

BLEACHING

thollet in 1785, and shortly afterward introduced into Great Britain, where it was first used simply dissolved in water, afterward dissolved in alkali, and then in the form of bleaching powder, commonly called chloride of lime, the manufacture of which was suggested by Mr. Tennant, of St. Rollox, Glasgow, in 1798. At first he passed the chlorine into milk of lime, and thus obtained the solution known as bleach liquor. In 1799 he took out a patent for absorbing chlorine by dry lime, and thus obtained bleaching powder. Bleaching powder has little bleaching action till the chlorine is liberated by the action of an acid. The best bleaching powder contains about 36 per cent of available chlorine; that is, chlorine which is liberated by acid.

In Silesia and Bohemia, where the chlorine process is not adopted, the linens are exposed to a fermenting process, then washed, and steeped in alkaline liquors, with alternate exposures upon grass, which processes are repeated a great number of times for 60 to 70 days; but to render them properly white, they are afterward passed through a bath acidulated with sulphuric acid, then treated again with the potash lye several times and alternately exposed on the grass, and finally thoroughly cleansed by washing in a revolving cylinder called a dash-wheel. This machine is also employed in the English and Scotch processes for washing the goods without subjecting them to unnecessary wear. The frequent repetition of the different processes is rendered necessary by the complete diffusion of the coloring matters through the flax fibres, and their close union with them; each operation decomposing and removing in succession small portions only.

In the bleaching of cotton cloth, the pieces, after being singed, by passing them over a red-hot plate or a semi-cylinder of iron or copper, are steeped in lukewarm water or old lyes, till they are completely soaked, which loosens any paste or filth got during weaving; they are then well washed through the dash-wheel, and put through the hydro-extractor or drying machine. If the cotton is in the hank, this process of steeping and washing is not required.

Bleaching (Fr. *blanchiment*, "whitening"), the process of removing the coloring matters from fabrics of cotton, linen, wool, silk, etc., or from the raw materials, and also from straw, wax, and other substances, and leaving them perfectly white. Steeping cloths in lyes extracted from the ashes of plants, appears to have been practised by the ancient Egyptians for this purpose. In modern times the Dutch have almost monopolized the business, at least till within about 100 years. Previous to this time the brown linens manufactured in Scotland were regularly sent to Holland to be bleached. A whole summer was required for the operation; but if the cloths were sent in the fall of the year, they were not returned for 12 months. It was this practice which caused the name of Hollands to be given to these linens. The Scotch introduced the business of bleaching for themselves about the year 1749; but it was long believed that the peculiar properties of the water about the bleaching grounds of Haarlem gave to this neighborhood advantages which no other region could possess. The use of chlorine as a bleaching agent was first proposed by Ber-

The mechanical operations of the bleaching house vary considerably, according to the quality of the goods and the facility for mechanical appliances. In the chemical operations of whitening the cloth there is little variation, further than that heavy fabrics require longer time and more frequent repetition of the processes. The first operation, after steeping and washing, is boiling. The boiling liquor is made by adding a quantity of water to slaked lime, and when the grosser particles of lime have settled to the bottom of the vessel, the milky liquor is put into the boiler, or, it may be, filtered through a cloth. Some bleachers use with the lime a little carbonate of soda; the quantity of lime varies from four pounds to eight pounds for every 100 pounds of cotton, and from one pound to two pounds of soda ash, where this is used. The boilers used for boiling the goods are called *kiers*, and many kinds are used, the boiling liquid being made to shower over the goods and percolate down through them. This is effected by having a false bottom or frame fitted inside the boiler at about one third of its depth from the bottom, upon which the goods are laid. The space between the false bottom

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and real bottom of the boiler is filled with the liquor or lye, connected with which is a pipe leading to the top of the boiler. When the heat is applied, either by steam or fire, and the liquor begins to boil, it is forced up through this pipe, which is made to shower its contents over the surface of the goods. This boiling is continued, according to the quality of the goods, from 6 to 12 hours. The goods are now removed from the boiler and washed in water; they are then passed through dilute hydrochloric acid, again washed, and boiled for 12 hours with dilute caustic soda, after which they are passed into a solution of bleaching powder contained in a large stone or wooden trough or cistern, where they are left for from two to four hours. The bleaching solution is prepared by first dissolving a quantity of bleaching powder in water in a large cask and allowing the whole to settle; a quantity of the clear liquor is then drawn from the cask and put into the large bleaching cisterns, which have been previously nearly filled with water. To ascertain the necessary quantity of this strong bleaching liquor to be added to the troughs or cisterns, a certain measure of sulphate of indigo is taken in a graduated vessel, termed a test glass, and then, according to the number of graduated measures of the bleaching solution required to decolor the sulphate of indigo, the strength of the bleaching liquor is regulated. These test glasses and sulphate of indigo are carefully prepared for the purpose.

Instead of dash wheels, a more improved method of cleaning and washing is adopted by some bleachers previous to boiling the goods. They are all sewed together, end to end, making one line of the whole. This line of pieces is drawn along by machinery between rollers and squeezers, with a plentiful supply of water, and having been thus thoroughly washed and cleaned, is at last laid out by a mechanical contrivance into the bleaching trough. The goods are allowed to steep in the bleaching liquor from two to four hours; they are then lifted and washed, either by the dash wheel or rollers, as before, and are then laid in a sour, made by adding about one pint of hydrochloric or sulphuric acid to every four gallons of water. After steeping in the sour for four hours, the goods are again washed, as before, and are subjected to another boiling for eight hours; but this time the lye is caustic soda or potash, generally the former, made caustic by boiling together a quantity of soda ash and slaked lime, and allowing the sediment to settle, and using only the clear solution. About eight pounds of soda ash suffice for 100 pounds of goods. After the boiling the goods are again washed and steeped in the bleaching liquor for eight hours, and again washed and soured—the sour in this case being always made with sulphuric acid. Light fabrics require no further treatment; but heavy fabrics need a clearing process, which is a repetition of the last course, the liquors being generally, however, a little weaker, and the processes shorter. Cotton, in the hank, undergoes the same operation, except in the washings, which are performed by hand, not with the wheel. The goods being bleached and dried by the extractor, are now prepared for the operations of finishing. For this purpose they are stretched by women to their breadth, and the folds, as much as possible, taken out by beating them; then they are stitched together by the

ends with a sailor's needle, and being thus prepared for the mangle the cloth is now starched, common wheat flour and a portion of porcelain clay being employed. It is then subjected to the action of the stiffening machine, and having been thus impregnated with starch, the superfluous portion of which is pressed out as it passes through the rollers above, the goods are then hung upon rails in an apartment, called the stove, heated by two furnaces from which flues are led through the room. The heat thus generated is sometimes so great that the workmen, in hanging up the cloth, are obliged to throw off most of their clothes. When the goods are dried thoroughly, they are taken from the stove and carried to the damping machine, where they are subjected to the action of a shower of water. When the cloth comes from the damping machine, it may be seen covered with wet spots, the greater portion, however, being dry; but after remaining some time it becomes uniformly damp. The goods are now passed through the calender; they are then regularly folded and put into a Bramah press, with a sheet of pasteboard between each, and, being sufficiently pressed, they are then finished for the market. The process has been greatly shortened by the introduction of the Mather-Thompson process (1884). In this process an important feature is the use of the steamer kier, in which the goods are submitted to the action of low-pressure steam. The material is passed through soda lye, squeezed, and washed; then through boiling caustic soda, squeezed, and run into a steamer kier, where it is boiled for four hours under a pressure of four pounds, washed with hot water, and then passed continuously through a series of vats containing water, bleaching powder solution, carbonic acid gas, water, alkaline solution, water, bleaching powder, carbonic acid gas, water, hydrochloric acid.

The bleaching of linen is conducted after a similar manner to that of cotton; but there is much more coloring matter in the former than in the latter, and it is therefore found necessary in the bleaching of linen to repeat the boiling in lye and the steeping in chloride of lime three or four times. An electrolytic method of bleaching (the Hermite process) has recently been introduced. The chlorine for bleaching is liberated by the action of an electric current on solutions of calcium or magnesium chloride. Wool and silk cannot be bleached with chlorine, so sulphur dioxide, usually prepared by burning sulphur, is used instead. In the case of wool, the material is well washed with water and scoured with alkaline solutions to remove fatty matters. It is then exposed, while still wet, to the action of sulphur dioxide in a brick chamber for six or eight hours,—or it may be soaked for several hours in a solution of sulphurous acid,—after which it is well washed. Silk is treated with dilute acid, then worked in a soap bath for about 20 minutes to remove the gummy matter present, after which it is rinsed, tied up in bags of cotton, and boiled for from one to three hours in water, and rinsed in dilute alkali and finally in water. The bleaching is effected by stoving in sulphur dioxide, exactly as in the case of wool. In place of sulphur dioxide, hydrogen peroxide is coming into use for both wool and silk bleaching.