

UNITED STATES PATENT OFFICE.

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CLEANING OF METAL BY ELECTROLYSIS.

No Drawing.

Application filed May 1, 1925. Serial No. 27,302.

This invention relates to a method of cleaning the surface of iron or steel articles, and particularly to that method wherein the articles to be cleaned are placed in an electrolyte and an electric current is passed therethrough.

Heretofore when such articles have been coated with dirt and grease and were, in addition, coated with an oxide of iron such as rust or scale, it has been the practice to subject them to a suitable alkaline bath which removes the dirt and grease, either alone or by the aid of an electric current, remove and rinse them, and then subject them to a second bath containing a mineral acid, often with the aid of an electric current, to remove the rust. Thus two distinct operations have been necessary to clean such articles, and in the second operation the acid in the bath has had a tendency to eat or pit the surface of the article. This eating or pitting will be particularly evident when a straight pickling operation is employed while in the use of an electric current the pitting action will be less evident, but still present. The cause in either case is the dissolving action of the acid on the metal, the dissolving of the metal beneath the oxide or rust loosening the latter so that it will fall or may be rubbed off. The use of an electric current causes cathodic hydrogen to be formed which partially protects the article being cleaned from the action of the acid as well as to loosen oxide or rust, but nevertheless the acid action on the metal still results. Furthermore, in cases where the metal of the article is somewhat porous, the acid often works its way into the pores and is not completely removed in the subsequent rinsing process, with the result that after the article has been put in service the acid works out to the surface and causes the same to rust, and if the article has been covered with a coating of paint or enamel, it causes the latter to scale or loosen. The pitting of the surface of the article is highly detrimental in some classes of work, and it is the elimination of this pitting, and the simultaneous removal of grease and rust and other iron oxides as well as the prevention of subsequent rusting as described above that the present invention contemplates, as well as effecting saving in labor, time and material.

In accordance with the present invention I provide an electrolyte, composed of a solu-

tion of an organic acid, such as citric or tartaric acid, to which enough alkali, such as caustic soda or sodium carbonate, has been added to slightly more than neutralize it, or in other words, to make it slightly alkaline. The organic acid and the alkali join to form an alkali salt of an organic acid, which is neutral in reaction, and the electrolyte is in reality a water solution of such salt which has been made slightly alkaline by the addition of an excess of the alkali. This solution is then preferably heated to about 180° Fahrenheit but preferably not less than 165° Fahrenheit and the iron or steel article to be cleaned is hung on or clamped to a hook or other member connected to the negative side of low tension direct electric current and immersed in the solution, the current passing thereto from an anode of iron or other suitable material also immersed in the solution. While the removal of the grease and dirt and the rust, of course, occurs practically simultaneously, for the sake of explanation it is preferable to consider the action on each separately. In thus considering the action on the grease and dirt, the rapid evolution of the hydrogen at the cathode, which the article forms, is instrumental in removing the same almost instantly, "lifting it off" so to speak, from the surface of the article. The grease being light ascends to the surface of the electrolyte where it is removed by the skimming or other process and the dirt usually is deposited on the bottom of the tank where it may be removed at convenient intervals.

In the removal of the oxides of iron on the surface of the article, whether it be the ferric hydroxide commonly known as rust, or ferric and ferrous oxides formed in thermo-mechanical operations, there are probably two actions that occur in the same, first, the ferric hydroxide and the other iron oxides may be gradually reduced to a lower form of iron oxide which may be soluble in the electrolyte, or which may be readily removed in the subsequent rinsing operation, or, second, it may be mechanically carried off through the evolution of the hydrogen, or through a combination of both.

Although any organic acid may be used for the electrolyte, I prefer to use either citric, oxalic or tartaric acid. I have found that by using approximately four ounces of citric acid to one gallon of water, and

thereafter adding sufficient caustic soda to neutralize the acid, and then adding a small excess of caustic soda, say up to one ounce per gallon of solution to make it slightly alkaline, a very satisfactory electrolyte results. The practical limits of the amount of resulting salt from the combination of the acid and the alkali per gallon of water is approximately from 6 to 16 ounces. With such a solution I prefer to use an electric current of six to twelve volts and a current density of not less than 50 amperes per square foot of surface of the articles being cleaned, the current density being varied according to the speed desired to effect the cleaning. I have found that with a current density of seventy-five amperes per square foot of article surface a heavily rusted and very dirty and greasy article may be thoroughly cleaned in less than one minute.

After the article has been subjected to this cleaning process it is removed and rinsed and then preferably wiped to remove any particles of foreign matter that might be still clinging to its surface.

Inasmuch as this process uses a slightly alkaline electrolyte it will be evident that it has no action on the basic metal itself, and consequently no pitting of the metal occurs. Neither will the absorbing of any of the electrolyte by the pores of the metal have any subsequent effect on the metal. In addition, the double effect of removing the dirt and grease and the oxide is accomplished in one process in a much less space of time than heretofore used.

What I claim is:—

1. An electrolyte for use in the electrolytic cleaning of ferrous articles, comprising a water solution of an alkali metal salt of an organic reducing acid which has been made slightly alkaline in reaction.

2. An electrolyte for use in electrolytic cleaning of ferrous articles at a temperature of not less than 165° Fahrenheit and a current density of not less than 50 amperes per square foot of article being cleaned, said electrolyte comprising a solution of an alkali metal salt of an organic reducing acid to which .1 to 4 ounces of an alkali has been added per gallon of electrolyte.

3. An electrolyte for use in the electrolytic cleaning of ferrous articles at a temperature of not less than 165° Fahrenheit and a current density of not less than 50 amperes per square foot of surface of article being cleaned, comprising a solution of 6 to 16 ounces of an alkali salt of an organic reducing acid to which .1 to 4 ounces of an alkali has been added per gallon of electrolyte.

4. The process of electrolytically cleaning ferrous articles which comprises subjecting said articles to the action of a direct electric current of a density of not less than 50 amperes per square foot of surface being

cleaned in an electrolyte of not less than 165° Fahrenheit, said electrolyte comprising a water solution of an alkali metal salt of an organic reducing acid which has been made slightly alkaline in reaction

5. The process of electrolytically cleaning ferrous articles which comprises subjecting said articles to the action of a direct electric current of not less than 50 amperes per square foot of surface to be cleaned in an electrolyte comprising a solution of 6 to 16 ounces of an alkali metal salt of an organic reducing acid per gallon of water, said solution having been made slightly alkaline and being at a temperature of not less than 165° Fahrenheit.

6. An electrolyte for use in the electrolytic cleaning of ferrous articles, comprising a citrate of an alkali metal which has been made slightly alkaline in reaction

7. An electrolyte for use in electrolytic cleaning of ferrous articles at a temperature of not less than 165° Fahrenheit and a current density of not less than 50 amperes per square foot of surface of articles being cleaned, said electrolyte comprising a solution of a citrate of an alkali metal to which .1 to 4 ounces of alkali per gallon of electrolyte has been added.

8. An electrolyte for use in electrolytic cleaning of ferrous articles at a temperature of not less than 165° Fahrenheit and a current density of not less than 50 amperes per square foot of surface of article being cleaned, comprising a solution of 6 to 16 ounces of a citrate of an alkali metal and from .1 to 4 ounces of an alkali per gallon of water.

9. The process of electrolytically cleaning ferrous articles which comprises subjecting said articles to the action of a direct electric current in an electrolyte at a temperature of not less than 165° Fahrenheit, said electrolyte comprising a solution of a citrate of an alkali metal which has been made slightly alkaline in reaction.

10. An electrolyte for use in the electrolytic cleaning of ferrous articles, comprising an oxalate of an alkali metal which has been made slightly alkaline in reaction.

11. An electrolyte for use in electrolytic cleaning of ferrous articles at a temperature of not less than 165° Fahrenheit and a current density of not less than 50 amperes per square foot of surface of articles being cleaned, said electrolyte comprising a solution of an oxalate of an alkali metal to which .1 to 4 ounces of alkali per gallon of electrolyte has been added.

12. An electrolyte for use in electrolytic cleaning of ferrous articles at a temperature of not less than 165° Fahrenheit and a current density of not less than 50 amperes per square foot of surface of article being cleaned, comprising a solution of 6

to 16 ounces of an oxalate of an alkali metal and from .1 to 4 ounces of an alkali per gallon of water.

13. The process of electrolytically cleaning ferrous articles which comprises subjecting said articles to the action of a direct electric current in an electrolyte at a temperature of not less than 165° Fahrenheit, said electrolyte comprising a solution of an oxalate of an alkali metal which has been made slightly alkaline in reaction.

14. An electrolyte for use in the electrolytic cleaning of ferrous articles, comprising a tartrate of an alkali metal which has been made slightly alkaline in reaction.

15. An electrolyte for use in electrolytic cleaning of ferrous articles at a temperature of not less than 165° Fahrenheit and a current density of not less than 50 amperes per square foot of surface of articles being cleaned, said electrolyte comprising a solution of a tartrate of an alkali metal to

which .1 to 4 ounces of alkali per gallon of electrolyte has been added.

16. An electrolyte for use in electrolytic cleaning of ferrous articles at a temperature of not less than 165° Fahrenheit and a current density of not less than 50 amperes per square foot of surface of article being cleaned, comprising a solution of 6 to 16 ounces of a tartrate of an alkali metal and from .1 to 4 ounces of an alkali per gallon of water.

17. The process of electrolytically cleaning ferrous articles which comprises subjecting said articles to the action of a direct electric current in an electrolyte at a temperature of not less than 165° Fahrenheit, said electrolyte comprising a solution of a tartrate of an alkali metal which has been made slightly alkaline in reaction.

Signed by me at Detroit, Michigan, U. S. A., this 28th day of April, 1925.

IVAR H. LEE.