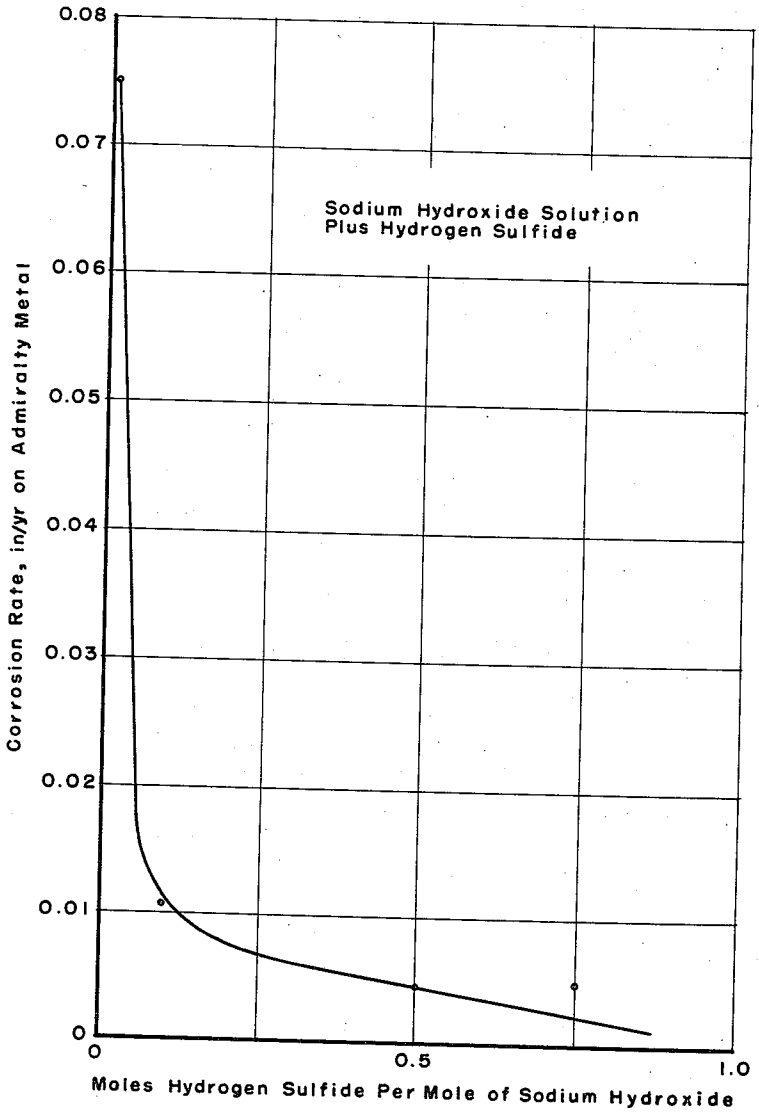
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SUPPRESSION OF CORROSION

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SUPPRESSION OF CORROSION

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The present invention is directed to a method for suppressing the corrosion of a surface comprising a major portion of metallic copper which is exposed to a fluid comprising an alkaline compound in corrosion-producing amounts.

In many commercial operations involving the processing of fluid components, the fluid becomes contaminated by acid which causes the relatively rapid corrosion of parts, constructed, for example, of steel, used in fabricating a relatively large portion of the equipment used. It is desirable to add an alkaline reagent to the fluid being passed through the apparatus in order to reduce the acidity of the fluid and render it less corrosive to these parts. However, the equipment employed in handling the fluid is usually not manufactured of a single metal or metallic alloy but instead includes several dissimilar metals. For example, while the walls of vessels and the piping connecting vessels may be constructed of steel, it is common to employ copper or copper alloys in conjunction therewith; in heat exchangers and condensers the shells may be of steel and the tubes of copper or a copper-bearing alloy such as Admiralty metals. While the addition of an alkaline agent to the acid-containing fluid being processed may reduce or eliminate the corrosion of that part of the apparatus constructed of ferrous materials, the contact of the alkaline reagent with the copper or copper-bearing alloys may cause corrosion of these parts at a relatively rapid rate.

It is an object of the present invention to suppress the corrosion of a surface comprising a major portion of metallic copper which is contacted with a fluid in which an alkaline compound is present in corrosion-producing amounts.

In accordance with the present invention the corrosion of a surface comprising a major portion of metallic copper when brought into contact with an aqueous solution including an alkaline reagent in corrosion-producing amounts is suppressed by the addition to the solution of an acidic sulfur-containing compound. For the most satisfactory results in suppressing the corrosion, the acidic sulfur-containing compound should be added in an amount in excess of a predetermined minimum. The predetermined minimum amount of acidic sulfur-containing compound may be expressed either in terms of the molar ratio of acid reacting sulfur compounds to alkaline reagents in the solution or in terms of the ratio of the phenolphthalein end point to the methyl orange end point. When expressing the amount of acidic sulfur-containing compound in the alkaline fluid in terms of molar ratio, it may be stated that for the most satisfactory results it is desirable for the solution to have added to it no less than 0.1 mole of acidic sulfur-containing compound for every mole of alkaline reagent present in the solution. When expressing the amount of acidic sulfur-containing compound added to the alkaline solution in terms of phenolphthalein end point and methyl orange end point, it may be stated that upon the titration of a given amount of the solution with a standardized acid solution employing phenolphthalein as the indicator and carrying out the titration under the same conditions but employing methyl orange as the indicator, the ratio of twice the amount of standardized acid solution employed using phenolphthalein to the amount of standardized acid solution employed when using methyl orange as the indicator should be no less than 1.8. As specific examples of acidic sulfur-containing compounds suitable for use as the inhibiting agent in the practice of the present invention may be mentioned hydrogen sulfide, sulfur dioxide and mercaptans, such as ethyl, propyl and butyl mercaptans. It will be understood that these specific compounds are given by way of example only and for the purpose of illustrating generally the class of acidic sulfur-containing compounds to be used in the present invention.

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The practice of the present invention will now be described in further detail by the following example:

EXAMPLE

A 4° Bé. aqueous sodium hydroxide solution was divided into five equal portions. One portion was retained in its original state and hydrogen sulfide was added to the remaining portion such that the molar ratio of H_2S to NaOH was 0.098, 0.5, 0.6 and 0.77 in the respective samples. The corrosion rate of Admiralty metal in each of the samples was then determined in accordance with usual laboratory methods for determining rate of corrosion. The characteristics of the samples, both as to the molar ratio of H_2S and NaOH and the ratio of twice the phenolphthalein end point to the methyl orange end point as well as the corrosion rate are given in the following table:

Table

Corrosion Rate in./yr. Penetration Admiralty Metal	0.075	0.011	0.004	0.002	0.004
2 × (Phenolphthalein end point) Methyl Orange End Point	2.0	1.795	1.0	0.805	0.42
pH	11.8	11.8	11.8	-------	11.7
Moles H_2S Absorbed in Each Mole of NaOH	0	0.098	0.5	0.6	0.77

It will be seen from the above table that when the acidic sulfur-containing compound is added to the solution containing an alkaline reagent in such amounts as to adjust the molar ratio of the acidic sulfur-containing compound to the alkaline agent within the range of 0.1 to 1, the corrosion rate of the solution is markedly diminished. When the amount of acidic-sulfur containing compound in the alkaline solution is expressed in ratio of twice the phenolphthalein end point to methyl orange end point it will be seen that when the ratio is 1.8 or less the rate of corrosion is greatly reduced over the rate of corrosion of the original alkaline solution.

The results obtained in the example are shown in the drawing which is in the form of a curve in which the corrosion rate of the Admiralty metal is plotted as the abscissa and the ratio of moles of hydrogen sulfide per mole of sodium hydroxide is plotted as the ordinate. The tests carried out on the samples as set out in the table are shown on the drawing as small circles which appear on or adjacent the curve.

Having fully described and illustrated the practice of the present invention, what is desired to be claimed as new and useful and secured by Letters Patent is:

1. A method of inhibiting the corrosiveness of a corrosive solution consisting of an alkali metal hydroxide and water in contact with a corrodible copper surface which consists in the step of maintaining in said corrosive solution while in contact with said corrodible copper surface an amount of combined hydrogen sulfide in an amount at least 0.1 mole per mole of alkali metal hydroxide and less than required to neutralize all the alkali metal hydroxide.

2. A method in accordance with claim 1 in which the alkali metal hydroxide is sodium hydroxide.

3. A method of inhibiting the corrosiveness of a corrosive solution consisting of sodium hydroxide and water having a gravity of 4 degrees Baumé in contact with a corrodible copper surface which consists in the step of maintaining in said corrosive solution while in contact with said corrodible copper surface an amount of combined hydrogen sulfide in an amount at least 0.1 mole per mole of sodium hydroxide and less than required to neutralize all the sodium hydroxide.

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