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TREATMENT OF NICKEL-CHROMIUM ALLOYS

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The present invention relates to the treatment of nickel-chromium alloys.

It is an object of the present invention to provide a process for the treatment of nickel-chromium alloys involving the protection of the surface of such alloys during heat treatment whereby the products can be subsequently pickled satisfactorily and successfully without impairment to the surface.

A further object of the invention provides a process of treating nickel-chromium alloys in which a protective coating is utilized for the purpose of controlling the surface characteristics of the products.

It is also within the contemplation of the invention to provide a process of treating nickel-chromium alloys particularly sheets and strips whereby surface blemishes are eliminated and a satisfactory and acceptable bright surface is produced.

The invention likewise contemplates the provision of a process of treating nickel-chromium alloys in such a manner to decrease the rejections due to surface blemishes and the like caused by pickling, to decrease the metal loss due to pickling, to decrease the cost of the pickling solution, and to decrease the maintenance and depreciation costs of pickling tanks.

Other objects and advantages will become apparent from the following description.

Generally speaking, the invention contemplates providing a process wherein a protective coating is applied to the surface of the nickel-chromium product. Thus, satisfactory results have been obtained by coating the products with slaked lime, fuller's earth, bone ash, and clay. In this manner, a protective coating is provided which affords a means of controlling the surface characteristics of the products under treatment, especially during annealing and heating operations. The coated nickel-chromium products are heated to elevated temperatures within a range of about 1600° F. to about 2000° F. The heated products may be cooled in atmospheres containing practically no free oxygen or can be cooled in the air or can be cooled in any other appropriate manner.

After the heat treatment or annealing, the nickel-chromium products are immersed in suitable pickling solutions. Thus, for the treatment of a nickel-chromium-iron alloy, a solution containing approximately 10% sulphuric acid, 5% sodium nitrate, and copper and nickel sulphates has been satisfactorily employed. This solution is preferably used in a temperature of about 180° F. for a time cycle of about 15 to about 30 minutes. For other nickel-chromium alloys, other appropriate pickling solutions can be used as will be explained hereinafter.

By proceeding in the foregoing manner, it has been discovered that there is practically no noticeable impairment to the surface of the product such as a sheet, strip or the like and that it is possible to produce pickled finished nickel-chromium products superior in characteristics to those produced heretofore. This is particularly true with respect to nickel-chromium iron alloys, especially sheets and strips with mirror-like or highly reflecting surfaces. As a result of extensive experimentation and actual use it has been found that bright nickel-chromium sheets can be produced without blemishes caused by surface oxidation and the like.

For the purpose of giving those skilled in the art a better understanding of the invention the following specific example will be given:

Example

A nickel alloy containing about 75% to 85% of nickel, about 10% to about 20% of chromium and about 5% to about 10% of iron is produced in the form of a cold rolled sheet having the following dimensions: 96" x 36" x 0.025". The cold rolled sheet is thoroughly cleaned in any appropriate manner. It is essential to remove oil and grease from the surface of the sheet and to make sure that the sheet is as clean as possible. For this operation hot water and steam may be used, but it is preferred to use a suitable degreasing solution. For instance, a degreasing solution containing tri-sodium phosphate may be employed.

After the sheet is thoroughly cleaned, it is coated completely with an inert material of the character referred to herein. Thus, satisfactory results have been obtained by giving a sheet three or four immersions of approximately three minutes each, in a fairly thick slurry of slaked lime which is heated to a temperature of approximately 180° F. Each time the sheet is withdrawn, the water evaporates from the surface and leaves a thin film of lime thereon. By immersing the sheet several times the desired thickness of the coating can be obtained. Of course, the coating may be applied in any other manner such as by spraying, brushing or any other appropriate method as one skilled in the art will readily understand.

The sheet coated with slaked lime is ready for annealing. The annealing may be conducted

in any standard furnace such as a continuous annealing furnace. For example, a continuous annealing furnace may be employed which is about 170 feet long and of which the first 60 feet are under fire, the next 40 are semi-cooled and the remaining 70 are cooled by a water-jacket. The atmosphere in the annealing furnace is controlled and may, for example, have approximately the following composition for continuous sheet process:

	Percent
Nitrogen	82.5
Carbon dioxide	9.0
Carbon monoxide	4.0
Hydrogen	4.5
Oxygen	0.0

In annealing the sheet, a temperature of about 1800° F. to about 1900° F. may be employed. Under the aforesaid conditions, the sheet may be conveyed through the furnace at a speed which provides an exposure of the sheet in the hot zone of approximately 8 minutes.

When it is desired to bright anneal a sheet of the aforesaid composition, an atmosphere of practically pure dry hydrogen has given satisfactory results. A discussion regarding atmospheres and procedures in connection with bright annealing may be found in United States Letters Patent No. 1,901,039 to Owens and Fraser.

After annealing, practically the entire coat of lime adheres to the surface of the sheet. The sheet may now be pickled in any suitable manner. Thus, a pickling solution containing about 10% of sulphuric acid and about 5% of sodium nitrate may be employed. In addition, both copper and nickel sulphates are present in the solution. A temperature of approximately 180° F. has been found to give satisfactory results and an immersion time of about 15 to 30 minutes. This treatment removes the lime and any other coating such as chromium oxide, etc. The immersion in the pickling solution appears to progressively "rot" the layer of oxide until it all sluffs off and leaves a metal surface which is clean, bright and free from pickling blemishes. The immersion time can be reduced, if desired, by utilizing a subsequent scrubbing operation which will remove oxide which has not fallen off into the pickling tank. In the event that copper sulphate is not present, the pickling time must be increased.

It is to be observed that the present invention provides a process for the treatment of nickel alloys by the use of which improved results and superior products are obtained and by the use of which the prior pickling solutions containing hydro-fluoric acid may be eliminated.

It is also to be noted that the present invention provides a process of treating nickel alloys in which there is a decrease in the metal loss, due to pickling, of over 60% and that actual use has shown that the average loss by the present improved method is about 0.35 ounce per square foot of surface area treated as compared with prior loss under old practice of approximately one ounce per square foot of surface treated.

Although the present invention has been described in connection with a preferred embodiment thereof, i. e., nickel-chromium and equivalent alloys, it is to be understood that modifications and variations may be resorted to by those skilled in the art. Variations and modifications are considered to be within the purview of the present specification and within the scope of the appended claims.

We claim:

1. In the manufacture of articles constituted of nickel chromium alloys subject to surface impairment by heat treating and pickling, the improved process which comprises removing grease, oil and dirt from an article constituted of a nickel-chromium alloy to produce a cleaned article, coating said cleaned article with a film of inert material for the purpose of controlling the surface characteristics of the alloy, heat treating said alloys in an atmosphere substantially devoid of oxygen, cooling said heated article, and immersing said heat treated article in an aqueous bath containing a non-volatile mineral acid, an alkali metal nitrate and sulfates of copper and nickel whereby a heat treated nickel-chromium alloy is produced having a surface showing substantially no noticeable impairment.

2. In the manufacture of articles constituted of nickel chromium alloys subject to surface impairment by heat treating and pickling, the improved process which comprises cleaning the surface of an article constituted of a nickel chromium alloy to produce a cleaned article, coating said cleaned surface with an inert material of the group consisting of fuller's earth, bone ash, clay and lime for the purpose of controlling the surface characteristics of the alloy, heat treating said article in an atmosphere substantially devoid of oxygen for a period of time, cooling said article, immersing said cooled article in an aqueous bath containing sulfuric acid, an alkali metal nitrate and sulfate of copper, and removing excess solution whereby a heat treated article constituted of a nickel-chromium alloy is produced having a surface substantially free from surface blemishes due to oxidation.

3. In the manufacture of nickel-chromium alloys containing up to about 10% iron and up to about 20% chromium, the improved process which comprises cleaning the surface of a nickel-chromium-iron article to produce a cleaned article, coating said cleaned article with a substance selected from the group consisting of lime, fuller's earth, bone ash, and clay for the purpose of controlling the surface characteristics of the alloy, heating said coated articles to about 1800° F. to about 1900° F. in the absence of carbon dioxide, water vapor, and oxygen, cooling said heated article, subjecting said cooled article to the action of an aqueous solution containing about 10% sulfuric acid, about 5% sodium nitrate, sulfate of nickel and more than 20 grams per liter of sulfate of copper, and removing excess solution whereby heat treated nickel-chromium-iron articles are produced having a bright finish and having a surface showing substantially no noticeable impairment.

4. In the manufacture of articles of nickel-chromium alloys containing up to about 10% iron, the improved process which comprises cleaning an article constituted of a nickel-chromium-iron alloy to remove grease, oil and dirt to produce a cleaned article, coating said cleaned article with a substance selected from the group consisting of lime, fuller's earth, bone ash, and clay for the purpose of controlling the surface characteristics of the alloy, annealing said coated articles, subjecting said annealed articles to an aqueous solution containing about 10% sulfuric acid, about 5% sodium nitrate, and at least about 20 grams copper sulfate per liter, and washing said article with water whereby an annealed nickel-chromium-iron article is produced having substantially no surface blemishes due to oxidation.

5. In the manufacture of articles of nickel-chromium alloys subject to surface impairment by heat treating and pickling, the improved process which comprises coating a clean article constituted of a nickel-chromium alloy with a film of inert material for the purpose of controlling the surface characteristics of the alloy, annealing said coated article, and subjecting said annealed article to a solution containing a non-volatile mineral acid, an alkali metal nitrate and sulfates of nickel and copper whereby annealed alloys are obtained having substantially no surface blemishes.

6. In the manufacture of articles of nickel-chromium alloys, the improved process which comprises protecting the surfaces of an article constituted of a nickel-chromium alloy from deleterious effects during annealing with an inert material, and pickling said anealed alloy in a dilute solution of a non-volatile mineral acid containing sulfates of copper and nickel whereby an annealed nickel-chromium alloy article is produced having substantially no surface blemishes due to oxidation.

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