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CORROSION INHIBITING COATING
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The present invention relates to corrosion prevention coatings and more specifically to coatings for preventing corrosion of metal surfaces by the water often associated in small amounts with water-immiscible liquids.

In the storage and handling of various water-immiscible liquid materials, particularly hydrocarbons, it is often necessary both to transport and/or to store such materials in metal containers, as in steel drums or tanks and the like. Since these materials often contain varying amounts of water in solution or in suspension, which may separate due to temperature changes, for example, internal corrosion of the container by the water almost always occurs to a greater or lesser degree. This problem is particularly serious when gasoline is under consideration. In spite of all reasonable and practicable precautions during the manufacture of gasoline, when the same is stored in drums or tanks for a period, especially as is so often practiced in handling aviation gasoline, an appreciable amount of water separates and will be found as a film or in minute droplets on the container walls or even in small pools in the bottom of the container. This, of course, brings about ideal conditions for corrosion and consequent damage to the container as well as the even more serious contamination of the gasoline or similar product stored within the container.

The presently described corrosion inhibiting coating is also suitable for use as a coating for sheet steel, machine parts, equipment, etc., which may be subject to corrosion due to condensation of atmospheric moisture thereon.

It is to be clearly understood that the corrosion inhibiting coating described below is intended for use preferably in those cases in which relatively small quantities of water come in contact with the surfaces to be protected, as distinguished from primarily aqueous systems, such as water tanks, etc.

As a result of the above-described corrosion, it has become necessary for manufacturers and shippers of such products to apply various internal coatings to the walls of such containers or to add corrosion inhibitors of one type or another to the product being stored.

It is an object of the present invention to provide an improved corrosion inhibiting coating for

metal surfaces which is inexpensive to prepare, easily applied to the surfaces to be protected and easily removed therefrom when desired.

It is another object of the present invention to provide an improved internal coating for containers which are to be used as described above. It is a further object of this invention to provide an internal coating which will both prevent corrosion and remove to a large extent any suspended corrosion products already present in material which may be transferred to containers protected with the hereinafter described improved coating. Another object is to provide an internal container coating which will prevent contact between the dirt, scale, corrosion products, etc. on container walls and the material stored therein, thus, preventing contamination of the stored materials by suspension, solution or reaction of container walls and matter present on them with the stored materials. A still further object is to supply a coating which does not contaminate in any way hydrocarbon materials stored in containers protected by the same.

Broadly, the present improved coating comprises a hydrocarbon insoluble, water soluble mucilaginous material, a plasticizer if necessary, and sodium nitrite. By mucilaginous material is meant those materials which either alone or in the presence of a suitable plasticizer provide a continuous, pliable film when applied in solution and the solvent removed therefrom. Most of the proteins and carbohydrates of animal and vegetable origin and products derived therefrom fall within the limits of this definition. For example, pure grades of the following types of compounds and mixtures of the same will be found suitable: proteins, albuminoids, glues, gelatins, phosphoproteins, caseins, sugars, starches, dextrins, gums and cellulose derivatives. More specifically, the following compounds are among those suitable as the mucilaginous base material in the presently disclosed coating: corn starch (partially hydrolyzed), molasses, gum arabic, agar-agar, dextrin, pectin, barley sugar, caramel, xylan, wheat gluten and gum tragacanth.

Particularly suitable and preferred mucilaginous materials of the type described above are the modified starches which are commonly denoted as "thin boiling starches" and are described in "Comprehensive Survey of Starch Chemistry,"

vol. I, page 169, by R. P. Walton, published in 1928 in New York by the Chemical Catalog Company, Inc. A specific compound of this type is the product sold under the trade name of "Stayco M." This compound is a chemically modified corn starch and has the following physical properties:

H ₂ O content.....	per cent.....	11-13
Viscosity (Saybolt seconds, starch cooked at a temperature of 180° F. for 10 minutes with a concentration of 10 grams per 100 cc. of distilled water. Cooled to 125° F.).....		38-43
pH.....		7.0-7.4
Solubility in water.....	per cent.....	2-3

For application in used drums or other places where there is a possibility that incomplete cleaning of the surface to be protected has been carried out, it will be found advantageous to incorporate a small amount of a wetting agent in order to insure complete coverage of the surface to which the coating is applied. The majority of the many wetting agents commonly used will be found satisfactory for the purpose, those which are relatively stable for long periods in solutions having a pH in excess of 6 being preferred. Those which do not fall in this category may be used, however, if they are added to the coating composition immediately before application. Particular examples of suitable wetting agents are the dioctyl esters of sodium sulfosuccinic acid, dibutyl esters of sodium sulfosuccinic acids, sodium salts of fatty alcohol sulfates, sodium salts of secondary branched-chain higher alcohol alkyl sulfates, sodium or potassium soaps, and sodium lauryl sulfate.

In those instances where a plasticizer is found to be necessary, as for example when utilizing modified starches as the mucilaginous base or in coating such surfaces as the interior of drums where flexibility of the coating is of importance, the following types of compounds will be found useful: water soluble, substantially hydrocarbon insoluble polyhydric alcohols and esters of polyhydric alcohols such as glycerin, glycol, glycerin polymers, amines, polyamines, hydroxy amines, hydroxy ethers, higher polyhydroxy alcohols such as sorbitol, mannitol, penta-erythritol, polyvinyl alcohol, ethyl ethers of glycerol, and similar materials having known plasticizing properties. In those instances where a substantially dry coating is not required, water may be utilized as a substitute for a plasticizer, the coating being only partially dehydrated after application. Thus, in preparing a coating for a gasoline drum, the coating may be applied as directed below and dehydrated only to the point whereat a coating of suitable flexibility is attained and further flowing of the coating has ceased. The drum may then be filled with gasoline which will prevent further dehydration with consequent formation of a brittle coating.

As a specific example and in one embodiment of the invention, the following composition has been found satisfactory:

Example I

	Per cent by weight, approximately
Dextrin	59.9
Glycerin	30
Inhibitor	10
Wetting agent.....	.1

The above material is applied preferably as an

approximately 40% water solution and the water thereafter is permitted to evaporate or is removed by heating the container at a temperature not substantially exceeding 300° F., for a period of time not substantially exceeding 10 minutes. The resulting coating is pliable, tacky, water soluble and hydrocarbon insoluble. It is odorless and may be easily removed by the usual drum washing processes. Under prolonged severe testing conditions containers protected with the above coating and containing gasoline evidenced no traces of internal corrosion; unprotected containers subjected to the identical tests were severely corroded and their contents so thoroughly contaminated as to be practically valueless without recovery treatment.

The coating is preferably applied to containers by spraying a quantity of the 40% solution into the container and drawing off any excess before drying, although other methods such as brush application in large storage tanks may be utilized if desired. In any case, application conditions should be adjusted to provide at least approximately 3 milligrams of dehydrated coating per square inch of surface to be protected. A usually satisfactory coating is attained if from 1 to 2 fluid ounces of the 40% solution are sprayed into a 55 gallon drum, in a manner to cover all internal surfaces, the drum then being subjected to a temperature of about 250° F. for approximately 5 minutes while flushing with an air stream.

This process may be easily included in the commonly employed drum cleaning treatment wherein dirty drums are washed with a hot alkaline solution, rinsed, steamed, dried and heated prior to painting the exterior surfaces. After the drums have been dried, the above described coating may be applied and the drums passed on to the heating stage in the usual manner. The washing steps will remove all traces of a previous protective coating if such has been applied.

Another example of a preferred embodiment of the invention includes the following composition and has been found especially satisfactory:

Example II

	Per cent by weight, approximately
Modified starch.....	55
Glycerin	35.0
Sodium nitrite.....	10.0

If the above composition is to be applied to used drums or other surfaces which have not been properly cleaned, a wetting agent may be added, approximately 0.1% of 7-ethyl-2-methylundecanol-4 being particularly suitable, the amount of glycerin added being reduced to 34.9% in such instances. In other cases up to 0.5% of a wetting agent may be used, in which instance the amount of glycerin added is reduced down to 34.5%.

The plasticizer may be omitted from both of the above coatings if the use of a partially dehydrated coating, obtained as described above, is feasible.

In Example II above, and in other coatings wherein modified starches and similar materials are utilized as the mucilaginous base, the coating is preferably prepared by adding the modified starch slowly to about 10 times its weight of water at a temperature of approximately 160° F. to 205° F. and stirring for approximately one-half hour after all of the starch has been added.

The wetting agent is preferably added after the solution has cooled, the other materials being added before the starch.

This composition is preferably applied as an approximately 20% water solution and the water thereafter is permitted to evaporate or is removed by heating the coated surface at a temperature not substantially exceeding 400° F. for a time not substantially exceeding 10 minutes. When applying this coating to drums the same procedure is followed as outlined above with regard to Example I, except that from 3 to 8 fluid ounces of the 20% solution is sprayed into a 55 gallon drum, the drum then being subjected to a temperature of 300° F. for approximately 10 minutes.

The amounts of the various components of the coating may be varied within rather wide limits without deleterious effects. The formula given above, in relation to Example I, i. e. base, plasticizer and inhibitor in the approximate proportions of 60:30:10, has been found to be generally satisfactory for normal conditions of service. Sodium nitrite, is known to be an efficient inhibitor in water at concentrations as low as .02%; however, in view of the relatively small quantities actually used in employing the various formulas and in order to obviate completely any danger of localized corrosion due to the possibility of a relatively large pool of water occurring in the container, it is considered preferable to incorporate an ample quantity of inhibitor in the coating composition to insure corrosion inhibition under severe localized conditions, approximately 10% by weight being satisfactory in most instances. However, as much as 50% or more of inhibitor may be incorporated in the coating composition if desirable or necessary for any reason, the upper limit depending upon the particular mucilaginous base used and its ability to carry a large quantity of the inhibitor in the finished coating without cracking or flaking. The relative proportions of base and plasticizer used will of necessity vary with the specific materials utilized. In the case where dextrin is used as a base and glycerin as a plasticizer, from approximately 40% to 85% dextrin, the balance being glycerin and inhibitor, has been found satisfactory, a wetting agent being added if desired.

With regard to coatings which include modified starches as the mucilaginous base, it has been found that compositions containing more than 6 parts of starch to 1 part of plasticizer or less than 1/2 part of starch to 1 part of plasticizer are unsatisfactory for most purposes. The preferred ratio has been found to be approximately 1 1/2 parts of starch to 1 part of plasticizer. The amount of wetting agent added, if this component is desired, will, of course, vary with the particular wetting agent used, the amount usually being of the order of 1% or less.

When using other materials than dextrin or modified starches as the mucilaginous base, the relative quantities of the various components may require modification. For example, a suitable coating may be formulated using the following materials in the proportions noted:

Example III

	Per cent by weight, approximately
Arrowroot starch	5
Glycerin	84.9
Sodium nitrite	10
Wetting agent	0.1

In this formula, the quantity of starch may be varied from approximately .5% by weight to approximately 10% by weight. Not less than approximately 60% by weight of glycerin should be used, however, or an unsatisfactory coating will result. This composition is preferably applied in an approximately 50% solution in water.

Example IV

Another coating which has been found suitable is formulated as follows:

	Per cent by weight, approximately
Liquid glue (animal)	80
Glycerin	9.9
Sodium nitrite	10
Wetting agent	0.1

The above is preferably applied in an approximately 30% solution in water. In many instances, depending primarily upon the particular source from which the liquid glue is derived, the glycerin may be eliminated from this formula, using instead a composition comprising not less than 0.02% and preferably about 10% by weight of sodium nitrite and the balance liquid glue. This coating can be most advantageously applied in an approximately 40% solution in water.

This application is a continuation-in-part of my application Serial No. 403,533, filed July 22, 1941.

I claim as my invention:

1. A water-soluble corrosion-inhibiting coating composition suitable for protecting ferrous metal surfaces in contact with hydrocarbons containing small amounts of water against corrosion consisting essentially of at least approximately 0.02% by weight, based on the total composition, of sodium nitrite and the remainder of said composition being a plasticized mucilaginous base comprising approximately one part by weight of a water-soluble substantially hydrocarbon insoluble plasticizer and from approximately 1/2 to approximately 6 parts by weight of "modified starch," said plasticizer being selected from the group consisting of polyhydric alcohols and the esters and ethers thereof.

2. A water-soluble corrosion-inhibiting coating composition suitable for protecting ferrous metal surfaces in contact with hydrocarbons containing small amounts of water against corrosion consisting essentially of at least approximately 0.02% by weight of sodium nitrite, a small amount of a wetting agent, and the remainder of said composition being a plasticized mucilaginous base comprising approximately one part by weight of a water-soluble substantially hydrocarbon-insoluble polyhydric alcohol and from approximately 1/2 to approximately 6 parts by weight of "modified starch."

3. The coating composition according to claim 1, wherein the plasticizer is glycerin.

4. A water-soluble corrosion inhibiting coating composition suitable for protecting ferrous metal surfaces in contact with hydrocarbons containing small amounts of water against corrosion comprising the following components in the following approximate composition by weight:

	Per cent
"Modified starch"	55
Glycerin	34.5
Sodium nitrite	10
Wetting agent	0.5

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