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HALOGEN TIN ELECTROPLATING

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ABSTRACT OF THE DISCLOSURE

An improvement in the halogen tin electroplating process is provided in which drag-out is largely reduced and in which buildup of salt from the electrolyte on the deflector rolls positioned prior to the water rinse system is prevented or minimized. This is accomplished by using a counter-current rinse system in which the deflector rolls prior to the rinse system are maintained in a steam atmosphere.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to processes for the electrodeposition of tin and more particularly to processes for the electrodeposition of tin from halogen tin plating baths.

Prior art

Halogen tin electroplating lines are operated with electrolyte as described in U.S. Pat. 2,407,579, issued Sept. 10, 1946, to E. W. Schweikher. Some problems caused by the peculiar crystallization characteristics of this electrolyte are described in U.S. Pat. 3,658,664, issued to Donald A. Swalheim on Apr. 25, 1972. Basically, when ever crystallization occurs at a low rate, for example, on a surface caused by evaporation or a reduction in temperature, the deposited salts are very tenacious and form a hard, crust-like material.

In halogen tin electroplating lines, the bottom side of a steel strip is plated in the first deck which consists of a number of plating cells containing the electrolyte. The strip is then reversed and passes through another series of cells on the second deck to plate the other side of the steel strip. The strip is guided and fed through the cells by a series of nip rolls. After passing through the cells of the second deck, the tin plated strip is deflected by a roll to pass vertically up to a third deck where it is deflected by a roll back to its original direction. On the third deck, the tin plated strip passes through a rinse tank to remove plating salts from the surfaces of the plated strip.

Electrolyte for the plating cell is contained in a storage tank. The electrolyte is circulated from the storage tank to each of the plating cells and overflow from the cells returns to the storage tank by downcomers. During operation, the volume of electrolyte is normally maintained relatively constant in order to obtain optimum plating performance. At strip speeds of 1500-2000 ft./min., a considerable volume of electrolyte passes through the nips of the guiding wringer rolls and coats the surface of the strip as drag-out. Some of the electrolyte on the surface of the strip is recovered by spraying the surface with water prior to the water rinse, collecting the water and returning it to the storage tank. The remaining electrolyte on the surface is diluted further by water in the rinse tank. In order to prevent buildup of the volume of electrolyte in the storage tank, the volume of water sprayed onto the strip surface must be carefully regulated since the rate of flow of water returns to the storage tank cannot exceed the water lost by evaporation in the cells and storage tank.

In addition to serving the purpose of recovering some of the drag-out, water sprayed onto the strip surface helps reduce salt buildup on the deflector roll prior to the rinse tank; however, when water containing salts from the rinse tank is used to rinse the strip, salts form on the surface of the rolls a short distance from each edge of the strip. If the width of the strip being plated is increased, the accumulated hard salt buildup will then result in dented tinplate which is unsuitable for sale.

Water is also added to the rinse tank to prevent excessive salt buildup in the rinse water. Most of the inflow from this tank is normally discarded because return of the rinse water to the storage tank does not permit the maintenance of a constant volume in the system. Thus, electrolyte losses from drag-out result in a considerable loss of electrolyte per operating day. In addition to electrolyte losses, the presence of fluoroide and ferrocyanide salts in the overflow from the rinse tank presents a pollution problem. There is, therefore, a need to make the electrolyte system substantially self-contained with minimal discharge of electrolyte to waste and to minimize salt buildup on deflector rolls positioned just prior to the rinse tank.

SUMMARY OF THE INVENTION

According to the present invention, there is provided in a process for the electrodeposition of tin wherein a steel strip is tin electroplated on at least one surface from a halogen tin electrolyte having halogen tin plating salts dissolved therein, and the tin plated strip is then rinsed with diluted electrolyte from a rinsing system to reduce salt drag-out from the strip after passing over at least one roll prior to the rinse, the improvement comprising: maintaining the roll in an atmosphere of steam to minimize salt buildup thereon and then rinsing the strip with water in a counter-current rinse system.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a schematic, cross-sectional view of the drag-out recovery system of the present invention for a halogen tin line.

DETAILED DESCRIPTION OF THE INVENTION

With reference to the drawing, a steel strip 11 is tin plated on the bottom surface by the halogen tin cells (not shown) of the first deck 12, is reversed by deflector rolls 16 (not shown) and the other surface tin plated by the halogen tin cells (not shown) of the second deck 13. The strip is guided and fed through the cells by a series of nip rolls exemplified by nip rolls 16 and 17. The strip is deflected vertically by roller 18 and after being again deflected by roller 6, the strip passes through a three-stage counter-current rinse tank 19. The strip 11 after passing over deflector roll 6 is coated with a thin film of electrolyte containing a relatively high concentration of salts. The salts are removed by passing the strip through a series of rinse compartments 3, 2, 1. Wringer rolls 24 remove most of the electrolyte from the strip. The electrolyte falls back into compartment 3. Wringer rolls 22 and 23 function in a similar manner. Essentially all remaining salts are removed from the surface of the strip by the water spray 4 in compartment 1. For maximum efficiency in recovering drag-out, all water added to the system should be introduced as a spray and not as a rinse. The salt concentration of the rinse compartment 1 is then introduced into compartment 2 which in turn is then introduced into compartment 1 which is then returned to the solution in compartment 3. The concentration of salt built up in the solution in compartment 3 is higher than in compartments 2 and 1 which is higher than in compartment 1. In order to compensate for the water introduced into compartment 1, which is usually maintained at a rate of 1-2 gallons per minute, electrolyte must be removed from...
compartment 3 at a similar rate. Overflow of the more concentrated electrolyte from compartment 3 leaves in line 8, a portion of which is diverted in line 7 and is used to rinse strip 11 and the remainder is returned directly through line 9 to electrolyte storage tank 10. Some of the solution sprayed onto the strip is collected and returned to storage tank 10 through line 14.

Salt buildup on deflector roll 6 as well as on roll 27 is prevented by introducing steam through line 15 into a chamber 5 surrounding the roll so as to maintain a steam atmosphere around the surface of the roll. The steam flow rate and steam temperature do not appear to be critical. The important consideration is to use the steam in an amount sufficient to prevent salt buildup on the roll and in a small enough volume so that any condensate returned to the storage tank by collecting in collector line 14 or carried over into the countercurrent rinse tank does not upset the water balance of the system. Other rolls in the process prior to the rinse which may also be subject to salt buildup, such as deflector rolls between the first and second plating decks, can also be subjected to the steam environment.

The problem of salt buildup is attributed largely to the presence of sodium fluostannate in the electrolyte. The solubility of this salt decreases with even a slight temperature drop. Unlike other salts, it tends to crystallize on solid surfaces such as rolls to form hard tenacious deposits. Steam at a temperature of 100° C. has a high heat of condensation of 540 calories per gram. It will tend to condense largely on the surfaces of the rolls which normally have a surface temperature in the range of 50–60° C. Although the action of the steam in preventing salt buildup is not fully understood, its high heat of condensation is probably one of the primary factors. As it condenses, the surface temperature of the rolls is increased thereby preventing salt buildup resulting from precipitation of sodium fluostannate.

What is claimed is:

1. In a process for the electrodeposition of tin wherein a steel strip is tin electroplated on at least one surface from a halogen tin electrolyte having halogen tin plating salts dissolved therein, and the tin plated strip is then rinsed with diluted electrolyte from a rinse system to reduce salt drag-out from the strip after passing over at least one roll prior to the rinse, the improvement comprising: maintaining the roll in an atmosphere of steam causing condensation on the surface of the roll to minimize salt buildup thereon and then rinsing the strip with water in a countercurrent rinse system having a higher salt concentration at the overall end than at the end at which the strip exits.

2. The process of claim 1 wherein a portion of the water from the overflow end of the countercurrent rinse system is sprayed onto the surfaces of the strip prior to the strip passing over the roll, and the remainder is passed to halogen tin electrolyte storage to make up water losses.

References Cited

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