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LEAD-COATED STEEL

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This invention relates to the production of corrosion-resistant coatings on iron and steel and more particularly to and improved method of coating steel with lead.

Lead-coated steel articles, for example lead-coated steel sheet, is utilized where corrosion resistance is important. Such lead-coated sheet is used, for example, for roofing. Another important example is in the chemical industry where lead-coated sheet is used in contact with corrosive materials. In making lead-coated articles of this sort, considerable difficulty is commonly encountered in obtaining good adherence of the lead to the steel surface. Since pure lead does not adhere well to ferrous metal surfaces, common practice is to utilize lead alloys which have better adherence. A common example is terne plate, which consists of iron or steel sheet coated with an alloy consisting essentially of 75-80% of lead and 20-25% of tin. Such alloy coatings are satisfactory for many purposes, but for other purposes where a substantially pure lead coating is required, or even where a coating of 95% or more by weight of lead is required, coatings such as those exemplified by terne plate are not satisfactory; and heretofore no suitable cheap method has been available for coating ferrous metals with lead of 95% or higher purity.

An object of the present invention is to provide an improved process for coating ferrous metal articles with lead. Another object is an improved, simple and cheap process for coating ferrous metal surfaces with substantially pure lead. My invention also includes the novel, lead-coated, ferrous metal articles as hereinafter described. Still other objects will be apparent from the following description of my invention.

I have discovered that substantially pure lead coatings or coatings containing about 95% or more by weight of lead can be produced on ferrous metal objects by first giving such objects a coating of copper and then immersing them in a bath of the molten lead. The preliminary copper coating may be applied by any known method, for example by immersion plating or by electroplating.

In one method of practicing my process, which is described by way of illustration, I first coat the steel article with copper by giving it a "copper strike" coating by plating in a conventional copper cyanide plating bath, e. g., for 0.5 to 5 minutes. I then provide a bath of molten lead and float thereon a layer of an alkaline flux, consisting of a molten mixture of sodium cyanide and caustic soda. The temperature of the bath

may be maintained at, for example about 325-400° C. The coppered steel article to be coated is then dipped through the molten cyanide caustic flux layer, and thence into the molten lead bath. On removal of the steel article and cooling, a dense, adherent, uniform coating of lead is found on the steel article.

In carrying out the above described operation, conventional apparatus for hot dip coating of steel may be utilized. If desired, the cyanide-caustic flux may be kept in a conventional flux box so that the article to be coated passes through the flux on its way into the lead bath but does not pass through the flux on removal from the bath. Likewise, if desired, the surface of the lead bath at the point the article is removed may be covered with a layer of suitable vegetable oil such as palm oil, or a hydrocarbon oil, for the purpose of smoothing and protecting the lead coating until it has cooled.

In practicing this invention, as distinguished from the conventional method of making terne plate, I have found it is essential to utilize an alkaline flux. Preferably I utilize an alkaline flux containing a metal cyanide. For this purpose I may use an alkali metal cyanide or mixtures of alkali metal cyanides with or without the addition of other alkaline materials such as alkali metal hydroxide, alkali metal carbonate, borax or the like. A cyanide-free alkaline flux may be used, for example, molten caustic soda or mixtures of caustic soda and caustic potash. However the best results usually are obtained when the flux at least contains an appreciable amount, such as 10% or more, of an alkali metal cyanide. The flux, if desired, also may contain a small amount of a heavy metal cyanide, for example a cyanide of copper, lead, zinc or the like, which may be dissolved in the molten alkali metal cyanide present.

It is not always necessary to locate the flux bath on the surface of the molten lead bath. If desired, the metal article may be first immersed in the flux bath in a separate container so as to take up a coating of the molten alkali flux and then dipped into a lead bath. Generally, however, I prefer to cover the lead bath with the alkaline flux, as this prevents oxidation of the lead and thereby avoids waste of that metal.

I have further found that the preliminary copper coating on the steel article may be obtained by contacting the ferrous metal surface with a molten bath comprising alkali metal cyanide having copper cyanide dissolved therein. In thus producing the copper coating it is preferable to

utilize a temperature not lower than about 400° C.; temperatures in the range of 400–500° C. are suitable. The concentration of copper cyanide in the cyanide melt should be at least about 20% by weight. In this modification of the invention, the copper cyanide-alkali metal cyanide bath may be utilized as the flux floating on the surface of the lead bath, or the steel article first may be dipped into the copper cyanide bath to produce the copper coating and then dipped into the lead bath in a separate container. In this modification, generally I prefer to obtain the copper coating at a temperature of about 400–500° C. in a bath separate from the lead bath and then dip the copper-coated article through an alkaline flux which may or may not contain copper cyanide, the lead bath being maintained at a temperature not higher than 400° C.

In all cases I prefer to maintain the temperature of the lead bath not higher than about 400° C. While higher temperatures may be utilized if desired, and while baths at temperatures above 400° C. will produce lead coatings on steel, in general the most uniform and most adherent lead coatings are obtained at temperatures not above 400° C. I have discovered that at higher temperatures there is some tendency for the copper coating to be removed from the steel, with the result that when such removal occurs the high degree of adherence of the lead, which is an object of this invention, is not attained. This tendency may be offset to some degree by utilizing a heavier copper coating to begin with. However, for economical reasons, it is preferable to utilize a light copper coating and keep the temperature of the lead bath not higher than 400° C., preferably at about 325–375° C.

While a prime object of my invention is to coat iron or steel with substantially pure lead coatings, for example coatings of lead having a purity of 99% by weight or higher, the invention is not re-

stricted thereto. If desired, small amounts of other elements may be alloyed with the lead to modify its physical properties, for example, small amounts, not exceeding about 5% by weight, of tin, antimony, bismuth, magnesium, sodium, lithium, calcium, or the like. In the appended claims, the term "lead" is used to mean any grade of lead or lead alloy containing not less than about 95% by weight of elemental lead.

I claim:

1. The process which comprises coating a ferrous metal surface with copper and bringing the copper-coated surface into contact with molten lead in the presence of molten sodium cyanide.

2. The process which comprises contacting a ferrous metal surface with an alkaline melt comprising molten sodium cyanide having at least about 20% by weight of copper cyanide dissolved therein, maintaining said ferrous surface in contact with said melt at a temperature of about 400 to 500° C. until said surface has acquired a coating of copper, and then contacting the resulting coppered surface with molten lead at a temperature of about 325 to 400° C. in the presence of a molten alkaline flux comprising sodium cyanide.

3. The process which comprises contacting a ferrous metal surface with an alkaline melt comprising molten sodium cyanide having at least about 20% by weight of copper cyanide dissolved therein, maintaining said ferrous surface in contact with said melt at a temperature of about 400 to 500° C. until said surface has acquired a coating of copper, and then contacting the resulting coppered surface with molten lead at a temperature of about 325 to 400° C. in the presence of a molten alkaline flux consisting essentially of caustic containing at least 10% by weight of sodium cyanide.

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