

### THE USE OF PEROXIDE OF SODIUM FOR BLEACHING.

The use of Peroxide of Sodium for bleaching textile fibres and fabrics, wool, cotton and silk, is rapidly being enlarged in spite of the present drawback of its greater cost than the older bleaching materials, *i. e.*, sulphur and chlorine in their different forms. Doubtless, when the price of this material has been lowered by improvements in the processes of its manufacture or by competition, its use will become universal and it will almost entirely supersede the older agents.

The reason for this superiority of peroxide of sodium is very plain, in bleaching with it we simply follow Nature's process, using identically the same agent that she does—nascent oxygen—the only difference being that we use it in a more concentrated way and thereby hasten the operation. Like all of Nature's processes, it is very thorough, since it is based on destruction, not modification or addition, oxygen, the active agent, being the same agent that is employed by Nature when she wishes to destroy something for which she has no use in her scheme of economy. There is nothing left but the ultimate products of oxidation, water and carbon dioxide, when the process is complete, and consequently there are no bodies left in or on the fibre that can be restored or regenerated by the after action and oxidization of the air.

A further marked advantage of this natural process, and one that makes sodium peroxide very valuable to the bleacher, is that the action of the nascent oxygen it evolves is selective, that is, it acts only on the unstable bodies that are present and does not attack at all the stable bodies unless it is aided by heat. Consequently, when brought into contact with raw cotton, wool or silk, it attacks the unstable coloring bodies present, and satisfies their affinity for oxygen, without affecting at all the stable fibres themselves. The unstable coloring matters are converted into either stable, colorless compounds or are completely oxidized into still more stable water and carbonic acid gas, which may remain, in the former case in part, or which may be wholly removed by the after washing.

Its action is directly opposite to the action of the sulphur bleach, in which sulphurous oxide gas combines with and takes away some of the oxygen of the coloring matters of the fibre, reduces it, and thereby forms a still more unstable body than existed

at first. This unstable compound has a greater affinity for oxygen than the original substance, therefore, it is only a matter of time and exposure to the air when the fibre will regain its natural color, by the oxidization of these unstable bodies formed by the reducing action of the sulphur bleach. Thus it is that a sulphur bleach is not a permanent bleach, and it can never be made to give a permanent bleaching effect by itself alone.

The chloride of lime bleach is an oxygen bleach, its ultimate action being that of oxidization, but, in addition to this, we have also to consider the action of a powerful corrosive agent, chlorine, which has a marked affinity for animal fibres and which exerts a strong oxidizing effect on vegetable fibre, converting it into unstable oxy-cellulose. This is the cause of the well-known "tendering" of cotton goods when bleached by chlorine compounds. Even with the cheapness of chloride of lime and similar compounds, the care necessary for handling goods bleached by them and the complicated and tedious processes of after treatment make their use expensive in the end.

In addition to the drawbacks mentioned, there is the still greater fault that in both the sulphur and the chlorine processes of bleaching, compounds are formed which are very difficult to remove from the fibres or the fabric so treated, and these compounds exert a very harmful action on both the fibres themselves and on the dyes used later for coloring them. For an example, we have the fact that wool bleached by the sulphur process cannot be successfully dyed with many of the so-called coal-tar colors, the sulphurous acid remaining in the wool, in spite of washing, being directly antagonistic to some colors, and, if it does not actually destroy others, it seriously affects their shades. Similarly, when using chloride of lime, chlorine compounds are left in the fibre that require long and tedious processes for their removal, and if this is not completely done, the color or shade of the dye used will be greatly harmed.

Not only do sulphurous acid and chlorine compounds affect the dyes used but they also have an injurious action on the fibre itself, weakening and gradually rotting it. This is due to the former body being oxidized to sulphuric acid and the latter oxidizing the fibre itself. A serious defect in the sulphur process when applied to mixed goods, consisting of wool and cotton, is this after oxidization of the sulphurous acid and the production of sulphuric acid, which will "carbonize" the cotton fibres when the fabric is subjected to heat in later treatment.

In fact, both sulphur bleaching and chlorine bleaching are processes inherently defective, and they are really only makeshifts, producing results by indirect action, which is never as effective as direct action, and they are never wholly satisfactory or permanent in their effects.

The process of bleaching by peroxide of sodium

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

vessels are best for small operations. The pipe in the bottom of the vat, for admitting steam into the bath, should be made of lead, outside the vat for a few feet as well as inside it, to prevent possible contamination from iron rust or scale.

The water and the acid used must also be free from iron, otherwise, spots of iron rust will be formed on the goods that are very difficult to remove. Care must also be taken that no particles of iron, from tools or other objects, be allowed to fall into the vat. Second: the bath must be made as nearly neutral as possible when freshly made up, this being regulated by frequent testing with litmus paper. Then, if it is desired to hasten or to retard the bleaching action, the solution may be made alkaline or acid with exactness and the proper action insured. Third: the material or goods to be bleached must be thoroughly washed with soap or carbonate of soda and then rinsed off before being placed in the bath, to remove all grease, oil, dirt, etc., as the first two will prevent the oxygen from acting on the goods, or, if at all, very unevenly, and the last will waste it.

Peroxide of sodium is a chemical that requires very careful handling, both to preserve it from deterioration and to prevent accidents. It should always be kept in air-tight containers, and these must be well sealed every time some of the salt is taken out for use, otherwise it will absorb both moisture and carbonic acid gas from the atmosphere. On exposure to the air, peroxide of sodium rapidly "deliquesces," becomes liquid, and is converted into carbonate of soda, losing its available oxygen in both instances. Peroxide of sodium, in powder or in solid form, must *never* be brought into contact with damp organic matter, as it is so powerful a chemical that it may set fire to combustible substances in the presence of a little moisture. Never allow it to remain in contact with paper or in wooden barrels or stow it in a damp cellar.

A bath prepared with sodium peroxide can be easily used more than once and for separate lots of goods by adding to it fresh quantities of this chemical and acid, preserving the same proportions as at first. If it is not convenient to use the bath a second time the same day, it can be preserved in strength by making it markedly acid, since the solution of sodium peroxide gives off oxygen only very slowly when acid. To start up the bath the next day, all that is necessary is to add sufficient alkali—ammonia water or silicate of soda—to make it alkaline.

It is easily seen that peroxide of sodium is not only an ideal bleaching agent from the standpoint of efficiency and permanency, but that it is also ideal from the bleacher's standpoint, because of the ease with which the bleaching solutions are made up and the perfect control that he has of their action, and the absence of harmful fumes or poisonous gases. Furthermore, the apparatus required is of the simplest

kind and can be easily and cheaply obtained and set up, in fact, the cost of the wooden vat, the lead steam-pipe, etc., used in bleaching with peroxide of sodium is but a fraction of the cost of the apparatus necessary for any other method of bleaching. These are important considerations, and when it is borne in mind that the peroxide solution can be used in any part of the mill, or in any room, without danger of its injuring other apparatus or the workmen there employed, it certainly is plain that its greater cost, compared with other bleaching agents, is more than counterbalanced by its unique advantages and properties.

Of course it must not be taken for granted that any old way of handling it will do for peroxide of sodium; to get good results requires care and attention to details, then it pays in results and costs.