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PREVENTION OF FOAMING IN STEAM GENERATION

Paul G. Bird and Arthur L. Jacoby, Western Springs, Ill., assignors to National Aluminate Corporation, Chicago, Ill., a corporation of Delaware

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The present invention relates to antifoaming compositions which are used in steam boilers and similar steam generators, evaporators, etc., to overcome the tendency of the water therein to foam and hence to bring about the priming of the steam generator or the like.

One of the objects of the present invention relates to a liquid suitable for the generation of steam in steam generators and comprising water containing very small quantities of particular kinds of substituted-amino-N-substituted alkanamides, whereby, when such water is heated to the boiling point in a steam boiler or other generator, being thereby evaporated, the concentration of solids therein will not bring about excessive foaming and the resulting priming, these compounds being substantially nonvolatile with the steam, and stable, so that they will be retained by the water and neither they nor their decomposition products will appear in the steam and the resulting condensation thereof.

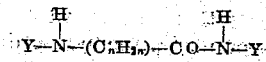
It is well known in the operation of steam boilers, such as in electric power plants, railroad locomotives and the like, or in evaporators, that the water therein, even though initially it shows very little tendency to foam, will, when the amount of total solids therein approaches a relatively high concentration, develop a very decided tendency to foam. When this occurs, considerable quantities of water are physically carried out of the boilers or evaporators with the steam, thus appearing in the steam lines and in the eventual condensate. Such priming has many disadvantages because it tends to contaminate the steam lines, to plug or corrode the valves, and under serious conditions may even impair the cylinders and piston rods of the steam engines, or the impeller blades of turbines in which the steam is used for the generation of power. Attempts have been made in the past to control this foaming by excessive blowdown of the boilers or by the injection thereinto of such materials as castor oil, tallow, and the like. While these fatty materials have some small degree of efficiency, they are, on the other hand, quite deficient in that they introduce new difficulties which, in some instances, are worse than the conditions they are intended to cure. In the first place, these fatty acids or glycerides are unstable under the conditions existing in the boilers, particularly as the pressure and temperatures increase, the high temperatures leading to rapid decomposition of the glycerides, which, if anything, will tend to increase the foaming and priming difficulties. Furthermore,

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in many instances certain of the decomposition products thus produced, or sometimes even the materials themselves, have a definite volatility with steam and will, therefore, steam-distil out of the boilers, thus appearing in the steam and in the condensate. This, of course, is also very undesirable. Furthermore, such types of antifoaming agents usually have to be employed in relatively large quantities, adding not only to the expense but also to the inconvenience of operating the steam generators; and those which have a tendency to decompose do so quite rapidly, and hence their effectiveness is of short duration, which therefore necessitates the continual charging into the boilers or other steam generators of relatively large amounts of these older antifoaming agents. Moreover, such antifoaming agents are difficult to use because the amounts in which they are efficacious are very critical, and any overdosage usually aggravates the difficulty instead of curing it.

Applicants have now discovered, however, that there is a series of compounds, which may be designated as substituted-amino-N-substituted alkanamides, which are of a high order of efficiency when used as an antifoaming and antipriming agent in steam generators.

These materials may be represented by the general formula:



wherein the substituent Y is a radical derived from a member of the group consisting of monoacylhydrazines, monoacylalkylenediamines, monoacylpiperazines, and partially acylated polyalkylenepolyamines; and n is a small whole number. They are most readily prepared by the interaction of about one mol of a halogen-acid, or the corresponding acid halide, with about two mols of a member of the group consisting of the above-mentioned acylated polyamines. By this reaction, a coupling is effected, bringing together the two mols of acylated polyamine with the residue of the halogen-acid between them.

The compounds of this invention have been observed to be most efficient as antifoam agents if the acyl groups of the acylated polyamines are fatty in nature and contain at least about 12 carbon atoms, and the efficiency appears to be increased with increasing molecular size of the finished derivative. It is to be understood that the formulas recited in the specification and claims are "probable" in that the formulas given are believed to be possessed by the compounds

disclosed, or whose method of preparation is disclosed, in the specification.

The examples given below are intended to illustrate satisfactory procedures for the preparation of some of the materials of this invention, but are not intended to limit the invention in any way.

Example 1.—Five-hundredths mol (15.7 g.) of monostearylhydrazine was condensed with 2.825 grams (0.025 mol) of chloroacetyl chloride at 150–160° C. by adding the acid chloride to the stirred hydrozide over a 15 minute period and continuing to stir for 1.5 hours.

Example 2.—Monostearylethylenediamine was prepared by mixing 13.4 grams of commercial stearic acid (having a mean molecular weight of 269) and 4.4 grams of a 68.3% aqueous solution of ethylenediamine and stirring 2.5 hours at 150–160° C. Then 1.9 cc. of chloroacetyl chloride was added dropwise and the stirring and heating continued 2 hours longer.

Example 3.—Monolauryltriethylenetetramine was prepared by stirring at 150–160° C. a mixture of 10 grams of lauric acid and 7.3 grams of triethylenetetramine for 2.5 hours. Then 1.9 cc. of chloroacetyl chloride was added dropwise and the stirring and heating continued 2 hours longer.

Example 4.—Monopalmitylpiperazine was prepared by mixing 12.8 grams of palmitic acid and 9.7 grams of piperazine hexahydrate. The mixture was then carefully heated with stirring to expel water without excessive frothing, and finally stirred at 150–160° C. for 2.5 hours. Then 1.9 cc. of chloroacetyl chloride was added dropwise and stirring and heating continued two hours longer.

Example 5.—Monopalmityl - p - phenylenediamine was prepared by melting 5.4 grams of the diamine at about 160° C. and adding 13.7 grams of palmityl chloride, dropwise with stirring, while gradually increasing the temperature to 225° C. Stirring was continued about 30 minutes while the temperature was allowed to drop to 175° C. Then 1.9 cc. of chloroacetyl chloride was added dropwise and the mixture stirred at 200–220° C. for 2 hours.

Example 6.—Monopalmitylhydrazine (0.048 mol) was stirred at 150–160° C. while 2.5 grams of beta-chlorobutyric acid was added. Stirring and heating was then continued 3 hours longer.

These compounds, while not ordinarily considered as soluble in water to any great extent, may be suitably dispersed in water or emulsified therewith, so that effective amounts thereof may be introduced and be present in the water within the steam generator under operating conditions. The emulsifying or dispersing agent used must, however, be of a kind that does not cause foaming, either by itself or by its decomposition products. The compounds may be used conjointly with each other as well as with other known antifoaming agents, such as, for example, castor oil.

The amounts of the above described materials which are required are extremely small, and in general one grain per gallon is ample. For many purposes, however, amounts of as little as 1/100 grain per gallon in the feed water will still give valuable results, and the amounts may be even further reduced. Depending of course upon the degree of concentration of solids, the dosage may be varied, but one grain per gallon is about as much as would ever have to be used even under serious conditions, and for many purposes 1/100 grain per gallon and even less can be used. The process is particularly effective at pressures of about 250 pounds per square inch.

The introduction of the antifoaming compounds of the present invention into the boiler may be accomplished in a number of ways. Thus, the antifoaming compositions may be dispersed or physically mixed with, say, sodium carbonate or some other material used for treating the boiler water and pumped with the feed water into the boiler by means of either an injector or a feed water pump. The compounds may also be dissolved in suitable organic water-miscible solvents such as alcohols, ethers, ketones, etc., and introduced in small measured amounts into the feed water entering the boiler. Suitable mechanical measuring devices which will periodically or continuously inject the required dosage of the antifoaming compounds into the feed water may be used, so that the introduction will be more or less in proportion to the steam consumption to which the steam generator is subjected. Another manner of introducing the antifoaming compounds is to form an emulsion thereof in water and then feed said emulsion either directly into the boiler or the feed water lines leading to it. The invention therefore is not to be limited by the manner of introduction of the antifoaming composition but rather is to be construed in the terms of the hereunto appended claims.

We claim:

1. A method of generating steam which comprises boiling, under superatmospheric pressure conditions, water containing an amount of total dissolved solids tending to produce foaming and priming, and a quantity of the condensation product of two mols of an acylated polyamine from the group consisting of monoacylhydrazines and monoacylated monoethylene and polyethylene polyamines, the acyl groups of said acylated polyamines containing at least about 12 carbon atoms, and one mol of a member from the group consisting of chloro lower fatty acids and the corresponding acid chlorides, said quantity being sufficient to substantially inhibit foaming and priming.

2. A liquid for the generation of steam, substantially devoid of foaming and priming tendencies when heated to the boiling point, comprising water containing an amount of total dissolved solids tending to produce foaming and priming and having dispersed therein a quantity of a condensation product of two mols of an acylated polyamine from the group consisting of monoacylhydrazines and monoacylated monoethylene and polyethylene polyamines, the acyl group of said acylated polyamines containing at least about 12 carbon atoms, and one mol of a member from the group consisting of chloro lower fatty acids and the corresponding acid chlorides, said quantity being sufficient to substantially inhibit foaming and priming.

3. A method of generating steam which comprises boiling, under superatmospheric pressure conditions, water containing an amount of total dissolved solids tending to produce foaming and priming and a quantity of the condensation product of 2 mols of monostearyl hydrazine and 1 mol of chloracetyl chloride, said quantity being sufficient to substantially inhibit said foaming and priming.

4. A method of generating steam which comprises boiling, under superatmospheric pressure conditions, water containing an amount of total dissolved solids tending to produce foaming and

priming and a quantity of the condensation product of 2 mols of monolauryl triethylenetetramine and 1 mol of chloracetyl chloride, said quantity being sufficient to substantially inhibit said foaming and priming.

5. A method of generating steam which comprises boiling, under superatmospheric pressure conditions, water containing an amount of total dissolved solids tending to produce foaming and priming and a quantity of the condensation product of 2 mols of monopalmityl piperazine and 1 mol of chloracetyl chloride, said quantity being sufficient to substantially inhibit said foaming and priming.

6. A liquid for the generation of steam, substantially devoid of foaming and priming tendencies when heated to the boiling point, comprising water containing an amount of total dissolved

solids tending to produce foaming and priming and having dispersed therein a quantity of the condensation product of 2 mols of monostearyl hydrazine and 1 mol of chloracetyl chloride, said quantity being sufficient to substantially inhibit foaming and priming.

PAUL G. BIRD.
ARTHUR L. JACOBY.

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