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ETHANOLAMINES

William P. Moore, Chester, Va., assignor to Allied Chemical Corporation, New York, N.Y., a corporation of New York

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This invention relates to ethanolamines and more particularly to a process for inhibiting color formation of ethanolamines when stored in ferrous containers.

Ethanolamines are known compounds useful for a wide variety of applications. They may be prepared by reacting ethylene oxide with aqueous ammonia to produce mono, di-, and triethanolamines. When prepared by the above and other known procedures, the ethanolamines are normally produced in a high degree of purity with little or no color and are suitable for immediate use for the preparation of uncolored salts, soaps, and shampoos. However, as is known when ethanolamines are shipped or stored over extended periods of time in conventional ferrous containers such as steel drums, tanks, and the like, they tend to become colored. In certain applications where highly colored products cannot be tolerated, e.g. soaps, shampoos, etc., this problem of storage of the ethanolamines is a serious one and serves as a limitation to use of the materials. By ferrous metal container is means a container fabricated from iron or alloys containing iron, i.e., a container in which the inner surface in contact with the ethanolamine contains iron.

It is an object of the present invention to provide a process for the treatment of the ethanolamines to inhibit color formation when stored in ferrous containers. Other objects and advantages will be apparent from the following detailed description.

In accordance with the present invention ethanolamines in ferrous containers may be treated to impart color inhibition thereto by the process which comprises adding to said ethanolamines an alkali metal borohydride preferably sodium borohydride in an amount usually from about 0.001% to 0.05% preferably 0.005% to 0.01% by weight of the ethanolamine.

By treating ethanolamines in accordance with the process of the present invention, I found that there was substantially little or no color formed within the ethanolamines while they were stored in conventional ferrous containers for periods of many months. In addition there was no increase in the color of soaps, salts, or other products made from the ethanolamines. I do not fully understand why the addition of an alkali metal borohydride to ethanolamines contained in ferrous containers tends to inhibit color formation either in the ethanolamines or in products derived therefrom. It may be conjectured that the alkali borohydride acts to inhibit degradation in the ethanolamine liquid itself or pacifies the surface of the ferrous metal container. Moreover, it appears that the effect cannot be directly attributed to chemical reduction because treatments of diethanolamine and triethanolamine with sodium hydride, lithium aluminum hydride or calcium hydride (materials with stronger and weaker reducing powers than the alkali borohydrides) were ineffective. Whatever the theory or phenomenon involved, I found that there was substantially little or no color formation in ethanolamines while they were stored in conventional ferrous containers.

The alkali metal borohydride which may be employed in the present invention includes sodium borohydride and potassium borohydride, preferably sodium borohydride because of its ready availability.

Procedurally the alkali metal borohydride is added to the ethanolamine while it is contained in or before it is introduced into the ferrous metal container and if desired either during or shortly after the addition, the system is slightly agitated in order to provide a thorough mixing of the components. The alkali metal borohydride may be employed in the form of a dry powder, as dry pellets, as an aqueous solution, or as aqueous alkaline solution. Although the alkali metal borohydride may be employed in solid form, i.e. as a dry powder or in pellet form, it takes somewhat longer to become distributed through the diethanolamine or triethanolamine than does aqueous solution of the inhibitor. Accordingly, it is preferred to employ the alkali metal borohydride as an aqueous solution because of the ease and simplicity of thoroughly mixing the alkali borohydride with the ethanolamine. An aqueous borohydride solution may be prepared by dissolving the solid alkali metal borohydride in water in an amount sufficient to cause a concentration of the alkali metal borohydride in water of about 20–25% by weight.

The amount of the alkali metal borohydride needed to effectively stabilize the ethanolamine is variable and depends upon the purity of the starting ethanolamine compound. Generally with commercial pure product satisfactory results are obtained by employing from about 0.001% to 0.05% by weight of the alkali metal borohydride and preferably from about 0.005% to 0.01%.

No particular control of temperature of the ethanolamine is required for the addition of the borohydride compound to it. For reasons of convenience and ease of mixing, it is preferred to effect the addition and mixing when the ethanolamine is at sufficiently high temperature to be relatively fluid, ordinarily 30° C. or higher. The ethanolamine in contact with steel drum containers at about 70° C. or higher exhibits a slight tendency to color even when ordinarily adopted quantities of the borohydride compound are put in. Hence, when mixing the inhibitor and ethanolamine in the drums, it is desirable to avoid temperatures above about 70° C. Easy, effective, and quick mixing are obtained when conducted at a temperature within the range of about 35° to 50° C. After treatment with the alkali metal borohydride, the ethanolamine is ready for shipment or for a long storage in ferrous metal containers.

Color of the inhibited ethanolamines before and after storage may be determined by the so called "citric acid test." This test is employed extensively by industry, and in this case is useful in determining any color formation in products resulting from treatment with ethanolamines. Generally, this is accomplished by measuring in APHA numbers, the generation of color of the ethanolamines when subjected to prolonged heating under acid conditions. The procedure normally involves adding about 50 ml. of distilled water containing about 6 grams of citric acid to about 30 grams of the ethanolamine sample in a 150 ml. round bottom flask fitted with a reflux condenser. The flask is thereafter heated and refluxed gently for about ½ hour. The solution is then cooled near room temperature and then placed in a Hellige Aqua Tester for color measurement in APHA numbers. The APHA number is determined by comparing the color of liquid in a test cylinder with the color of standard colored disks. The APHA number given to the liquid in the test cylinder is that of the standard disk which it matches. The following examples illustrate the present invention:

Example 1

Five hundred pounds of diethanolamine was added to each of three 55-gallon low carbon steel drums at 45° C. and atmospheric pressure. Samples were taken from each drum after loading and APHA and Citric Acid Colors were determined. The material in each drum had an APHA color of 5 and a Citric Acid Color of 10. The drums were numbered and treated as follows.

Drum 1 was sealed and put in storage. To drum 2 was added 11.3 grams $NaBH_4$, dissolved in 89.7 grams of distilled water. The mixture was agitated 15 minutes at 45° C. then sealed and put in storage. To drum 3 was added 22.7 grams $NaBH_4$, dissolved in 87.3 grams distilled water. Drum 3 was agitated 14 minutes at 45° C. then sealed and put in storage. The drums were stored together at 80–100° F. with all drums within 2° F. of the same temperature at all times.

The drums were sampled after periods of 0, 1, 2, 5, and 9 months. The table below shows the APHA and Citric Acid Test data obtained:

Drum No.	1					2					3				
Initial $NaBH_4$, Conc., wt. percent	0.00					0.005					0.010				
Length of Storage, Months	0	1	2	5	9	0	1	2	5	9	0	1	2	5	9
APHA Color	5	5	10	15	20	5	5	5	10	10	5	5	5	5	5
Citric Acid Color	10	15	20	30	45	10	10	10	15	20	10	10	10	10	10

Example 2

To three 55-gallon low carbon steel drums were added various amounts of commercial (98%) triethanolamine. Drum 1 was filled with 500 pounds at 45° C. sealed and stored. To drum 2 containing 300 pounds triethanolamine was added 13.6 grams $NaBH_4$ freshly dissolved in 45.6 grams of water. The drum was agitated for 15 minutes at 40° C. sealed and stored. To drum 3 containing 500 pounds triethanolamine, was added 45.5 $NaBH_4$ dissolved in 151.6 grams of water. Drum 3 was agitated at 50° C. for 15 minutes, sealed and stored along with drums 1 and 2. Storage temperature was 80–100° F.

The original APHA color of the starting material was 45 and the Citric Acid Color was 160. Throughout the storage, samples were withdrawn for evaluation. The table below shows the APHA and Citric Acid Color obtained:

Drum No.	1					2				3			
Initial $NaBH_4$, Conc., Wt. Percent	0.000					0.01				0.02			
Length of Storage, Months	0	.25	1	3	9	.25	1	3	9	.25	1	3	9
APHA Color	45	45	50	60	70	15+	20	20	25	20	20	20	20
Citric Acid Color	160	160	180	200	230	80	90	90	100	50	50	50	50

Although certain preferred embodiments of the invention have been disclosed for the purposes of illustration, it will be evident that various changes and modifications may be made therein without departing from the scope and spirit of the invention.

I claim:

1. A package comprising a ferrous metal container enclosing an ethanolamine having incorporated therein an alkali metal borohydride to prevent color formation resulting from contact of the metal container with the ethanolamine.

2. A package comprising a ferrous metal container enclosing an ethanolamine having incorporated therein an alkali metal borohydride in an amount of from about 0.001% to 0.05% by weight to prevent color formation resulting from contact of the metal container with the ethanolamine.

3. A package according to claim 1 wherein the alkali metal borohydride is sodium borohydride.

4. A package according to claim 1 wherein the alkali metal borohydride is potassium borohydride.

5. A package comprising a ferrous metal container enclosing an ethanolamine having incorporated sodium borohydride in an amount of from about 0.005% to 0.01% by weight to prevent color formation resulting from contact of the metal container with the ethanolamine.

6. A process for inhibiting color formation of ethanolamines in ferrous containers which comprises adding to said ethanolamines an alkali metal borohydride in an amount of from about 0.001% to 0.05% by weight at a temperature within a range of about 30° to 70° C.

7. A process as claimed in claim 6 where the alkali metal borohydride is sodium borohydride.

8. A process as claimed in claim 6 where the alkali metal borohydride is potassium borohydride.

9. A process for inhibiting color formation of ethanolamines in ferrous containers which comprises adding to said ethanolamines a sodium borohydride in the amount of from about 0.005% to 0.01% by weight at a temperature within a range of about 30° to 70° C.

10. A process for inhibiting color formation of ethanolamines in ferrous containers which comprises adding to said ethanolamines sodium borohydride in the amount of from about 0.005% to 0.01% by weight at a temperature within a range of 35° to 50° C.

No references cited.