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ALKALINE OXIDANT AND ALUMINUM METAL

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The present invention relates to apparatus and to chemicals, and particularly to apparatus the exposed material of which is chiefly aluminum metal or metal having the characteristics of aluminum as regards the solutions employed, and to chemical solutions containing alkalies which normally attack the metal and oxygen-releasing compounds which are capable of preventing the attack of the alkali on the metal. More particularly, the invention relates to the use of aluminum apparatus for alkaline hydrogen peroxide solutions such as are used in bleaching operations.

From one aspect of the invention, it may be considered as the provision of apparatus which is made of metal possessing the combined characteristics of strength and other structural properties, of cheapness, of durability, of resistance to the action of the solution to be associated with it, and of a non-injurious influence upon such solution.

From another aspect the invention may be considered as a method of safeguarding metal such as aluminum from attack by alkaline solutions.

The development of hydrogen peroxide and similar active agents capable of releasing oxygen as bleaching agents, has created new engineering problems, such as the provision of suitable apparatus for the preparation, storage, shipping and use of solutions containing them.

A suitable material for such apparatus must combine physical properties which permit ready construction of various forms, such as stills, kettles, vats, pipes, coils, conduits, etc., together with such economic features as cheapness and durability, and certain chemical properties. The latter must insure freedom from attack by the solution, and eliminate danger of injury to the solution by the nature of the metal. Since hydrogen peroxide is a rather unstable compound which readily releases oxygen, the material must have a minimum of influence upon the decomposition of the peroxide solution. Tin and lead do not have all the desired characteristics above suggested, but they have been used to a great extent as they have been found the most satisfactory. The particular disadvantages are the lack of structural qualities, the decomposing influence upon the solution, and the tendency to corrosion by the solution.

It is well known that aluminum and its alloys high in aluminum, or its alloys which retain the pertinent characteristics of aluminum are readily attacked by alkaline solutions. This is especially true of solutions of the alkali metal compounds, such as the sodium compounds, and their type. Even dilute solutions of strong and weak alkalies have this effect.

The present day use of hydrogen peroxide involves solutions weakly alkaline with sodium alkalies, such as caustic soda, sodium carbonate and sodium silicate. Owing to the proverbially well known effect of such alkalies on aluminum, the use of such metal for apparatus has been avoided in connection with alkaline hydrogen peroxide solutions. Aluminum, and its commercial alloys, possess the desirable characteristics of cheapness, strength and mechanical workability, as well as resistance to action by hydrogen peroxide solutions, and have also a minimum decomposing influence upon such solutions. But for its reactivity towards alkalies it appears that it is otherwise a very suitable metal for such apparatus.

We have discovered that the normal reactions of alkali on aluminum do not occur in the presence of hydrogen peroxide. Under oxidizing conditions aluminum readily tends to exhibit a protective skin effect, or film coating, perhaps in the nature of an oxide, which insulates the metal per se from the action of the solution. Such a film readily prevents attack of the metal by the alkali. The hydrogen peroxide present with the alkali provides the protective film or protective effect and also maintains it. By the term "maintaining", we infer that the mere formation of the protective effect is not sufficient to prevent action between the alkali and the metal, because the effect appears to be the result of an unstable condition which is maintained by the continued presence of hydrogen peroxide. If the hydrogen per-

oxide content of the alkaline solution in the aluminum apparatus is reduced to an ineffectual minimum, the protective action ceases. It seems that a sufficient peroxide content is necessary to act as a force which maintains the protective film or effect.

Accordingly, therefore, from one aspect of the invention the combination of hydrogen peroxide and aluminum, or its similarly acting alloys, is an advantageous one in the presence of alkali, in that the peroxide prevents reaction between the aluminum and the alkali.

The alkalies which are now used in connection with hydrogen peroxide are customarily dilute solutions of silicate of soda, caustic soda, sodium carbonate, ammonia, ammonium carbonate, etc. The strength of hydrogen peroxide may vary over a considerable range, but the invention contemplates that an effectual concentration is maintained in keeping with the type and strength of the alkali solution employed, and in keeping with the particular prevailing conditions which may influence the tendency of the aluminum and the alkali to react.

Within this view of the invention its application to the preparation, the shipping and the storing and using of oxidants may be considered. In preparing hydrogen peroxide, the invention is especially useful in permitting aluminum to be employed in each instance where an alkali is present. The absence of an alkali at any stage will not at all affect the use of aluminum, for there is no disadvantageous result from the association of aluminum and hydrogen peroxide in the absence of alkali. It is the absence of hydrogen peroxide in the presence of aluminum and alkali that brings forth the undesirable conditions remedied by the addition of hydrogen peroxide. In shipping or storing oxidants, as an alkaline solution, the invention provides for the successful use of aluminum for tanks, drums, tank cars, etc., thus to take advantage of the physical properties of the aluminum for economic and structural reasons, and the chemical properties for the preservation of both the apparatus and the solution. In using alkaline oxidizing solutions, as in commercial bleaching operations, aluminum apparatus in the form of tanks, coils, agitators, pipes, conduits, troughs, etc., is permitted without endangering the apparatus and without danger of bringing into solution metal from the apparatus which may effect or contaminate the material being bleached.

From another aspect of the invention, the maintainance of a hydrogen peroxide content, as a potential source of releasable oxygen, in an alkaline solution will permit the association of aluminum or like metal with the alkali. Such a modification of a solution which ordinarily attacks the metal so that an attack is prevented, may be desirable in many instances.

As an example to show the practical use of the invention the bleaching process for cotton may be cited. A solution commonly employed contains hydrogen peroxide, and caustic soda. Bleaching of cotton may be effected with such a solution in aluminum apparatus at 150° to 212° F. without action of the alkali on the aluminum. A scale or coat, visible in character is formed on the aluminum apparatus which is an effective insulation of the underlying metal from the solution. After bleaching the waste liquor, still weakly bleaching in character and still alkaline, may be stored in the vessel without change of the skin protection while oxygen is available.

We claim:

1. The method of preventing a dilute corrosive alkaline solution from attacking the aluminum content of a metal subjected to corrosive action of said solution, which comprises maintaining in the alkaline solution in contact with said metal a protective concentration of hydrogen peroxide.

2. The method of preventing a corrosive dilute alkaline sodium compound solution from attacking the aluminum content of a metal subjected to the corrosive action of said solution, which comprises maintaining in the alkaline sodium compound solution in contact with said metal a protective concentration of hydrogen peroxide.

3. The method of preventing a corrosive dilute caustic soda solution from attacking the aluminum content of a metal subjected to the corrosive action of said solution, which comprises maintaining in the dilute caustic soda solution in contact with said metal a protective concentration of hydrogen peroxide.

4. The method of alkaline bleaching in apparatus which is essentially aluminum in composition, which comprises subjecting material to be bleached in a vessel which is essentially aluminum in composition to the bleaching action of hydrogen peroxide in a dilute alkaline sodium compound solution, and maintaining said alkaline solution at all times with a protective concentration of hydrogen peroxide.

In testimony whereof we have hereunto affixed our signatures.

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