

- [54] **PROCESS FOR REMOVING COPPER DEPOSITS FROM SURFACES**
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- [58] Field of Search **134/3, 13, 41, 10; 252/82; 75/101 BE, 117; 423/24; 210/58; 23/312 ME**

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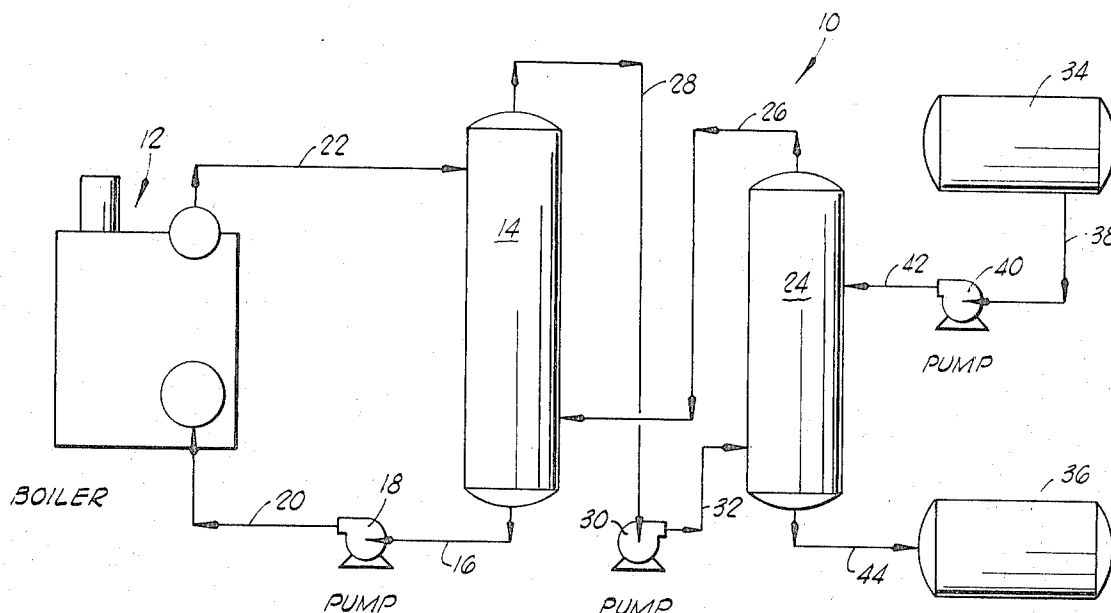
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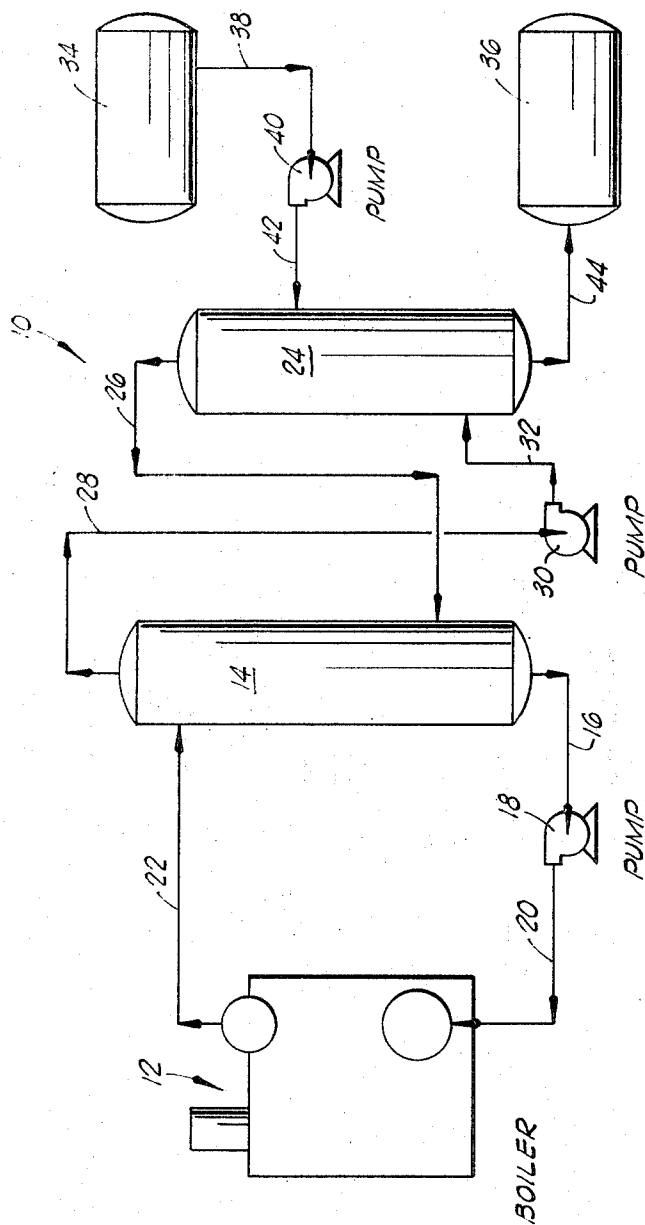
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[57] **ABSTRACT**

Copper deposits are removed from a ferrous metal surface by circulating an aqueous acidic solution containing an hydroxy carboxylic acid and/or one of its acidic salts into contact with the surface, regenerating the spent acid solution by contacting it with an immiscible liquid which preferentially extracts copper dissolved in the solution, and recontacting the surface with the regenerated acid solution. Substituted hydroxy benzophenoximes and/or α -hydroxy oximes are used as the immiscible extraction liquid.

16 Claims, 1 Drawing Figure





PROCESS FOR REMOVING COPPER DEPOSITS FROM SURFACES

The present invention relates to the removal of copper deposits from surfaces, and more particularly, but not by way of limitation, to the removal of water insoluble deposits or scale containing copper from metal surfaces by dissolving the deposits in an aqueous acid solution.

In the use and maintenance of industrial equipment the requirement for the removal of metallic copper or copper containing scale often presents itself. For example, steam condensers used in conjunction with steam generation facilities commonly include surfaces formed of a copper alloy which are a source of copper metal for the formation of undesirable deposits on the heat exchange surfaces of the steam generation equipment. In steam generation facilities associated with electrical power plants, the deposits which include copper and iron oxides (usually magnetite) are commonly formed on steel heat exchange surfaces. In order to insure the efficient operation of such equipment, the deposits must periodically be removed.

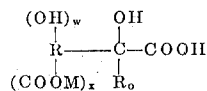
A common procedure presently employed for removing copper and iron oxide deposits from metallic surfaces is to initially contact the surfaces with an ammoniacal oxidant wash to remove part of the copper deposit followed by rinsing and the subsequent contact of the surfaces with a cleaning solution containing an acid plus a copper complexing material. The copper complexing material functions to tie up the copper so that it is dissolved and held in the cleaning solution. Such multi-stage cleaning procedures are expensive to carry out, and the copper complexing materials and cleaning solutions which must be used are costly.

While strong mineral acid solutions can be used to dissolve deposits containing copper in a single stage, the dissolved copper readily plates out on surfaces subsequently contacted by the acid solution. By the present invention a single stage process for the removal of deposits containing copper is provided wherein the deposits are removed by dissolution in an aqueous acid solution and retained therein without the addition of a copper complexing material to the aqueous acid solution being required. In another aspect of the present invention, dissolved copper is removed from the aqueous acid solution so that the acid solution can be readily disposed of in a conventional manner without incurring copper poisoning pollution. In a further aspect of the present invention a continuous process is provided for the removal of deposits containing copper or copper and iron oxide wherein the aqueous acid cleaning solution is continuously recycled into contact with the surface to be cleaned and dissolved copper is continuously removed from the cleaning solution.

The invention will be further understood from a reading of the following description of preferred embodiments thereof and by the reference to the accompanying Drawing which is a diagrammatic representation of one system which can be used for carrying out the invention.

Broadly stated, the process for the removal of copper deposits of the present invention comprises dissolving the deposits in an aqueous solution containing an effective quantity of an α -hydroxy carboxylic acid, an acidic salt thereof or a mixture of the acid and acidic salt

wherein the acid or salt is represented by the following formula:

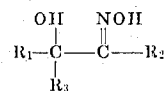


wherein R is hydrogen or an alkyl radical having in the range of from about 1 to 5 carbon atoms, R₀ is hydrogen or a —CH₂ COOH radical M is hydrogen, sodium, potassium or ammonium, W is an integer having a value in the range of from 0 to 5, and X is an integer having a value in the range of from 0 to 5. Examples of such α -hydroxy carboxylic acids are gluconic acid, glycolic acid, mucic acid, 2-hydroxy-butanedioic acid and citric acid. Examples of useful acidic salts of such α -hydroxy carboxylic acids are monoammonium citrate, monosodium gluconate and monopotassium malate. Aqueous solutions containing an α -hydroxy carboxylic acid or acidic salt thereof, or mixtures thereof which are useful in dissolving copper deposits or scale are those wherein the α -hydroxy carboxylic acid, acidic salt or mixture thereof is present in an amount in the range of from about 0.5% by weight of the solution to saturation. Below a concentration of about 0.5% by weight, the acid solution is generally ineffective to remove the scale. The scale removing effectiveness of the solution increases with increasing concentrations up to saturation, and the particular concentration used depends on a variety of factors such as the type equipment to be cleaned, the particular type of scale to be removed, and economic factors.

The aqueous acid solutions described above are particularly suitable for removing deposits containing copper and iron oxide from steel surfaces in that both the iron oxide and copper are dissolved by the solution upon contact therewith. This ability to remove such scale in a single stage process is due in part to the capability of the α -hydroxy carboxylic acids or acidic salts thereof to complex or tie up copper ions to a limited degree.

As stated above, a further aspect of the present invention is the removal of dissolved copper values from the spent aqueous acid solution so that the acid solution can be readily disposed of and the copper values can be recovered if desired. This step is carried out by contacting the spent aqueous acid solution with a material having the property of preferentially extracting copper from low pH aqueous solutions. Materials which have been found to be suitable for this purpose are certain oxime derivative compounds which can be adsorbed on a non-reactive solid support such as silica gel or activated charcoal or dissolved in a water immiscible solvent.

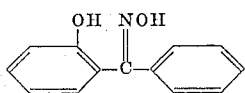
Particularly suitable oxime derivative copper extractants for use in accordance with the process of the present invention are comprised of α -hydroxy oxime compounds having the following general formula:



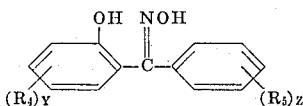
R₁, R₂ and R₃ can be any of a variety of organic hydrocarbon radicals such as aliphatic and alkylaryl radicals

and R_3 can also be hydrogen. Preferably, R_1 and R_2 are selected from the group consisting of straight or branched chain alkyl radicals having in the range of from about 6 to about 20 carbon atoms, and R_3 is hydrogen or a straight or branched chain alkyl radical having in the range of from about 6 to about 20 carbon atoms. α -hydroxy oximes having a total carbon atom content in the range of from about 14 to about 40 carbon atoms are preferred. Examples of such compounds are 19-hydroxyhexatriaconta-9,27-dien-18-oxime; 5-10-diethyl-8-hydroxytetradecan-7-oxime; and 5,8-diethyl-7-hydroxydodecane-6-oxime.

In addition to the above described α -hydroxy oximes, a class of substituted hydroxy benzophenoximes are also particularly suitable for use in accordance with the present invention. These compounds have the following basic structure:



In order to impart solubility to the hydroxy benzophenoximes so that they can be dissolved in a suitable solvent, they are substituted by saturated or ethylenically unsaturated aliphatic groups or the corresponding ether groups. Preferred such compounds are substituted hydroxy benzophenoximes having the following general formula:



R_4 and R_5 can be alike or different and are saturated aliphatic groups having in the range of from about 1 to 25 carbon atoms, or ethylenically unsaturated aliphatic groups having in the range of from about 3 to 25 carbon atoms; or R_4 and R_5 are $-OR_6$ groups where R_6 is a saturated aliphatic group having in the range of from about 1 to 25 carbon atoms, or an ethylenically unsaturated aliphatic group having in the range of from 3 to about 25 carbon atoms; and Y and Z are integers having values in the range of from 0 to 4. Preferably, the position ortho to the phenolic OH substituted carbon atom and the position ortho to the oxime carbon atom on the other aromatic nucleus are unsubstituted. Branched chain saturated aliphatic hydrocarbon substituents are preferred.

Examples of such substituted hydroxy benzophenoximes are 2-hydroxy-3-methyl-5 ethylbenzophenoxime; 2-hydroxy-5-(1,1-dimethylpropyl)-benzophenoxime; and 2-hydroxy-5-octylbenzophenoxime.

The oxime derivative compounds described above can be utilized in accordance with the present invention for extracting copper from the aqueous acid cleaning solution individually, in mixtures, in the pure state, adsorbed on a non-reactive solid adsorbent, or dissolved in a solvent. When the compounds or mixtures thereof are utilized adsorbed on non-reactive solid adsorbent, the spent aqueous acid solution containing

copper is flowed through a stationary bed of solid adsorbent so that the copper is extracted from the solution.

When a solvent for the oxime derivative compounds is used it can be present in an amount in the range of from 0 to about 99.5% by weight of solution. Preferred solvents for use in accordance with the present invention are water immiscible organic solvents. Aliphatic hydrocarbon solvents such as the petroleum-derived liquid hydrocarbons are particularly suitable, e.g., kerosene, diesel oil, etc. Various aromatic solvents may also be used, such as benzene, toluene and xylene. The most preferred solvent is kerosene present in the solution containing the oxime derivative extractants in the range of from about 80% by weight to about 98% by weight of solution.

In carrying out the process of the present invention for the removal of deposits containing copper from surfaces, the surfaces can be contacted with the aqueous solution of an α -hydroxy carboxylic acid, an acidic salt thereof or mixtures of the acids and acidic salts described above in a batch procedure or the acid solution may be continuously circulated into contact with the surface for a period of time sufficient to dissolve the deposits.

The removal of copper from the spent aqueous acid solution is particularly advantageous in industrial cleaning applications in that the resultant acid solution can be disposed of at the site of the cleaning operation in a conventional manner without incurring copper poisoning pollution. As indicated previously, the step of removing the copper from the spent acid solution can be carried out by flowing the solution into contact with one or more stationary beds of adsorbent material having one or more of the oxime derivative copper extractants mentioned above adsorbed thereon. Alternatively, the oxime derivative extractants can be dissolved in a substantially water immiscible organic solvent of the type described above and the copper extracted from the aqueous acid solution by means of a liquid-liquid extraction step. When the liquid extraction technique is used, the liquid extract solution is stripped of the copper contained therein and reused. The stripping of the copper from the extract solution is accomplished by contacting it with a strong acid. When one or more stationary beds of adsorbent material having the oxime derivative compounds adsorbed thereon are used, the beds are also regenerated by contact with a strong acid. Suitable such acids include aqueous mineral acid solutions such as aqueous sulfuric acid or hydrochloric acid with the acid being present in the solution in an amount of from about 2% to about 30% by weight of solution. The stripping of the extract solution transfers the copper into a small volume of aqueous stripping medium which can be processed further for the recovery of the copper values if economical, such as by direct electrolysis, or the relatively small volume solution may be transported to a safe area for the disposal thereof.

Referring now to the drawing, one system which may be used for carrying out the process of the present invention including the removal of copper from the aqueous acid cleaning solution by liquid-liquid extraction is illustrated and generally designated by the numeral 10. The system 10 is particularly suitable for carrying out the process of the invention in industrial cleaning applications in that the various components of the system can be truck or skid mounted for mobility. The system

10 is shown connected to a steam boiler 12 to be cleaned.

The system 10 includes a conventional liquid-liquid contactor 14 through which the aqueous α -hydroxy carboxylic acid cleaning solution is circulated after contacting the surfaces to be cleaned in the boiler 12. That is, the aqueous acid solution is conducted by a conduit 16 from the bottom portion of the contactor 14 to a conventional liquid pump 18. From the discharge of the pump 18, the aqueous acid solution is caused to flow by way of a conduit 20 into and through the boiler 12 so that the surfaces having copper deposits or scale thereon are contacted by the aqueous acid solution. After flowing over the surfaces and contacting the deposits, the acid solution exits the equipment 12 by way of a conduit 22 and is conducted to the top portion of the contactor 14. Thus, as will be understood, the aqueous acid solution of the present invention is circulated over the surfaces to be cleaned at a rate and for a time period such that the scale containing copper deposits or copper and iron oxide deposits is dissolved by the acid solution.

A second conventional liquid-liquid contactor 24 is provided, the top portion of which is connected to the bottom portion of the liquid-liquid contactor 14 by a conduit 26. A stream of the substantially water immiscible extractant liquid described above, i.e., one or more of the oxime derivative extractants dissolved in an organic solvent, is caused to flow from the contactor 24 to the contactor 14. As will be understood, the water immiscible liquid extractant is of a density less than the aqueous acid cleaning solution so that it flows upwardly within the contactor 14 intimately contacting the aqueous acid solution passing downwardly therein. As the intimate contact takes place between the aqueous phase and organic phase within the contactor 14, copper values contained in the aqueous phase are extracted therefrom into the organic phase. The organic extract solution exits the contactor 14 by way of a conduit 28 connected to the top portion thereof and flows to a liquid pump 30. From the pump 30, the organic extract solution passes through a conduit 32 into the bottom portion of the contactor 24 and flows upwardly therein. A tank or container 34 is provided having a quantity of strong aqueous acid solution therein, and a tank or container 36 is provided for receiving the acid solution. A conduit 38 connected to the bottom portion of the tank 34 leads a stream of the acid to a pump 40 from where it is conducted to the upper portion of the liquid-liquid contactor 24 by a conduit 42. A conduit 44 is provided connected to the bottom portion of the contactor 24 and to the tank 36.

In operation of the system 10 for removing copper and iron oxide deposits, the stream of aqueous α -hydroxy carboxylic acid solution is continuously circulated over the surfaces of the boiler 12. The temperature at which the acid solution contacts the surfaces is preferably maintained in the range of from about 100°F to 200°F and depending upon the atmospheric conditions encountered, a heater (not shown) can be connected into the conduit 20 to control the temperature of the acid solution at the desired level.

As the aqueous acid solution containing dissolved copper and iron flows through the liquid-liquid contactor 14, it is contacted by the organic extractant solution described above. The organic extractant solution is continuously circulated between the contactors 12 and

24 so that copper is continuously extracted from the aqueous acid solution by the organic extractant solution, and copper is continuously stripped from the extractant solution by the aqueous stripping medium flowing through the contactor 24. The aqueous acid stripping medium containing stripped copper flows by way of the conduit 44 into the tank 36.

As will be understood by those skilled in the art, the flow rates of the various streams circulated within the system 10 and through the equipment 12 being cleaned will vary considerably depending upon a variety of factors. For example, the maximum flow rate of aqueous acid cleaning solution circulated through the boiler 12 and contactor 14 is dependent upon the rate of extractant liquid flowing through the contactor 14 and the time required for separation of the two liquid streams which in turn is governed by the size of the liquid contactor 14. Generally, the optimum size of the equipment used in the system 10, the various flow rates required, etc., are determined using conventional engineering techniques.

The pH of the stream of aqueous solution of α -hydroxy carboxylic acid, acidic salt or mixture utilized in accordance with the process of the present invention for dissolving copper deposits is preferably maintained at a level in the range of from about 1.5 to 5. The most preferred acid solution pH is in the range of from 2 to 4. The lower pH limit is dictated by the ability of the oxime derivative compounds described herein to extract copper from the acid solution. Such extraction can be carried out at an aqueous acid solution pH of as low as 1.5. The upper pH limit is dictated by the acid solution's ability to dissolve the copper deposits. Generally, a pH of 5 or below is required.

Corrosion inhibitors can be added to the aqueous acid cleaning solution if desired in order to protect the surfaces contacted from acid corrosion. However, the corrosion inhibitor used should be of a type such that it does not cause the organic liquid copper extractant to emulsify. A particularly suitable corrosion inhibitor which can be added to the aqueous α -hydroxy carboxylic acid or acidic salt solution to minimize corrosion of steel surfaces without causing emulsification of the copper extractant solution is a saturated hydrocarbon sulfonate surface active agent having the chemical formula $C_{13}H_{27}SO_3Na$. Such a surface active agent can be prepared by reacting chlorine with sulfur trioxide and a hydrocarbon of suitable length in the presence of actinic light. U.S. Pat. No. 2,999,812 illustrates a method of preparing such a surface active agent.

In order to further describe the present invention the following examples are given:

EXAMPLE 1

A laboratory system for carrying out the process of the present invention including a horizontal extraction chamber is prepared. A 5% by weight aqueous gluconic acid solution having a pH of about 2 is circulated through the extraction chamber into contact with a steel surface having copper and magnetite deposited thereon. The extraction chamber contains a kerosene solution having a mixture of the oxime derivative extractants described above dissolved therein in an amount of 10% by weight of solution. Two test runs are made wherein the aqueous acid solution is circulated for 6 hours while being maintained at a temperature of 150°F. At the end of each 6 hour test the copper con-

tents of the aqueous acid phase and organic extractant phase are determined. The results of these tests are shown in Table I below.

sium or ammonium, W is an integer having a value in the range of from 0 to 5, and X is an integer having a value in the range of from 0 to 5;

TABLE I

Run	Total Weight of Copper Originally Deposited on Test Surface, mg	Volume of Aqueous Gluconic Acid Solution Circulated, ml	Volume of Organic Extractant In Extraction Chamber, ml	Copper Content of Aqueous Acid Solution, mg	Copper Content of Organic Extractant Phase, mg
1	254	1376	400	0.83	82
2	380	1400	400	3.71	220

EXAMPLE 2

A second horizontal extraction chamber is added to the laboratory system described in Example 1 for stripping the kerosene extractant solution with a 5% by weight aqueous sulfuric acid solution. The procedure of Example 1 is repeated except that the liquid extractant solution is continuously circulated through the second extraction chamber which contains a quantity of the sulfuric acid stripping solution. Runs of 6 hours, 5.5 hours and 3 hours are made and the copper contents of the various aqueous and organic streams determined. The results of these tests are shown in Table II below.

contacting the resultant spent aqueous acid solution containing dissolved iron and copper with a substantially immiscible liquid having the property of preferentially extracting at least a portion of dissolved copper from the acid solution;
separating the resultant extract liquid containing copper from the extracted aqueous acid solution; and
recirculating the extracted aqueous acid solution into contact with said surfaces.

2. The process of claim 1 wherein the said hydroxy carboxylic acid, acidic salt thereof or mixture of acid

TABLE II

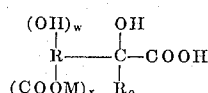
Run	Duration of Test	Total Weight of Copper Originally Deposited On Test Surface, mg	Volume of Aqueous Gluconic Acid Solution Circulated, ml	Volume of Organic Extractant Circulated, ml	Volume of Aqueous Sulfuric Acid Used, ml	Copper Content of Aqueous Gluconic Acid Solution, mg	Copper Content of Organic Extractant, mg	Copper Content of Aqueous Sulfuric Acid, mg
1	6	100	1325	1100	1000	Negligible	Negligible	27.5
2	6	571.1	1360	1100	1000	74.8	Negligible	512.5
3	3	390.5	1400	1340	800	157.5	Negligible	112.5
4	3	534.6	1500	1340	750	120.0	Negligible	157.5
5	5.5	569.8	1430	1560	620	93.5	Negligible	248.0

The foregoing examples clearly illustrate the operability of the process of the present invention for the removal of deposits containing copper and iron oxide.

It is to be understood that the invention is not to be limited to the exact details of operation or the exact process techniques shown and described in that modifications and equivalents will be readily apparent to those skilled in the art, and the invention is to be limited only by the scope of the appended claims.

What is claimed is:

1. A process for removing copper and iron oxide deposits from steel surfaces which consists essentially of: circulating an aqueous acid solution having a pH in the range of about 1.5 to about 5 and containing an hydroxy carboxylic acid, an acidic salt of said hydroxy carboxylic acid or a mixture of said acids and salts into contact with said surfaces so that the copper and iron oxide deposits are dissolved therein, said hydroxy carboxylic acid or acidic salt thereof having the general formula:



wherein R is hydrogen or an alkyl radical having in the range of from 1 to 5 carbon atoms, R₀ is hydrogen or a —CH₂ COOH radical, M is hydrogen, sodium, potas-

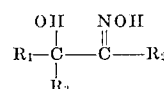
and acidic salt is present in said aqueous acid solution in an amount in the range of from about 0.5% by weight to saturation.

3. The process of claim 2 wherein said aqueous acid solution contains an hydroxy carboxylic acid selected from the group consisting of gluconic acid, glycolic acid, mucic acid, 2-hydroxy-butanedioic acid and citric acid.

4. The process of claim 2 wherein said aqueous acid solution contains an acidic salt of an hydroxy carboxylic acid selected from the group consisting of monoammonium citrate, monosodium gluconate and monopotassium malate.

5. The process of claim 2 wherein said substantially immiscible liquid having the property of preferentially extracting copper is selected from the group consisting of:

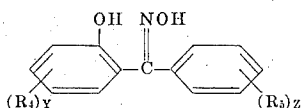
an α-hydroxy aliphatic oxime having the general formula:



wherein R₁ and R₂ are selected from the group consisting of straight or branched chain alkyl radicals having in the range of from about 6 to about 20 carbon atoms

and R_3 is hydrogen or a straight or branched chain alkyl radical having in the range of from about 6 to about 20 carbon atoms;

a substituted hydroxy benzophenoxime having the general formula:



wherein R_4 and R_5 are alike or different and are saturated aliphatic groups having in the range of from about 3 to 25 carbon atoms, or R_4 and R_5 comprise $-OR_6$ groups where R_6 is a saturated aliphatic group having in the range of from about 1 to 25 carbon atoms or an ethylenically unsaturated group having in the range of from about 3 to 25 carbon atoms, Y and Z are integers having values in the range of from 0 to 4, but both Y and Z are not 0; and mixtures of the foregoing compounds.

6. The process of claim 5 wherein said substantially immiscible liquid having the property of preferentially extracting copper is further characterized to include a water immiscible organic solvent for said α -hydroxy aliphatic oximes, substituted hydroxy benzophenoximes or mixtures thereof, said organic solvent being present in an amount in the range of from 0 to about 99.5% by weight of solution.

7. The process of claim 6 which is further characterized to include the step of removing copper from the separated extract liquid containing copper.

8. The process of claim 7 wherein the step of removing copper from the extract liquid comprises contacting said liquid with an aqueous acid solution so that copper is stripped therefrom.

9. A process for removing a copper deposit from a ferrous metal surface consisting essentially of:

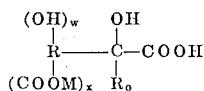
a first step of contacting said copper deposit with an aqueous solvent therefore to thereby produce a copper-containing solvent solution,

a second step of contacting said copper-containing solvent solution in a first solvent extraction zone with a substantially immiscible liquid having preference for copper to remove at least a portion of said copper from said copper-containing solvent solution to thereby produce a first extract phase consisting essentially of said substantially immiscible liquid and copper and a first raffinate phase consisting essentially of said aqueous solvent,

a third step of separating said first extract phase from said first raffinate phase, and

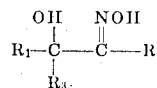
a fourth step of contacting said copper deposit with said first raffinate phase,

wherein said aqueous solvent is an aqueous solution containing an hydroxy carboxylic acid, an acidic salt of an hydroxy carboxylic acid or a mixture of said acids and salts, the hydroxy carboxylic acid or acidic salt thereof having the general formula



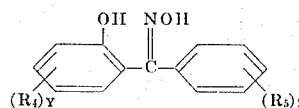
wherein R is hydrogen or an alkyl radical having in the range of from 1 to 5 carbon atoms, R_6 is hydrogen or a $-CH_2COOH$ radical, M is hydrogen, sodium, potassium or ammonium, W is an integer having a value in the range of from 0 to 5, and X is an integer having a value in the range of from 0 to 5; further wherein said substantially immiscible liquid is selected from the group consisting of

an α -hydroxy oxime having the general formula



wherein R_1 and R_2 are selected from the group consisting of straight or branched chain alkyl radicals having in the range of from about 6 to about 20 carbon atoms and R_3 is hydrogen or a straight or branched chain alkyl radical having in the range of from about 6 to about 20 carbon atoms,

a substituted hydroxy benzophenoxime having the general formula



wherein R_4 and R_5 are alike or different and are saturated aliphatic groups having in the range of from about 1 to 25 carbon atoms, ethylenically unsaturated aliphatic groups having in the range of from about 3 to 25 carbon atoms, or R_4 and R_5 comprise $-OR_6$ groups where R_6 is a saturated aliphatic group having in the range of from about 1 to 25 carbon atoms or an ethylenically unsaturated group having in the range of from 3 to 25 carbon atoms, Y and Z are integers having values in the range of from 0 to 4, but both Y and Z are not 0, and

mixtures of the foregoing compounds; and still further wherein said first step and said second step are conducted at a pH in the range of from about 1.5 to about 5 and at a temperature in the range of from about 100°F to about 200°F.

10. The process of claim 9 further including a fifth step of contacting said first extract phase in a second solvent extraction zone with an aqueous inorganic acid having preference for copper to remove said copper from said first extract phase to thereby produce a second raffinate phase consisting essentially of said immiscible liquid, and a second extract phase consisting essentially of said copper dissolved in said aqueous inorganic acid,

a sixth step of separating said second extract phase from said second raffinate phase, and

a seventh step of contacting said copper-containing solvent solution in said first solvent extraction zone with said second raffinate phase.

11. The process of claim 10 wherein said inorganic acid is a mineral acid and is present in an amount in the range of from about 2% to about 30% by weight of solution.

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12. The process of claim 9 wherein said hydroxy carboxylic acid, acidic salt thereof or mixture of acid and acidic salt is present in said aqueous solvent in an amount in the range of from about 0.5% by weight to saturation.

13. The process of claim 12 wherein said hydroxy carboxylic acid is selected from the group consisting of gluconic acid, glycolic acid, mucic acid, 2-hydroxybutanedioic acid and citric acid.

14. The process of claim 12 wherein said acidic salt of said hydroxy carboxylic acid is selected from the group consisting of monoammonium citrate, monosodium gluconate and monopotassium malate.

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15. The process of claim 13 wherein said substantially immiscible liquid having preference for copper is further characterized to include a water immiscible organic solvent for said α -hydroxy aliphatic oximes, substituted hydroxy benzophenoximes or mixtures thereof, said organic solvent being present in an amount in the range of from 0 to about 99.5% by weight of solution.

16. The process of claim 15 wherein said water immiscible organic solvent is kerosene present in an amount in the range of from about 80% to about 98% by weight of solution.

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