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METHOD OF REMOVING RUST

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This invention relates to sequestering agents useful in alkaline solutions where it is desired to sequester ferric or other heavy metal ions, and aims to provide sequestering agents for this purpose characterized by much enhanced activity. More particularly, it relates to synergistic mixtures of the 6 and 7 carbon atom sugar acids with each other and with six carbon hexahydroxy alcohols derived from sugars.

Sequestering agents are widely used to render undesirable metallic ions inactive for one reason or another. In particular, ferric ions are often undesirable because they catalyze an undesired reaction; in alkaline media, it is more often undesirable simply because the iron precipitates at some stage to give the undesirable dirty brown color of rust in the end product. Such undesirable precipitation can be avoided by sequestering agents which will sequester ferric ions. These agents are also largely used in the removal of rust and rust stains from such widely divergent materials as rusty metal, rusty beverage bottles and textiles.

Among the sequestering agents which have been suggested for rust removal and iron sequestration are the sugar acids. These sugar acids include the six carbon polyhydroxy acids made by oxidizing aldohexose sugars, and the seven carbon atom acids made from various six carbon and twelve carbon sugars by hydrocyanation and subsequent hydrolysis. These acids are all active sequestering agents, but have widely divergent sequestering power for ferric hydroxide under various alkaline conditions, and vary widely in cost as well. Somewhat less sequestering ability has been observed with the six carbon sugar alcohols, obtained by reduction of the hexose sugars, e.g., sorbitol and mannitol.

The principal object of the present invention is to improve the sequestering power of sugar acids and sugar alcohols in alkaline media.

Another object of the invention is to reduce the overall cost of this class of sequestering agents.

A further object of the present invention is the provision of fast acting economical de-rusting compositions and methods.

These and other objects are obtained, in accordance with the present invention, by making use of the surprising discovery that alkali metal salts of six and seven carbon sugar acids, in which the carboxyl group is at the end of the chain and the other carbons are all substituted by either hydroxyl or amino groups, when mixed with each other and/or with six carbon straight chain hexahydroxy sugar alcohols, exhibit synergistic sequestering ability for ferric and other polyvalent metal ions, the mixtures having sequestering properties equal to or better than the best component of the mixture.

This makes it possible to obtain optimum sequestering power at minimum cost, by mixing a cheaper less powerful product with a more expensive, more powerful product. In many cases, it makes possible superior sequestering power to any heretofore obtainable with this group of materials.

Among the acids, the salts of which have been used for this purpose, are gluconic acid (2,3,4,5,6-pentahydroxy hexoic acid), glucoheptonic acid (2,3,4,5,6,7-hexahydroxy heptoic acid), isomers of glucoheptonic acid including galactoheptonic acid, fructoheptonic acid, and the mixed hexahydroxy heptoic acids obtained by hydrolysis,

hydrocyanation and hydrolysis of sucrose, blackstrap molasses and lactose, and 3-amino-2,4,5,6,7-pentahydroxy heptoic acid; sorbitol and mannitol are the hexahydroxy alcohols available.

The synergism is noticeable with all mixtures of these acids with each other and with the hexahydroxy sugar alcohols, in the range of about 1 to 3 parts by weight of one component to 3 to 1 parts by weight of the other component, in combination with any strength caustic alkali over the entire useful range of alkali concentration (from a fraction of a percent to 50%). In all cases, the mixtures are equal or superior to the best component in sequestering ability.

The sequestering agent is useful in any quantity and will be used at the concentration most desirable for the intended purpose. Amounts as low as .01% are sufficient to prevent precipitation of trace quantities of iron, as in alkali cellulose and viscose solutions. Where more iron is present, more agent is needed; in general, the quantities used will be under 1.0% of the solution weight, although quantities up to 10% are sometimes used for special purposes. Above 10%, the solutions become too concentrated to permit of economic use of the sequestering agent.

The following examples illustrative of the invention are given by way of illustration only and not by way of limitation.

EXAMPLE I.—DE-RUSTING OF STEEL DRUMS

A composition was prepared comprising:

	Parts by weight
NaOH	15
Sodium glucoheptonate	0.3
Sorbitol	0.1
Water	84.6

Rusty steel drums were sprayed with this solution, maintained between 180° F. and boiling for ten minutes. The drums were then rinsed and dried; they were clean, and showed a considerable degree of resistance to rerusting.

The results obtained were compared with an identical composition containing 0.4% sodium glucoheptonate with no sorbitol, and with a composition containing 0.4% sorbitol and no sodium glucoheptonate. The composition containing only sorbitol was not effective, the rust remaining on the drum; the composition containing only sodium glucoheptonate was effective but not as good as the mixed composition, and in addition was more expensive.

EXAMPLE II.—CLEANING OF BEVERAGE BOTTLES

A number of beverage bottles having rust films about their tops (presumably caused by the metal closures used) were treated for ten minutes at 150° F. to 180° F., with a composition comprising:

	Parts by weight
NaOH	3
Sequestering agent	0.3
Water	96.7

Rust removal was complete when the sequestering agent was sodium glucoheptonate alone or a mixture of 3 sodium glucoheptonate to 1 sorbitol or mannitol. Compositions containing sorbitol or mannitol alone as the sequestering agent failed to remove the rust under these conditions.

EXAMPLE III.—CLEANING OF RUSTY COTTON

The degree of synergism is more clearly observable in the removal of rust stains from white cotton cloth, because here the speed and completeness of removal can be

directly compared by measuring the residual color of the cloth after treatment.

A white sheeting was uniformly stained with rust by successive dips in solutions containing respectively, 1% ferric chloride, 10% ammonium hydroxide, and pure water, followed by drying at 100° C. The cloth thus obtained was cut up, and the pieces treated at near the boil for two and one-half hours in 5% caustic soda solutions containing various sequestering agents and mixtures thereof. In each case, 100 ml. of 5% caustic soda solution was used along with the indicated quantity of an aqueous solution of a sequestering agent containing the indicated percentages of various agents:

Level of sequestering agent added to obtain good rust removal

		Quantity, ml.	Concentration, percent	Agent Used
A.	1	1.25	25	sorbitol.
	2	0.75	25	sodium glucoheptonate.
	3	0.75	6.25	Do.
			18.75	sorbitol.
	4	0.50	18.75	sodium glucoheptonate.
			6.25	sorbitol.
B.	5	1.25	25	Do.
	6	0.75	25	sodium aminoglucoheptonate.
	7	0.75	18.75	Do.
			6.25	sorbitol.
C.	8	1.25	25	mannitol.
	9	0.75	25	sodium gluconate.
	10	0.75	18.75	Do.
			6.25	mannitol.
D.	11	0.75	25	sodium glucoheptonate.
	12	0.75	25	sodium fructoheptonate.
	13	0.50	12.5	sodium glucoheptonate.
			12.5	sodium fructoheptonate.
	14	0.50	25	sodium hexhydroxyheptoates (ex.: sucrose).
E.	15	0.75	25	sodium glucoheptonate.
	16	0.75	25	sodium galactoheptonate.
	17	0.50	12.5	sodium glucoheptonate.
			12.5	sodium galactoheptonate.
	18	0.50	25	sodium hexahydroxyheptoates (ex.: lactose).
F.	19	1.25	25	sorbitol.
	20	0.50	25	sodium hexahydroxyheptoates (ex.: sucrose).
	21	0.25	8.33	sorbitol.
			16.67	sodium hexahydroxyheptoates (ex.: sucrose).
G.	22	1.25	25	sorbitol.
	23	0.50	25	sodium hexahydroxyheptoates (ex.: lactose).
	24	0.25	8.33	sorbitol.
			16.67	sodium hexahydroxyheptoates (ex.: lactose).
H.	25	1.25	25	sorbitol.
	26	0.50	25	sodium hexahydroxyheptoates (ex.: sucrose).
	27	0.50	25	sodium hexahydroxyheptoates (ex.: lactose).
	28	0.25	8.33	sorbitol.
			16.67	sodium hexahydroxyheptoates (ex.: 1:1 sucrose+lactose).

It will be apparent from the above that the synergism is observable whenever sequestering of ferric ions is done in aqueous alkali solution with salts of the six and seven carbon sugar acids used in admixture with one another, or with the six carbon hexahydroxy sugar alcohols; in every case, in the range of 1 to 3 parts by weight of one component to 3 to 1 parts by weight of another, the resultant mixed sequestering agent is equal to or better than the best component in sequestering ability.

It will be understood that the invention is not limited to the precise compositions and methods shown in the examples, but that changes may be made therein without departing from the scope of the invention as defined in the claim.

What is claimed is:

The method of removing iron rust from rusty objects, which method comprises treating rusty objects with a solution consisting essentially of from 1% to 50% by weight of sodium hydroxide and from 0.01% to 10% by weight of a sequestering agent, the balance being essentially water, said sequestering agent consisting essentially of a mixture of from 1 to 3 parts by weight of sodium glucoheptonate with from 3 to 1 parts by weight of sorbitol, for a sufficient time to remove the rust from the objects and cause the rust to dissolve in the solution, discontinuing the aforesaid treatment when the rust has been removed, and thereafter rinsing and drying the objects.

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