hot surfaces cause rapid convection movement of the solution across the surface of the steel thus reducing diffusion gradients of the zinc into the solution boundary layer.

[0026] Experience to date has shown that when a sheet of zinc coated steel is dezincing the portion of the sheet that has been heated is dezincing before the unheated part of the sheet is dezincing. Extending the above effects of heating and deformation, the process can be performed by charging the materials to be dezincing to a shredder such as a hammer mill which is operated to deform the steel, mechanically remove zinc from part of the surface and concurrently heat the steel.

[0027] In the process outlined in Fig. 1, a flat linear conveyor is used and there is little movement between the adjacent pieces of steel scrap. Thus there could be areas that shield each other from the solution and cause "dead" zinc concentrated areas where reaction is slowed. This can be avoided by vigorous agitation and recycling of the hot solution or alternatively it may be overcome by using a rotating drum instead of a flat conveyor. When fitted with lifters or inclined at an angle, the rotating drum will tumble the steel moving each piece relative to the other, mix the solution, cause one surface to abrade against others, remove concentrated boundary layers, and ensure that the coated surfaces are more likely to "see" a clean steel surface. This arrangement can also cause the steel to be moved through the solution and continuously discharged.

EXAMPLE 1

[0028] In this test, hot dipped steel scrap (2.4% Zn) having a size of about 5 to 10 centimeters was galvanically corroded in a dezincing bath consisting of an aqueous solution containing 30% by weight NaOH maintained at a temperature of 180 °F (82 °C). Prior to being immersed in the dezincing bath, some of the samples were heated to a temperature of 600 °C while others were not. All of the steel scrap, however, was immersed in and carried through the dezincing bath by a rotating steel drum in which the steel scrap was tumbled. The residual zinc content was analyzed for a variety of times in the dezincing bath. The results are presented in Table 1.

TABLE 1

Time (min)	Preheating Temperature	Residual Zinc (%)
5	600°C	0.9
5	no pre-heating	1.9
10	600°C	0.15
10	no preheating	1.6
20	600°C	0.006
20	no preheating	0.48

EXAMPLE 2

[0029] The test of Example 2 was repeated except that some of the samples were heated to a temperature of 750 °C prior to being immersed in the NaOH solution. The results are presented in Table 2.

TABLE 2

TIME IN DEZINCING BATH MINUTES	TEMPERATURE °F (°C)	PREHEAT TEMPERATURE °C	RESIDUAL ZINC %
5	180 (82)	No	1.8
5	180 (82)	600	0.6
10	180 (82)	No	0.9
10	180 (82)	600	0.15
15	180 (82)	No	0.4
15	180 (82)	600	0.10
20	180 (82)	No	0.24

TABLE 2 (continued)

TIME IN DEZINCING BATH MINUTES	TEMPERATURE °F (°C)	PREHEAT TEMPERATURE °C	RESIDUAL ZINC %
20	180 (82)	600	0.004
30	180 (82)	No	0.11
30	180 (82)	600	0.002
40	180 (82)	No	0.006
40	180 (82)	600	0.002
10	180 (82)	No	0.9
10	180 (82)	No	0.04
20	180 (82)	No	0.24
20	180 (82)	750	0.002
30	180 (82)	No	0.11
30	180 (82)	750	0.001

Claims

1. A process of removing zinc from galvanized steel comprising

immersing the galvanized steel in an aqueous electrolyte containing sodium or potassium hydroxide, galvanically corroding the zinc from the surface of the galvanized steel in a reaction in which there is an anode and a cathode, wherein the zinc serves as the anode and the material serving as the cathode is principally a material having a standard electrode potential which is intermediate those of zinc and cadmium in the electrochemical series, and

treating the galvanized steel to accelerate the corrosion rate of the zinc from the galvanized steel, said treatment comprising heating the galvanized steel to form an alloy of zinc on the surface of the galvanized steel.

2. A process according to Claim 1, wherein the the galvanic corrosion rate is increased by heating the surface of galvanized steel to a temperature which causes zinc from the zinc coating to diffuse into the steel and iron from the steel to diffuse into the zinc coating.

3. A process according to Claim 2, wherein the surface of the galvanized steel is heated to a temperature of at least about 470°C.

4. A process according to Claim 3, wherein the surface of the galvanized steel is heated to a temperature of at least 600°C.

5. A process according to any one of Claims 1 to 4, wherein the galvanic corrosion rate is increased by mechanically abrading or deforming the galvanized steel.

6. A process according to Claim 5, wherein the mechanically abraded or deformed surface area exceeds about 10% of the surface area of the galvanized steel.

7. A process according to Claim 6, wherein the mechanically abraded or deformed surface area exceeds about 15% of the surface area of the galvanized steel.

8. A process according to any one of Claims 1 to 7, wherein the galvanic corrosion rate is accelerated by mixing the galvanized steel with a material having a standard electrode potential intermediate those of zinc and cadmium in the electrochemical series, the proportion of said material being at least 5% by weight of the mixture.

9. A process according to any one of Claims 1 to 8, wherein the galvanic corrosion rate is accelerated by mixing the galvanized steel with a material having a standard electrode potential intermediate those of zinc and cadmium in the electrochemical series, the proportion of said material being at least 10% by weight of the mixture.

10. A process according to any one of Claims 1 to 9, wherein the galvanized steel is in a carriage which rotates while

the galvanized steel is immersed in the electrolyte.

11. A process according to any one of Claims 1 to 10, wherein the galvanized steel is shredded into pieces having a size between 10 cm. to 20 cm. to accelerate the corrosion rate.
12. A process according to any one of Claims 1 to 11, wherein the galvanized steel is shredded into pieces, the majority of which have a size of 10 cm. to 15 cm. to accelerate the corrosion rate.
13. A process according to any one of Claims 1 to 12, wherein the electrolyte contains at least 15% by weight sodium or potassium hydroxide and has a temperature of at least 75°C.
14. A process according to Claim 13, wherein the electrolyte contains at least 30% by weight of sodium hydroxide and has a temperature of at least 85°C.

Patentansprüche

1. Verfahren zur Entfernung von Zink aus galvanisiertem Stahl, umfassend
das Eintauchen des galvanisierten Stahls in einen wässrigen Elektrolyten, enthaltend Natrium- oder Kaliumhydroxid,
das galvanische Korrodieren des Zinks von der Oberfläche des galvanisierten Stahls in einer Reaktion, in der eine Anode und eine Kathode vorhanden sind, worin das Zink als Anode dient und worin das Material, das als Kathode dient, hauptsächlich ein Material mit einem Standardelektrodenpotential ist, welches sich zwischen demjenigen von Zink und Cadmium in der elektrochemischen Reihe befindet, und
das Behandeln des galvanisierten Stahls zur Beschleunigung der Korrosionsgeschwindigkeit des Zinks aus dem galvanisierten Stahl, worin die Behandlung das Erwärmen des galvanisierten Stahls zur Bildung einer Legierung von Zink auf der Oberfläche des galvanisierten Stahls umfasst.
2. Verfahren gemäß Anspruch 1, worin die galvanische Korrosionsgeschwindigkeit durch Erwärmen der Oberfläche des galvanisierten Stahls auf eine Temperatur gesteigert wird, die das Zink zum Diffundieren aus der Zinkbeschichtung in den Stahl und das Eisen zum Diffundieren aus dem Stahl in die Zinkbeschichtung veranlasst.
3. Verfahren gemäß Anspruch 2, worin die Oberfläche des galvanisierten Stahls auf eine Temperatur von mindestens etwa 470°C erwärmt wird.
4. Verfahren gemäß Anspruch 3, worin die Oberfläche des galvanisierten Stahls auf eine Temperatur von mindestens 600°C erwärmt wird.
5. Verfahren gemäß einem der Ansprüche 1 bis 4, worin die galvanische Korrosionsgeschwindigkeit durch mechanisches Abreiben oder Deformieren des galvanisierten Stahls gesteigert wird.
6. Verfahren gemäß Anspruch 5, worin die mechanisch abgeriebene oder deformierte Oberfläche etwa 10 % der Oberfläche des galvanisierten Stahls übersteigt.
7. Verfahren gemäß Anspruch 6, worin die mechanisch abgeriebene oder deformierte Oberfläche etwa 15 % der Oberfläche des galvanisierten Stahls übersteigt.
8. Verfahren gemäß einem der Ansprüche 1 bis 7, worin die galvanische Korrosionsgeschwindigkeit durch Mischen des galvanisierten Stahls mit einem Material mit einem Standardelektrodenpotential zwischen demjenigen von Zink und Cadmium in der elektrochemischen Reihe beschleunigt wird, wobei der Anteil dieses Materials mindestens 5 Gew.-% der Mischung beträgt.
9. Verfahren gemäß einem der Ansprüche 1 bis 8, worin die galvanische Korrosionsgeschwindigkeit durch Mischen des galvanisierten Stahls mit einem Material mit einem Standardelektrodenpotential zwischen demjenigen von Zink und Cadmium in der elektrochemischen Reihe beschleunigt wird, wobei der Anteil dieses Materials mindestens 10 Gew.-% der Mischung beträgt.
10. Verfahren gemäß einem der Ansprüche 1 bis 9, worin sich der galvanisierte Stahl in einem Wagen befindet, der

rotiert, während der galvanisierte Stahl in den Elektrolyten eingetaucht ist.

11. Verfahren gemäß einem der Ansprüche 1 bis 10, worin der galvanisierte Stahl zu Stückchen mit einer Größe zwischen 10 cm bis 20 cm zerkleinert wird, um die Korrosionsgeschwindigkeit zu beschleunigen.
12. Verfahren nach einem der Ansprüche 1 bis 11, worin der galvanisierte Stahl zu Stückchen zerkleinert wird, deren Mehrheit eine Größe von 10 cm bis 15 cm aufweist, um die Korrosionsgeschwindigkeit zu beschleunigen.
13. Verfahren gemäß einem der Ansprüche 1 bis 12, worin der Elektrolyt mindestens 15 Gew.-% Natrium- oder Kaliumhydroxid enthält und eine Temperatur von mindestens 75°C hat.
14. Verfahren gemäß Anspruch 13, worin der Elektrolyt mindestens 30 Gew.-% Natriumhydroxid enthält und eine Temperatur von mindestens 85°C hat.

Revendications

1. Procédé de retrait du zinc de l'acier galvanisé comprenant l'immersion de l'acier galvanisé dans un électrolyte aqueux contenant de l'hydroxyde de sodium ou de potassium, la corrosion galvanique du zinc depuis la surface de l'acier galvanisé dans une réaction où il y a une anode et une cathode, où le zinc sert d'anode et le matériau servant de cathode est principalement un matériau ayant un potentiel d'électrode standard qui est intermédiaire entre ceux du zinc et du cadmium dans la série électrochimique, et le traitement de l'acier galvanisé pour accélérer la vitesse de corrosion du zinc depuis l'acier galvanisé, ledit traitement comprenant le chauffage de l'acier galvanisé pour former un alliage de zinc sur la surface de l'acier galvanisé.
2. Procédé selon la revendication 1 où la vitesse de corrosion galvanique est augmentée par chauffage de la surface de l'acier galvanisé à une température qui amène le zinc provenant du revêtement de zinc à diffuser dans l'acier et le fer provenant de l'acier à diffuser dans le revêtement de zinc.
3. Procédé selon la revendication 2 où la surface de l'acier galvanisé est chauffée à une température d'au moins environ 470°C.
4. Procédé selon la revendication 3 où la surface de l'acier galvanisé est chauffée à une température d'au moins 600°C.
5. Procédé selon l'une quelconque des revendications 1 à 4 où la vitesse de corrosion galvanique est augmentée par abrasion ou déformation mécanique de l'acier galvanisé.
6. Procédé selon la revendication 5 où l'aire de surface abrasée ou déformée mécaniquement dépasse environ 10 % de l'aire de surface de l'acier galvanisé.
7. Procédé selon la revendication 6 où l'aire de surface abrasée ou déformée mécaniquement dépasse environ 15 % de l'aire de surface de l'acier galvanisé.
8. Procédé selon l'une quelconque des revendications 1 à 7 où la vitesse de corrosion galvanique est accélérée par mélange de l'acier galvanisé avec un matériau ayant un potentiel d'électrode standard intermédiaire entre ceux du zinc et du cadmium dans la série électrochimique, la proportion dudit matériau étant au moins 5 % en masse du mélange.
9. Procédé selon l'une quelconque des revendications 1 à 8 où la vitesse de corrosion galvanique est accélérée par mélange de l'acier galvanisé avec un matériau ayant un potentiel d'électrode standard intermédiaire entre ceux du zinc et du cadmium dans la série électrochimique, la proportion dudit matériau étant au moins 10 % en masse du mélange.
10. Procédé selon l'une quelconque des revendications 1 à 9 où l'acier galvanisé est dans un chariot qui tourne tandis que l'acier galvanisé est immergé dans l'électrolyte.

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11. Procédé selon l'une quelconque des revendications 1 à 10 où l'acier galvanisé est déchiqueté en fragments ayant une taille entre 10 cm et 20 cm pour accélérer la vitesse de corrosion.

5 12. Procédé selon l'une quelconque des revendications 1 à 11 où l'acier galvanisé est déchiqueté en fragments dont la majorité ont une taille entre 10 cm et 15 cm pour accélérer la vitesse de corrosion.

13. Procédé selon l'une quelconque des revendications 1 à 12 où l'électrolyte contient au moins 15 % en masse d'hydroxyde de sodium ou de potassium et a une température d'au moins 75°C.

10 14. Procédé selon la revendication 13 où l'électrolyte contient au moins 30 % en masse d'hydroxyde de sodium et a une température d'au moins 85°C.

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FIG. 1

