

Fabric Analysis.

Water Tests.

One of the strong points in textile manufacturing as well as "Testing Yarns and Fabrics," etc., is the use of a soft water and which must be "Zero," in order to make reliable tests.

The following data comprises simple methods of testing water for the presence of iron, lime, magnesia, sulphates, ammonia, nitrates and organic matter. For the process, take a porcelain dish and not a glass one, because glass is attacked by boiling water—more so than porcelain.

Boil 2,000 grms. of carefully-collected water in the porcelain dish down to one-half. This generally produces a precipitate containing those constituents of water which are only kept in solution through the agency of free carbonic acid, as carbonate of lime, carbonate of magnesia and sesquioxide of iron; pass the fluid through a filter perfectly clean and free from any trace of iron or lime, wash the precipitate well after removing the filtrate, then examine both thus:

Dissolve the precipitate on the filter in the least quantity of dilute hydrochloric acid (effervescence shows carbonic acid); treat separate portions as follows:

(a) Add sulphocyanide or ferrocyanide of potassium to test for iron; if iron is present, a red or blue color respectively is formed.

(b) Take another portion, boil with ammonia, filter if there is any cloudiness or precipitate, mix the filtrate with oxalate of ammonia in excess and keep it for some time in a warm place; a white precipitate indicates lime as carbonate, sulphate, chloride or some other combination. Filter off any precipitate and mix the filtrate again with ammonia, and add some phosphate of soda, stir well and allow to stand for half-a-day; a white crystalline precipitate, which may often be visible only on the side of the glass when the fluid is poured out, indicates magnesia.

(c) Add some chloride of barium to another portion of water and allow to stand for some time, say 10 to 17 hours; a white precipitate indicates that sulphates are present.

Examine the filtrate:

(a) Mix a portion with a little hydrochloric acid and chloride of barium; a white precipitate indicates sulphates.

(b) Mix a portion with nitric acid and add nitrate of silver; a white precipitate or turbidity indicates chlorine.

(c) Evaporate a fairly large quantity of the filtrate to concentration point, and add a little brucia dissolved in concentrated sulphuric acid; then the solution immediately acquires a magnificent red color, indicating nitrates. This is a very delicate test.

(d) Acidify a large portion of the water after filtering (to remove suspended matter) with hydrochloric acid and evaporate nearly to dryness; add hydrate of lime thoroughly mixed in a mortar; then if ammonia is present it betrays its presence by its characteristic odor, and if a glass rod dipped in hydrochloric acid is brought in contact with the solution, white fumes appear.

(e) Organic matter is detected by the blackening which occurs when a portion of the water is evaporated to dryness and gently ignited. The precipitate which is formed is at first white, then darkens, and, when the organic matter is driven off, returns to a light color again.

QUICK TESTS.

The following are some rapid tests for pure water.

Water should show no change on the addition of sulphide of ammonia; if it does, it shows the presence of heavy metals, such as copper, iron or lead.

If carbonic acid is present, baryta water turns it turbid; add oxalate of ammonia, and if lime is present the water becomes cloudy.

If chloride of barium and hydrochloric acid are added to the water, the latter becomes turbid if sulphates are present. Nitrate of silver and nitric acid show chlorides present if the water shows white cloudiness, and chloride of mercury and carbonate of soda indicate ammonia.

Testing Soaps for Textile Purposes.

Several points have to be considered in testing soaps intended for use in fulling woolen goods. The soap should first be subjected to an ordinary chemical analysis. In this it is necessary to determine the amount of water in the soap, the amount of free alkali and unsaponified fat, if any, and also the quantity of any adulteration or filling, such as rosin, water-glass, etc., that may be present.

After this, if the first investigation has turned out satisfactory, the spinning test should be applied. This will show

whether the soap is capable of forming a paste having the necessary toughness for fulling, *i. e.*, felting purposes.

Ten grammes of the soap are cut into very thin shavings and dissolved over the water bath in 100 c. c. of water in a beaker. The beaker is then stood in cold water and the solution, which must be quite free from solid particles, is stirred with a thermometer until it will draw out into threads. The temperature probably depends upon the fusion points of the fatty acids of the soap, but it is independent of the amount of water in it. Nevertheless, the spinning temperature decreases much faster than the melting points of the fatty acids. A tallow grain soap, the fatty acids of which melted at 43.5° C., spun at 43°; while a Marseilles soap, with fatty acids melting at 26°, would not spin till the temperature was as low as 4°, so that it was useless for fulling purposes.

As regards the use of soaps in textile industries, the branch which requires the best soap is silk dyeing. Here free alkali, whether caustic or carbonated, and also saponified fat, are all inadmissible.

The wool trade also requires soap perfectly free from alkali or alkaline salts, except in the production of inferior qualities of goods. A good fulling soap must be free from excess either of fat or alkali, must have a great detergent power, and must assist the felting during the fulling process.

One of the worst impurities of a fulling soap is water-glass. It has a mechanically-abrading action on the wool, as well as a corrosive effect on it. If there is much of it, it often coats the fibre and gives the fulled cloth a very bad feel.

Both hard and soft soaps are used for fulling. The best fats to use in their manufacture are tallow, palm oil and sulphur oil. Rosin is a very harmful filling in a fulling soap, and, in short, the standard to be aimed at is a soap consisting solely of pure fatty acid salts of soda or potash. It need hardly be said that a washing powder, or even a powder professing to be pure soap in a ground state, should never be used for fulling purposes.

Dye Testing.

The fastness of dyestuffs is always comparative. Unfortunately no standards for comparisons have been devised, and published statements of dye stuff manufactures varying greatly. Personal opinion also differs to a great extent in this matter of fastness, and tests are made often necessarily under widely different conditions.

In most cases when *fastness* of a product is in question, it is best for those interested to make tests in a small way themselves before arriving at any definite conclusions regarding the properties of fastness, and such tests are satisfactory only when they are carefully made to approximate closely the conditions of actual practice.

Most important are the fastness to light, washing and fulling. Goods are often washed with soap and soda, and the fastness to alkali must be known. Fastness to acids is also frequently required for cotton warps intended for cross dyeing and for woolen goods to be carbonized after dyeing. Materials to be worn next the skin should be dyed with color not affected by the organic acids contained in the perspiration. Fastness to stoving (that is, the action of sulphurous acid) and fastness to chlorine are sometimes required where piece goods are bleached after dyeing. Wool blankets and cotton towelling with colored stripes or borders are often bleached in this manner. When goods have to be steamed, as in calico printing, or hot-pressed in finishing, care must be taken to obtain colors that are not stripped or do not change their shade in these operations.

The method of estimating the fastness of a product is obvious, and consists in putting a properly dyed sample through the operations it must withstand. It is not necessary to make a large dyeing in order to obtain samples to experiment upon. A 10 *grm.* skein can be dyed by any prescribed method, and except in the case of fastness to perspiration can be given the necessary test. It is often required that in washing a color shall not bleed on to white cotton or wool.

Whenever several tests are to be made comparatively, it is necessary that they be made under the same conditions. For example, suppose several colors were to be tested for their fastness to washing and bleeding into white cotton, the same amount of the dyed sample would be taken in each case; a convenient amount would be, say, fifty strands 18 inches long. These would be braided with twenty strands white cotton and twenty strands wool. For each test the same amount of soap solution would be used, and the washing carried out at the same temperature. The washing operation would thus have been carried out under the same conditions for all the samples, and the results would be comparative.

Generally, the "light" test is made under glass exposed to

the direct rays of the sun, so as to get the greatest possible proportion of the direct rays, and thus the maximum effect in the shortest time. Sometimes it is best to let the dyeing stand not only the light, but also the weather; this latter test is better when the finished product must stand similar conditions, as for awnings, etc. When a light test is made, one part of the dyeing should be protected, so that any change taking place can be easily seen and compared with the original dyeing.

A good way for testing dyeing on yarn for exposure to light is to wind the yarn on heavy cardboard about 4 inches wide, covering about 1 inch. Several dyeings can thus be wrapped side by side. One-half of the dyeing is then covered with a piece of black paper, and over this a strip of heavy oiled paper is placed, large enough to turn under, and be firmly fastened with small brass fasteners. The length of the exposure depends of course on the requirements, and varies from a few days to several months.

To get a general idea of the fastness of a dyestuff, the following tests should be made:

FASTNESS TO LIGHT: Samples prepared (as before explained) should be exposed one to six weeks in summer and nearly twice as long in winter (under glass) to the direct rays of the sun, or (if required) to the combined action of light and weather.

FASTNESS TO WASHING: The dyed yarn should be braided with undyed cotton and wool and washed with a solution of soap, using for 5 grms. goods, 200 cc. of a 5 per cent soap solution.

FASTNESS TO ALKALI: 5 grms. of the dyed yarn, together with 1 gm. skeins of undyed wool and cotton, should be treated for one hour at 70° C., with 200 cc. 5 per cent soda solution, or with 200 cc. of a 5 per cent solution of equal parts soap and soda.

FASTNESS TO ACIDS: 5 grms. of the dyed yarn, together with 1 gm. skeins of undyed wool and cotton, should be boiled for one hour with 4 per cent sulphuric acid and 10 per cent Glauber's salt, calculated on the weight of the goods; that is for 5 grms. goods, 2½ cc. sulphuric acid 1:10 and 5 cc. Glauber's salt 1:10, and water up to 200 cc.

FASTNESS TO CHLORINE: Samples should be immersed in a solution of chloride of lime 2° Tw. for from one-half to twenty-four hours. The number of colors that can stand twenty-four hours is limited.

FASTNESS TO STOVING: The dyed sample is moistened and subjected to the action of the fumes from burning sulphur for from one to twenty-four hours. The number of colors that will stand stoving is very much greater than for chloring.

FASTNESS TO FULLING: There are few colors that will stand a severe fulling, while a great many products will withstand a light fulling, and are sufficiently fast for many purposes. As a rule colors that will withstand an ordinary flannel fulling are considered to be fast to fulling.

FASTNESS TO PERSPIRATION: The fastness to perspiration must be determined by a practical test—that is, by actually wearing the dyed material in question.

LEVEL DYEING PROPERTIES: It is often desirable to test the levelling power of a dyestuff, and this may be determined by practical tests to determine the amount of turning or agitating necessary to produce level results. The selection of the proper amounts of assistants and the temperature at which the dyeing is conducted are also important factors.

It is frequently necessary to duplicate the results given by one color with mixtures of other colors of the same class. Matching one dyestuff with mixtures of others is an art only acquired after a large amount of experience. Often an exact match is an impossibility, but generally a very close approximation is possible. Colors are best matched in a small way, making series of comparative dyeings, a number of appropriate mixtures being dyed under identical conditions with two strengths of the standard.

It is always good practice to dye two strengths of a standard, as it makes possible a greater number of comparisons with fewer dyeings. In attempting to prepare a match it is often well to make a large series of combinations. The number of possible combinations and possibilities are infinite. The art of matching colors can be learned by experience only, and requires a broad knowledge of dyestuffs and their application.

Cotton and wool, both mordanted and unmordanted, should be dyed under various conditions. Systematic trials should be made as follows: In each of five dye-pots 50 cc. of a solution of the color 1:500 and 200 cc. water are placed. If a solution of the product is difficult to obtain, a small amount of the dye is heated in a test tube with hydrochloric acid and the escaping fumes tested with filter paper moistened with

lead acetate. If a dark coloration is formed, the product is a sulphur dye.

In the five dye-pots the following tests are applied: In No. 1 unmordanted cotton is dyed with 30 per cent Glauber's salt; No. 2, unmordanted wool with the solution neutral; No. 3, unmordanted wool with 4 per cent H₂SO₄ and 10 per cent Glauber's salt; No. 4, mordanted cotton (tannin and tartar emetic), having the solution neutral; No. 5, wool mordanted with bichromate of potash and tartar. After slowly heating to boiling and allowing to cool, the dyeings are taken out and thoroughly washed. The result will probably indicate at once to what class the color belongs.

As has been already stated, most dyestuffs are diluted with salt, Glauber's salt, or dextrine. If dextrine has been used, it is easily detected by the characteristic odor on dissolving in hot water. It is best detected when mixed in the dry state, as is usually the case, by means of the microscope.

Glauber's salt or sulphates may usually be detected by adding hydrochloric acid and barium chloride to a dilute solution of the dye. When the color of the solution obscures the reaction, the dye may be precipitated or salted out by saturating the solution with pure salt and the sulphate detected in the filtrate by adding hydrochloric acid and barium chloride.

Chlorides can usually be detected by simply adding nitric acid and silver nitrate to a dilute solution of the dye. The coloring matter can also be extracted with alcohol, leaving the salt undissolved in the residue, which is then tested for chloride in the usual manner with nitric acid and silver nitrate.

By far the larger proportion of dyes found in commerce, sold under various names, consist of mixtures of straight colors. A manufacturer may make but twenty straight colors, yet place hundreds of different mixtures on the market. When, as is most frequently the case, dyes have been mixed in the powdered state, they can be recognized by blowing gently a little of the powdered dye upon a large piece of filter paper that has been moistened with water, or if the dye be insoluble, with alcohol or some suitable solvent. Each particle as it dissolves forms a little streak of color, and if more than one coloring matter is present, each can be readily detected.

Another good method is to blow the powder over the surface of concentrated sulphuric acid contained in a white porcelain dish. The particles of dye are dissolved and give their color reaction with the sulphuric acid, and in this manner mixtures of dyes of the same shades in their water solution can be recognized.

Sometimes mixtures are made by dissolving two or more dyes together and reprecipitating them; in this case the before mentioned methods are not reliable. As most colors do not exhaust exactly the same, such mixtures can usually be detected by dyeing three or four successive samples from the same bath of the color in question, either by the difference in shade of the first and last trial, or the differences in the color reactions of the dye on the fibre will reveal the fact of its being a mixture.

Dyestuffs are recognized both on the fibre and in the coloring matters themselves by means of characteristic reactions or colorations that are given when they are treated with various reagents. In practice, however, shades are more frequently obtained by combinations of two or more coloring matters which often render detection extremely difficult, if not impossible. Many tables of reactions have been published, but the difficulties encountered in describing such reactions are great, and the number of products is getting to be so numerous that the practical dyer does not inquire further than the practical results to be obtained from a dyestuff or the properties possessed by a given dyeing. A man who is constantly testing dyestuffs, can in time recognize products with comparative facility, and when one coloring matter only has been applied to a fabric, can often tell what that coloring matter is.

Felt and Cloth Made From Spun Glass in Italy.

"IL SOLE," published at Milan, November 21, 1918, contains an article on the glass industry, in which it is stated that after a series of experiments made in Venice and Murano by Signor Luigi Bisigato, felt and cloth made from spun glass have now been successfully produced there.

A new society, the "Vitrum," has been formed, with extensive plants at Naples, for the manufacture of this felt and cloth for use as insulators in storage batteries.