

[54] **PROCESS FOR GALVANIZING HIGH
CARBON STEEL WIRE**

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[57]

ABSTRACT

The elimination of the conventional pickling and rinse steps following drawing to final gauge in the zinc coating of high carbon steel wire, by the use of water soluble soaps as a drawing lubricant, under controlled conditions, the lubricant and other contaminants being removed as an incident of the final coating operation wherein the drawn wire is passed through a flux bath and then into the zinc coating bath.

6 Claims, No Drawings

PROCESS FOR GALVANIZING HIGH CARBON STEEL WIRE

BACKGROUND OF THE INVENTION

The present invention relates to zinc coating and has to do more particularly with procedures for galvanizing high carbon (0.60–0.85 percent C) steel wire. Specifically, the invention is based upon the discovery that two of the steps heretofore believed essential in the galvanizing process can be eliminated without in anyway impairing the quality of the coated wire.

A conventional process in use for many years for zinc galvanizing high carbon steel wire consisted essentially of the following steps:

1. hot rolling of rods;
2. sulphuric acid bath;
3. rinse;
4. application of drawing lubricant (water-insoluble soap);
5. cold drawing to intermediate gauge;
6. lead bath (patenting);
7. sulphuric acid bath;
8. rinse;
9. application of drawing lubricant (water-insoluble soap);
10. cold drawing to final gauge;
11. hydrochloric acid bath (pickling);
12. rinse;
13. application of zinc-ammonium chloride flux;
14. immersion in zinc coating bath.

A similar procedure was followed in the galvanizing of low carbon steel wire, with the addition of an annealing step following cold drawing (step 10 above) to achieve the desired physical properties in the drawn wire.

In both the high and low carbon practices, as outlined above, the lubricants normally used for cold drawing were water-insoluble soaps. Where such soaps were employed, the pickling and rinse steps (steps 11 and 12 above) were required to remove the hard soaps, the rust caused by acid fumes, and general dirt picked up by the wire during processing. In addition, in the low carbon practice, an annealing step was required following drawing to final gauge to produce the desired softness and ductility of the wire, and this annealing step created oxides which also required the pickling step for removal. The pickling and rinse steps were thus integral parts of the coating procedure outlined above.

In more recent years, some wire galvanizers began the use of water-soluble lubricants in both steps 4 and 9 set forth above to improve the drawing characteristics of the wire. Both water-soluble and water-insoluble lubricants are in use today and numerous producers use both types, although many have stayed with the water-insoluble lubricants which are less expensive and easier to handle. In any event, the current practice, irrespective of whether water-insoluble or water-soluble lubricants are employed, has been to subject the cold drawn stock to a hydrochloric acid bath and hot water rinse prior to the fluxing and subsequent zinc coating bath.

In contrast to the foregoing, the present invention is based upon the discovery that where water-soluble soaps are used as drawing lubricants, under controlled processing conditions, the hydrochloric acid bath and its accompanying rinse can be completely eliminated

while at the same time insuring complete removal of the drawing lubricant as well as other residual contaminants. This offers a material cost saving in that there is no need for hydrochloric acid, a water rinse, or pollution treatment equipment for disposing of the spent hydrochloric acid pickling liquor.

RESUME OF THE INVENTION

In accordance with the present invention, the final drawing operation, i.e., the drawing operation immediately preceding the zinc coating, is conducted using a water-soluble drawing lubricant, preferably a sodium soap. It has been found that to the extent contaminants remain on the wire after drawing with a water-soluble lubricant, such contaminants are effectively removed by the action of the zinc-ammonium chloride flux which is applied to the wire immediately prior to coating. Thus, instead of subjecting the drawn wire to the usual hydrochloric acid bath and subsequent rinse, these steps are eliminated and the drawn wire is passed directly into the fluxing bath.

Wire surface chemistry is also important to the successful practice of the invention, that is, control over wire processing conditions must be exercised to maintain the wire in a reasonably clean condition during the various operations preceding coating. Specifically, once the incoming rod stock is lead or air patented, descaled in sulphuric acid, and rinsed in preparation for drawing to final gauge, care must be taken to prevent the stock from becoming contaminated with grease or dirt, or allowed to rust from exposure to rain or high humidity. Such cleanliness standards are now recognized practices in the industry; and consequently the degree of cleanliness is one which will be readily understood by the worker in the art with the foregoing considerations in mind.

It also has been found, however, that variations in the surface chemistry of the wire stock can be compensated for by increasing the flux concentration above normal levels. For example, if an excess of water-soluble soap is encountered on the wire, or if the wire has been contaminated with mill scale, lead oxide or grease, resulting in imperfect coating of the wire, these contaminants can be effectively removed by increasing the concentration of the flux bath above the level normally employed for fluxing purposes. Normally the flux bath is maintained between 8 and 12 degrees Baume, whereas if excessive contamination on the wire is encountered, it may be removed by increasing the flux concentration to about 15 to degrees Baume, depending upon the extent of contamination encountered. However, absent undue contaminations, conventional flux concentrations have been found to be wholly satisfactory.

In summary, in order to eliminate the pickling step; three controls must be present. First, control must be exercised over cleanliness practices to avoid unnecessary contamination of the stock prior to drawing. Second, a water-soluble lubricant must be used during the final cold drawing operation. Third, there must be no prior thermal treatment of the wire which would cause heavy scale or deleterious quantities of oxide to form on the drawn wire. While this latter control eliminates the use of the invention for low carbon steel wire processing wherein an anneal is required following final drawing to produce the desired softness and ductility in the wire, the invention is nonetheless applicable to

coating procedures wherein the wire is not subjected to an oxide forming heat treatment following drawing to final gauge.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Effectively, the present invention contemplates the customary steps in the galvanizing of high carbon steel wire, except for the elimination of the hydrochloric acid bath and rinse which immediately precede the application of the coating flux and the passage of the wire through the zinc coating bath, together with the mandatory use of a water-soluble lubricant during the drawing operation preceding coating. Thus, where the wire stock is to be galvanized at finished size, it may be prepared by air or lead patenting the stock to impart the desired tensile strength and toughness, whereupon the wire is subjected to a sulfuric acid bath and rinse to clean it for cold drawing to final gauge. The final drawing operation will be conducted using a water-soluble lubricant, preferably a sodium soap. Sodium stearate soaps which are free from insoluble metallic compounds have been found to be highly satisfactory, although any of the water-soluble sodium soaps may be employed. It will be understood that in some instances the stock will be initially drawn to an intermediate size prior to air or lead patenting. Where such preliminary cold drawing step is employed, the drawing lubricant for such intermediate draw may comprise any all-purpose soap, inclusive of water-insoluble soaps, the critical consideration being the use of a water-soluble soap for the drawing operation immediately preceding coating.

Following drawing to final gauge using a water-soluble lubricant, the wire is again cleaned. Prior to the present invention, this cleaning step was conducted in a bath of hot muriatic (hydrochloric) acid. The hydrochloric acid acted much more quickly than sulphuric acid, and it was much more effective in removing traces of lime remaining from the drawing operation. Subsequent rinsing served to remove iron chloride formed by the action of the acid, as well as any particles of loosely adhering scale or other contaminants.

In accordance with the present invention, the cleaning step performed by the hydrochloric acid bath and its subsequent rinse is effectively replaced by the zinc-ammonium chloride flux bath which precedes coating, the fluxing reaction being utilized to remove residual surface contamination, particularly the residual lubricant. Thus, the flux bath takes over and performs the cleaning function formerly performed by the acid bath in addition to its normal function of promoting the fusion of the zinc coating to the wire.

In most instances, the flux in its normal fluxing concentration (8 to 12 degrees Baume) is effective to remove residual contaminants; but if a situation is encountered wherein the wire fails to coat properly due to the presence of excessive quantities of lubricant or other contaminants, the contaminants may be effectively removed by increasing the concentration of the flux. For example, if an excessive concentration of water-soluble soap is encountered, the flux concentration may be raised several degrees above normal, say to 15 degrees Baume. If the contamination persisted, the concentration may be again raised until the contamination problem is overcome. In other words, the concentration of the flux will be increased empirically

depending upon the concentration of water-soluble soap encountered. Generally speaking, a flux concentration of 20 degrees Baume has been found to be sufficient to overcome even severe lubricant contamination.

It is to be understood, of course, that utilization of the flux to clean the wire presupposes wire stock which has been processed using currently acceptable cleanliness standards as well as the absence of prior thermal treatment which would cause oxide to form on the wire. The flux will, however, remove residual mill scale, lead oxide and other contaminants normally remaining after the final drawing operation.

As should now be evident, the present invention enables the galvanizer to eliminate processing steps which were heretofore believed essential to the galvanizing operation; and yet the elimination of these steps does not adversely affect the product quality in that the cleaning function formerly performed by the pickling step and subsequent rinse is assimilated by the fluxing bath. At the same time there is no deterioration in the function of the fluxing bath to perform its heretofore intended purpose of protecting the wire from oxidation and effecting a fusion reaction as the fluxed wire enters the zinc coating bath.

The embodiment of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a process for galvanizing high carbon steel wire wherein the steel wire in normally clean condition is subjected to a final cold drawing operation prior to galvanizing utilizing a water-soluble soap, the improvement which comprises the step of passing the wire directly from the final drawing operation into a zinc-ammonium chloride flux bath having a concentration of from 8 to 20 degrees Baume and thereafter into the zinc coating bath with the elimination of a pickling and a rinse step following the final drawing.

2. The process claimed in claim 1 wherein the drawing lubricant comprises a water-soluble sodium soap.

3. The process claimed in claim 2 wherein the flux bath has a normal concentration of from 8 to 12 degrees Baume.

4. The process claimed in claim 3 wherein the concentration of the flux bath is raised above normal in proportion to the extent of contamination of the wire following drawing, with particular reference to the quantity of residual lubricant carried by the drawn wire.

5. In a process for galvanizing steel wire in the absence of a heat treatment following the final drawing operation, the final drawing operation utilizing a water-soluble sodium soap as a lubricant, the improvement which comprises the step of introducing the wire into a zinc-ammonium chloride flux bath having a concentration of from 8 to 20 degrees Baume immediately following final drawing and utilizing the fluxing reaction of the bath to clean the wire of contaminants prior to galvanizing.

6. The process claimed in claim 5 wherein the primary contaminant is residual lubricant, and wherein the normal flux concentration is from 8 to 12 degrees Baume, including the step of adjusting the flux concentration upwardly to as high as 20 degrees Baume in proportion to the quantity of residual lubricant carried by the wire.

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