



has none of the defects of the older ones just mentioned, either in its application or in its after effects on the materials treated. Nothing is used to do the actual work but oxygen, a gas, which combines with the coloring matter of the fibre to form inert products of oxidization, water and carbonic acid gas, the action being exactly the same as if we burned off a coat of varnish from an iron rod by heating it in the air. The bleaching of the fibre by peroxide of sodium is actually a similar process, in which the coloring matter is "burned off" the cotton, wool or silk, leaving the fibre itself intact, the only difference being that one is rapid combustion and is accompanied by heat and the other is a slow combustion, the heat of which is taken up by the water of the bleaching bath. Neither are there any products of this process left in the fibre that can harm it by later action or combination, the only substance formed in the bleaching bath being an inert salt (or salts) of sodium, dependent on the acid used with the bath, which is readily soluble in water and can therefore be easily and completely washed out.

These points will be brought out clearly if we consider the methods of using peroxide of sodium as a bleach and of making the bleaching solution. The practical application of peroxide of sodium as a bleach is based on its property of being decomposed on contact with water into caustic soda and peroxide of hydrogen, the latter, in the presence of easily oxidized organic matter, gives up oxygen to it and itself is decomposed into water and oxygen. The oxygen is given off in a "nascent" state, *i. e.*, newly formed, and in this condition has a much more powerful chemical action than when it is in the form of a fixed gas. Therefore, any easily oxidized body or any substance that has an affinity for oxygen which is put in a bath of peroxide of sodium and water will be at once acted on by the oxygen evolved, and it will either be completely oxidized to water and carbonic acid gas or to a stable body of a higher oxidization. The only active agent in such a bath is the nascent oxygen given off by the peroxide of hydrogen formed from the peroxide of sodium, this substance playing the part of a carrier only. Herein lies the superiority of this substance over peroxide of hydrogen itself; the former is a solid and stable body, the latter is an unstable liquid, the former gives up more oxygen for an equal weight than the latter, and is therefore commercially more readily available and economical. There are other highly oxidized bodies that act similarly to peroxide of sodium in the presence of water, but there are certain disadvantages of lack of control, too slow or too rapid action, higher cost, no commercial supply, etc., which render them unsuitable for use on a practical scale. Peroxide of sodium combines the desired action and qualities with commercial availability and reasonable cost, and is therefore the best.

Theoretically, to bleach with peroxide of sodium

all that would be necessary would be to add the chemical to water and immerse the articles to be bleached in this solution; practically, the procedure must be different. In the first place, the addition of peroxide of sodium to water causes a great amount of heat, because of the chemical action, and this heat would cause a rapid evolution of the oxygen and consequent loss; secondly, the strong alkali formed, caustic soda, would be injurious to many materials if not neutralized. These practical considerations require that certain modifications be made in the process of preparing the bleaching solution and of using it, an acid being added to the solution in sufficient amount to neutralize the alkali. The acid most commonly used is sulphuric acid, because of its cheapness, and also because of the inert and soluble nature of the salt it forms with the alkali, Glauber's salts, or sulphate of soda. Oxalic acid is also sometimes used in preparing the bath.

In practical operation, the method of using peroxide of sodium for bleaching is as follows:

To cold pure water, sufficient to cover the goods to be bleached, without packing them too closely together, is added the calculated amount of acid required to neutralize the alkali formed from the peroxide and thoroughly mixed with the water. Then the peroxide of sodium, in calculated amount, is added slowly from a scoop, and during the addition, the bath and the goods are continuously agitated, care being taken that the peroxide is dissolved completely and that no undissolved lumps are allowed to remain at the bottom of the vat. Towards the end of the addition of peroxide, steam is turned on through the lead heating pipe provided for this purpose at the bottom of the vat, to hasten the solution of the powder, this also later on serving to keep the liquid in circulation around the goods in the bath and to increase the rapidity of the bleaching. The material is left a sufficiently long time in the bath to allow perfect bleaching, then removed, drained and well rinsed off in fresh water.

This is the general method of procedure, the operation can be modified by the addition of a little ammonia or silicate of soda to increase the rapidity of the evolution of oxygen, since the peroxide of hydrogen decomposes more rapidly in an alkaline bath than in an acid one. If oxalic acid be used, it should be dissolved in hot water, and this solution be added to the bath, as this acid is rather slowly soluble in cold water.

There are a few points connected with peroxide of sodium bleaching that need special attention. First: the vat or vessel used to hold the goods and the bleaching solution must be so made as to be absolutely free from iron, that is, there must be no nails, bolts or anything of this metal used anywhere that it will come in contact with the bleaching solution. A vat made of clear white pine, free from knots, is the simplest and best form for large quantities; earthenware or glass

