

upon the steam lustring cylinder until the steam issues through everywhere. If the cloth is wanted a little looser, it is to be unwrapped at once and cooled when open. If it is desired to be boardy or firm, let it stand for a while upon the cylinder. Pieces that are to be soft and loose are pressed in the roller press, and then passed once or twice over the open steaming apparatus. Light or loose cloth is generally stretched out strongly by the roller press, and for this reason the plate press is suited best for this kind of cloth.

THE PROCESS OF BLEACHING.

By the term "bleaching" is understood the destruction of colored ingredients to be found as impurities in and upon different colorless fibrous material. The bleaching process is most generally based upon the condition that the material to be bleached more fully resists certain chemical agents which are used for bleaching than does the coloring substance. But since a thorough power of resistance cannot be relied on, the bleaching agents must be employed with very great care, in order not to impair the strength of the material to be bleached. The vegetable spinning fibres consist of colorless cellulose, but before the bleaching process they also contain resinous and wax-like besides the colored ingredients; the retted flax contains pectinic acid, etc., while the yarn and cloth are filled with substances such as glue, dextrine, starch (from the sizing), fat, dirt, etc. These impurities envelop the coloring substances, and render them impervious to the action of the bleaching agents, and it is, therefore, necessary to first cleanse the fibres, although it is advantageous to alternate the cleansing and bleaching process, and highly diluted liquors are invariably used, so as to prevent the fibres from being attacked.

The oldest bleaching process is the grass bleach, in which the fabrics are spread out upon the sward and wetted by rain, dew, or water sprinkled on them, and in which moist condition they are exposed to the action of the air or direct sunlight. Both light and oxygen exert a simultaneous action by forming ozone, but, more correctly speaking, peroxide of hydrogen, by which the coloring ingredients are destroyed. Much more rapid than the grass bleach, however, is the action of the chlorine bleach, in which process weak solutions of chloride of lime, hypochlorite of soda, or other hypochlorous acid salts are made use of, and the process is finished with a weak acid bath after the chlorine bath. The hypochlorous acid dissociates in the fabric, and forms oxygen and hydrochloric acid, which latter liberates again hypochlorous acid. The opinion that the chlorine bleach strongly corrodes the cloth is unfounded, considering the present rational method of treatment. Danger can only be anticipated if an unduly strong chloride-of-lime bath is used, or if it is permitted to act for too long a time, especially with the co-operation of air and light. Again, if the acid is not completely washed out it will concentrate in the drying fabric and corrode the fibre. If cloths in general are not so strong to-day as they formerly were, it is not due to the action of the chlorine bleach, but to the present method of harvesting and preparing the fibre, and to the spinning and weaving processes.

Repeated experiments have been tried for bleaching with chlorine developed electrolytically, but no great success has been achieved in this direction. On the other hand, peroxide of hydrogen has recently been extensively employed. It attacks the cellulose and forms oxycellulose, more especially in the presence of metallic oxides, for which reason a weak acid bath is first employed to remove the latter. An addition of magnesia has a very favorable effect in bleaching with peroxide of hydrogen. Sulphurous acid enters into colorless combinations with a number of dyestuffs, from which the latter can be recovered again unchanged by the use of dilute sulphuric acid, vapors of hydrochloric acid, chlorine, by heating, etc. Other dyestuffs, again, are not bleached by sulphurous acid. Many—for instance, the yellow pigment for silk dyeing—are destroyed only because under the influence of light the oxygen of the air present, besides the sulphurous acid, effects the decomposition of the dyestuffs. This circumstance explains the reason why goods bleached with sulphurous acid often turn

yellow again. The sulphurous acid frequently renders soluble only the coloring substances, so that these can be expelled by the subsequent cleansing baths. For bleaching wool and silk, a solution of hydrosulphite of soda, obtained by treating bisulphite of soda with zinc, has recently been recommended. The sulphite of zinc and sodium is permitted to crystallize and the diluted mother liquor is used.

The bleaching of cotton commences with a cleansing process, the purpose of which is also to remove the fat adhering to the cotton. Caustic soda, resin soap, soap, lime, and acids are employed in a number of different ways. According to one method the cotton is drawn through a soda solution in a washing machine, after which it is put in a basket-woven wagon of tinned flat iron and entered into a bucking kettle, and while the cotton is being constantly wet with weak soda solution, it is treated with steam at a pressure of about one atmosphere, and is afterwards washed with hot water. The cotton is then entered into the bleaching machine, through which it passes at a speed of 60 metres per minute. It is first conducted through water, then squeezed between rollers, after which it enters into a 0.4 per cent chloride-of-lime solution. It is squeezed again and then entered into a chamber with carbonic acid (or weak hydrochloric acid), and after this follows a washing with water and 0.1 per cent soda solution, wherein the material is beaten by rollers, and after repeated squeezing it is constantly sprayed again with water. The cotton, then passes through a hot soda solution, is again washed, passed through open air, and repeatedly subjected to the same treatment, and finally made ready in an ordinary washing machine. According to the size of the apparatus, from 2,000 to 5,000 kilos, cotton can be thoroughly bleached in from 18 to 20 hours. For bleaching cotton with peroxide of hydrogen the material is entered into cold, weak, sulphuric acid, in which it is left for some time, and after which it is boiled for six hours in a bath of caustic soda, soap, peroxide of hydrogen and calcined magnesia. It is then washed, treated with acid, washed again and dried. A very nice white is obtained in this manner.

In bleaching linen and hemp, a much larger quantity of impure substances is to be removed than in bleaching cotton, and it is therefore necessary to use a larger number of baths, which are alternated with grass bleaching, although it is also possible to advantageously use grass bleaching and chlorine bleaching, or else the latter alone.

Jute cannot be bleached in the customary manner with chloride of lime, because it enters with this in a chloric combination, which forms hydrochloric acid afterwards in the printing and steaming of the fabric, and this acid turns the fibre brown, and finally destroys it. The chloric combination also fixes the lime, whereby the fibre is made rough and brittle. The fabric is therefore washed with water glass, borax or soda, and bleached in hydrosulphite of soda with a trifling excess of carbonate of soda, in order to prevent the formation of chloric combinations. It is afterwards rinsed with water and entered in diluted hydrochloric acid with a little sulphurous acid, and this treatment imparts a pale cream color and a soft lustrous appearance to the fabric.

Vegetable substances may also be bleached in a manner similar to yarn and fabrics, and for this method a gaseous chlorine or chlorine water is often employed. This method is used especially in paper mills, in which the rags or the pulp are bleached.

Wool and silk do not resist the action of alkaline lyes and chlorine, and are therefore cleansed with soap, soda and ammonia, and bleached with sulphurous acid. The fabrics while moist are suspended in a chamber, in which sulphur is burned, and are exposed to the action of the gas for twenty-four hours. A hydrochloric acid bath follows next, and in case of insufficiency the processes are repeated. The sulphurous acid is often generated by heating sulphate of iron with sulphur. It is then washed in water and led through pipes into the chamber. Much more uniform than the gaseous sulphurous acid is the bleach with a saturated aqueous solution of sulphurous acid, in which the fabrics are left immersed for four hours. For producing such a