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LAUNDRY SOURING COMPOSITION

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EFFECT OF MAGNESIUM SILICOFLUORIDE CONTENT
ON BURSTING STRENGTH OF FABRIC

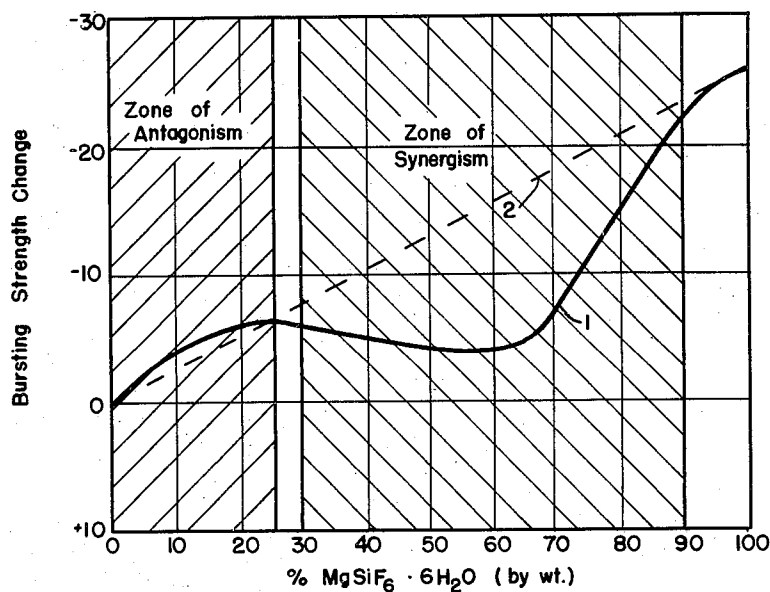


Fig. 1

NEUTRALIZATION CAPACITY OF AMMONIUM AND
MAGNESIUM SILICOFLUORIDE COMPOSITIONS

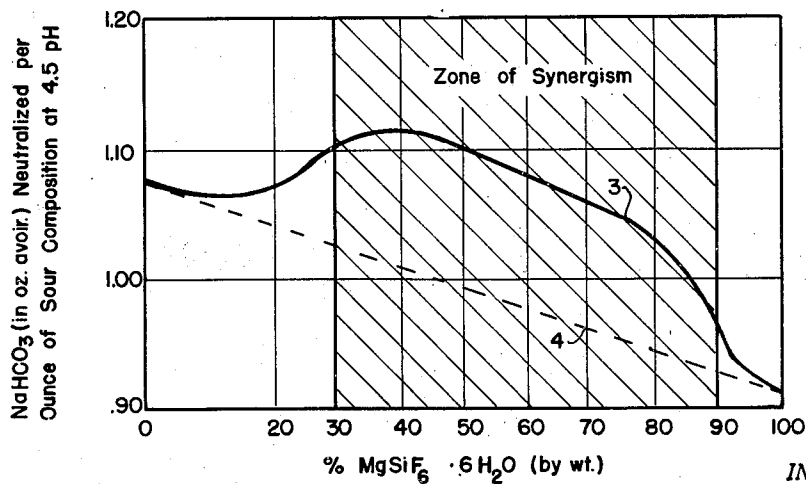


Fig. 2

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LAUNDRY SOURING COMPOSITION

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The present invention relates to acidic compositions particularly useful in commercial laundry operations for neutralizing the residual alkalinity of fabrics and of rinsing waters following an alkaline rinsing operation. Such acidic compositions are accordingly more commonly known as "laundry sourers."

Considerable attention has heretofore been given to the problem of formulating such laundry souring compositions. The essential objectives of this problem have been to produce a composition which has a good alkalinity neutralizing power, good storage properties, and lack of depreciation of the bursting strength of textile fabrics. Prior efforts to solve this problem have run the gamut from simple inorganic and organic acids, such as sulfuric-, oxalic-, and citric acids, through complex acidic salts. The alkali metal and ammonium salts of fluosilicic acid (alternatively called "silicofluorides") have been used in laundry souring compositions (see British Patent No. 449,257).

We have discovered that an excellent laundry souring composition, achieving the above outlined objectives, can be formulated from ammonium silicofluoride and magnesium silicofluoride, present in critical proportions. Our discovery is of an unexpected nature in that magnesium silicofluoride alone produces a substantial weakening or bursting strength loss upon textile fabrics; and even when employed in combination with ammonium silicofluoride, in proportions less than 30% by weight, the resultant fabric strength depreciation is even greater than the proportionate, mathematical sum of that achieved by the individual silicofluorides; whereas, in the critical proportion of 30-90% by weight of magnesium silicofluoride (calculated on the basis of the hexahydrate $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$) the bursting strength depreciation is less than the proportionate mathematical sum of that of each of the two ingredients. In other words, the subject matter of the instant invention is unusual and unpredictable in that in the case of a mixture of the two silicofluorides of less than 30% magnesium silicofluoride content, the bursting strength loss characteristic is "antagonistic," but in the case of a 30-90% proportion of magnesium silicofluoride, it is "synergistic."

The composition of our invention possesses excellent storage properties, such as freedom from caking and maintenance of a granular, free flowing physical characteristic. When it is considered that mixtures of other silicofluorides such as ammonium and sodium silicofluorides become

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caked and hardened on storage, the attainment of this physical property is also unusual.

A further advantage of the composition of our invention is that it possesses an unusually high water solubility, rendering it further desirable as a laundry souring composition.

To the accomplishment of the foregoing and related ends and to enable any person skilled in the art readily to understand and practice the invention, the following full and concise description and annexed drawing set forth the best mode in which we have contemplated applying the principle thereof.

In the annexed drawing

Fig. 1 is a chart showing the relationship between the effect on the bursting strength of textile fabrics (denoted "bursting strength change") and the percentage proportion by weight of hydrated magnesium silicofluoride; and

Fig. 2 is a chart showing the neutralization capacity of ammonium and magnesium silicofluoride compositions in which the proportion of the two silicofluoride ingredients is varied over a range of 0 to 100%.

The compositions consisting of the two ingredients, ammonium silicofluoride and hydrated magnesium silicofluoride ($\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$), were made up in varying proportions over a range of 0 to 100% for each ingredient and at 10% increments. Such formulations were then subjected to the following test:

For each test five 8 x 10 inch swatches of "Pequot" sheeting were placed in a one-gallon, miniature wash-wheel having a circumference of 19 3/4 inches, along with one liter of 0.1% by weight concentration bath solution of the sour composition being tested. The wash-wheel was then rotated for 10 minutes on the rollers of a jar mill at 83 R. P. M. The five test pieces were quickly removed and passed, one at a time, through a wringer set for cotton. After this, each was ironed 10 times with a roller-type ironer (manufactured under the trade name "Ironrite") at a temperature of 328-338° F. The entire cycle was then repeated four more times using freshly prepared sour solution each time. At the completion of the 5-cycle treatment just described, each test group was wetted with distilled water and hung up in a constant humidity room to be conditioned for 24 hours at 70° F. and 65% relative humidity. At the end of this period the bursting strength of each swatch was evaluated 10 times by means of the "Mullen" tester, the average of the 50 determinations for the entire group being taken as the final value.

Fabric strength change was obtained by comparing each of these values with that obtained from a control test in which no sour was employed.

Two duplicate runs of the above-described test were made and the results thereof are shown in the solid line curve 1 of Fig. 1. The dash line 2 represents the bursting strength change that would normally be expected from the mathematical proportion of the two ingredients. It will be noted that in compositions having up to about 27% $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$ that curve 1 rises above line 2 and that accordingly the bursting strength change is greater than that which would normally be expected. Hence this portion of the diagram has been marked the "zone of antagonism." However, above 30% $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$ content, the curve 1 undergoes a change in slope, from positive to negative, or drops below the line 2, thus illustrating the manner in which mixtures of the two ingredients having above 30% by weight of $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$ result in less than the bursting strength change which would be mathematically calculated according to the relative proportions of the ingredients present. It will be seen that at about 90% $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$ content that the curve 1 approaches the line 2. This marks the upper limit of the "zone of synergism" as denoted on the Fig. 1 diagram.

Although the effect of the ammonium-magnesium silicofluoride mixtures on the strength of textile fabric, as indicated by the results charted in Fig. 1, show that the broader range content of $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$ is 30-90% by weight, the preferred range is 50-70% by weight of such ingredient.

A laundry sour composition consisting of 40% anhydrous ammonium silicofluoride and 60% of hydrated magnesium silicofluoride represents a specific example and an unusually excellent formulation for a composition embodying our invention.

Fig. 2 represents the results of neutralization capacity tests performed upon ammonium-magnesium silicofluoride mixtures of varying proportions of ingredients. Such neutralization capacity tests were conducted as follows:

Freshly prepared sodium hydroxide standard solution of approximately 0.02 molar concentration was added with stirring in successive small volume increments to a 50 ml. sample of a 0.05% aqueous solution of each formulation. The temperature was maintained constant at 25° C. and the hydrogen ion concentration or pH was determined after each addition of standard NaOH solution, by means of a "Leeds and Northrup Potentiometer-Electrometer" equipped with a sodium glass-saturated calomel electrode system. When a pH reading of 4.5 was recorded, the amount of standard NaOH solution used was measured. This reading was converted by mathematical calculation, into equivalent ounces of NaHCO_3 neutralized per ounce of silicofluoride composition. The results of such tests are shown in Fig. 2 where the solid line curve 3 represents the actual neutralization capacity values obtained and the dash line 4 illustrates the theoretically or mathematically calculated values that would normally be expected according to the proportions of ingredients present. It will thus be seen that the characteristics of curve 3 confirm the synergistic nature of the compositions of our invention, as previously observed in connection

with Fig. 1. In other words, from a 30-90% by weight range content of $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$, the alkaline neutralization capacity of the compositions are substantially greater and improved, but above and beyond these range limits, such neutralization capacities tend to conform with the theoretically or mathematically calculated values.

The water solubility of the compositions of our invention is such as to highly commend them for use as a laundry sour, where the operator is highly desirous of causing the solid souring composition to enter into solution with as little difficulty as possible. A formulation of 40% $(\text{NH}_4)_2\text{SiF}_6$ and 60% $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$ is soluble to the extent of 31%, or 60 ounces per gallon of water, at a temperature of 77° F. For purposes of comparison, where 10% of sodium silicofluoride is substituted for the same proportion of ammonium silicofluoride in the last given formulation, the solubility drops to 3%.

In actual field testing of the 40% $(\text{NH}_4)_2\text{SiF}_6$, 60% $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$ composition of our invention in commercial laundries, the foregoing test results were confirmed as to the lack of fabric strength depreciation and alkali neutralization; in addition the iron stain removal capacity of the composition (another desirable objective) was found to be satisfactory.

Although the foregoing description has primarily referred to the magnesium silicofluoride ingredient in its hydrated form, since that is the form in which it is the most usually commercially available, it will be apparent to those skilled in the art that anhydrous magnesium silicofluoride can equally well be used in our compositions. In the latter case the mathematical value of the critical range content of anhydrous magnesium silicofluoride may be readily and simply calculated.

Other modes of applying the principle of our invention in addition to that hereinabove described and illustrated in detail may be employed, provided the combination of ingredients recited in any of the following claims or the equivalent of such ingredients be employed.

We, therefore, particularly point out and distinctly claim as our invention:

1. A laundry souring composition consisting essentially of 10-70% by weight ammonium silicofluoride and 30-90% magnesium silicofluoride, the amount of the latter ingredient being calculated on the basis of $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$.

2. A laundry souring composition consisting essentially of 30-50% by weight ammonium silicofluoride and 50-70% of magnesium silicofluoride hexahydrate.

3. A laundry souring composition consisting essentially of 40% by weight ammonium silicofluoride and 60% of magnesium silicofluoride hexahydrate.

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The following references are of record in the file of this patent:

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