Preparation and Application of Sodium Percarbonate as Bleaching Agent for Cotton Fabric

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A new method has been developed for the preparation of sodium percarbonate for use as a bleaching agent for coloured and white textiles. The maximum stabilization of sodium percarbonate is obtained with 2.2% crystalline magnesium sulphate and 1.2% sodium silicate.

Sodium percarbonate is an important bleaching agent for coloured and white textiles. Methods of preparation and the conditions for getting maximum bleaching efficiency with this compound are covered by patents which do not give full information about its preparation and application conditions. In the present paper, a new method for preparing sodium percarbonate and the conditions for its application as a bleaching agent for cotton fabrics have been described.

Experimental Procedure
Preparation of sodium percarbonate—Sodium percarbonate was prepared by mixing sodium carbonate (10 g) and sodium silicate (0.175 g) in 17.5 ml bidistilled water. To the cold mixture, 20 ml hydrogen peroxide (30% wt/vol) containing 0.325 g magnesium sulphate heptahydrate was added and the slurry of sodium percarbonate formed was dried in an oven at 60-65°C for 20 min.

Evaluation—Copper number, fluidity and wettability of cotton fabric were determined by the standard methods. The percentage of hydrogen peroxide stabilized in sodium percarbonate at room temperature as well as after boiling for 2 hr was determined by the potassium permanganate method.

The degree of whiteness was measured using a Hunterlab reflectometer (Model D 40).

Bleaching process—A bleaching solution of pH 10.7-10.9 was prepared by dissolving sodium percarbonate (1-6 g/litre) in the required amount of water. The cotton fabric specimen was placed in the bleaching solution for 1.5 hr at 95°C. The specimen was then removed from the bleaching solution, rinsed with water, squeezed and finally dried at 60°C.

Results and Discussion
The main parameters which can affect the stabilization of hydrogen peroxide in sodium percarbonate are: (1) type and amount of stabilizer, (2) amount of water, and (3) amount of sodium percarbonate. While studying the effect of both the type and amount of stabilizer, all other parameters were kept constant. It was found that increase in the quantity of sodium silicate or magnesium sulphate used up to 0.14 and 0.12 g respectively increases the amount of hydrogen peroxide which reacts with 10 g sodium carbonate. Further increase in the quantity of sodium silicate has no effect, while increase in the quantity of magnesium sulphate decreases the amount of combined hydrogen peroxide. Better results were obtained by using a mixture of 0.325 g magnesium sulphate and 0.175 g sodium silicate (Fig. 1). Sodium percarbonate is an important bleaching agent for coloured and white textiles. The maximum stabilization of sodium percarbonate is obtained with 2.2% crystalline magnesium sulphate and 1.2% sodium silicate.

"K..."X.....:. X

B

A

r--

0

ADEGREE OF WHITENESS

X

B

AVERAGE WETTABILITY

C

Fluidity

D

COPPER NUMBER

E

H2O2 STABILIZED

80-0.016 70-0.04 60-0.02 50-0.02 40-0.08 30-0.04 20-0.01 10-0.02
0-0.00 0

80-80 70-70 60-60 50-50 40-40 30-30 20-20 10-10 0-0

TEMPERATURE, °C

Fig. 1—Effect of temperature on fabric properties

Fig. 2—Effect of temperature on fabric properties

Fig. 3—Effect of concentration of sodium percarbonate on fabric characteristics

Effect of water—Only a small amount of bidistilled water should be used in the preparation of sodium percarbonate. Excess water accelerates the decomposition of hydrogen peroxide. If the amount of water is less than that required, a part of sodium carbonate remains suspended without reacting with hydrogen peroxide. The maximum stabilization is obtained by using 17.5 ml bidistilled water.

Effect of sodium carbonate—The optimum ratio of the quantities of hydrogen peroxide and sodium carbonate is 5:11; about 4.7 g hydrogen peroxide reacts with 10 g sodium carbonate. The optimum quantity of sodium carbonate is 10 g.

Bleaching of cotton fabric with sodium percarbonate—Sodium percarbonate which contains 65.8% sodium carbonate, 30.8% stabilized hydrogen peroxide, 1.16% crystalline magnesium sulphate and 1.1% sodium silicate can be used as a bleaching agent. The main parameters which govern the bleaching process, such as temperature, period of bleaching and the concentration of sodium percarbonate, have also been studied.

The effect of temperature on the characteristics of the bleached cotton fabric is shown in Fig. 2. The degree of whiteness improves and reaches its maximum value of 86.5 (in comparison to 62.5 for grey fabric) at 100°C without any change in fluidity and copper number. This means that the oxygen released from sodium percarbonate destroys the coloured matters in the fabric without scission of the cellulosic chains. The rate of decomposition of hydrogen peroxide increases with increase in temperature and it reaches its maximum value at 90°C. The wettability of the fabric also improves.

Both the fluidity and copper number remain unaffected after bleaching for 2 hr. However, the increase in bleaching period in alkaline medium at 95°C causes partial hydrolysis of the cellulosic chains. Also, the degree of whiteness improves and it is not dependent on the bleaching period.

The relationships between copper number \(N_{Cu}\), fluidity \(F\) and the concentration of sodium percarbonate \(C_{pc}\) are shown in Fig. 3 and can be expressed as follows:

\[ N_{Cu} = m C_{pc} + K \]
\[ F = m C_{pc} + K \]

The values of \(m\), \(m\), \(K\) and \(K\) are found to be 0.19, 0.76, 0.003 and 2.1 respectively. This illustrates that both copper number and fluidity increase with increase in the concentration of sodium percarbonate. The degree of whiteness and wettability improve with increase in sodium percarbonate concentration. It follows that in contrast to the conventional bleaching agents, sodium percarbonate is relatively stable during storage at room temperature up to 5 months in an open vessel. However, the content of hydrogen peroxide decreases from 30.8 to 26.0%.

References

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