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FABRIC ANALYSIS.

(Continued from May Issue.)

Chemical Tests.

By microscopic examination the nature of materials used, or to be used, in the manufacture of yarns or fabrics, can be in most cases ascertained; however in some instances this test may not be sufficiently conclusive, again the quantity and proportions in which two or more materials are present in a sample may have to be ascertained, and when then the microscope is of no value.

Chemical reaction not only indicates the type of material, but may also be employed to ascertain the proportion in which different materials are present.

Since all vegetable fibres are of practically the same chemical composition (cellulose) it is very difficult to obtain, by means of a chemical agent, a distinguishing color or feature in one fibre which the same agent does not impart in some degree to the other. Therefore, before any reliable results can be obtained the application of some knowledge and experience of chemistry is essential.

Practically, all fibres employed in the manufacture of yarns or fabrics are either of vegetable or animal origin, hence the chemical reagents used as solvents for fibres can be divided into two distinct classes:

(a) Those employed as solvents for animal fibres.

(b) Those employed as solvents for vegetable fibres.

Fibres, whether in the raw or in the manufactured state, are often incrustated with some extraneous material (oil, size, glue, dye, etc.) which prevents the direct action of chemical reagents upon them, necessitating (the same as was previously referred to when preparing yarns or fibres for testing by the microscope) a preliminary soaking in ether or benzine, or washing in soap and water, so as to remove this extraneous matter.

These chemical tests can be done at a small expense, requiring a Bunsen gas burner, supplied with a heavy cast-iron foot, into which is screwed a tube to connect the burner with the gas supply pipe by means of a rubber tube; two or three porcelain crucibles, large enough to contain about one gill of solution; a tripod stand with iron wire gauze to support the crucible; a few watch glasses and test tubes, and a graduated vessel for measuring liquids. The chemicals can be obtained at any required strength, and should be kept in glass-stoppered bottles.

A Few Chemical Tests for Cotton, Wool and Silk.

A comparison of animal and vegetable fibres shows that, chemically, they are composed of entirely different substances.

Animal fibres are of a gelatinous nature, while the base of all vegetable fibres is cellulose.

CAUSTIC SODA OR CAUSTIC POTASH.

On account of this difference in the chemical composition of the fibres, the chemical reagents, employed in testing these two classes of fibre, also differ. Thus, vegetable fibres are insoluble when boiled with caustic soda or caustic potash, whereas animal fibres are soluble, wool dissolving in a cold solution, whereas silk is unaffected when the solution is cold but is dissolved when hot.

SULPHURIC ACID.

Sulphuric acid, even when dilute, readily dissolves vegetable fibres, while a concentrated solution has little effect on animal fibres (wool as well as silk) unless at a very high temperature.

Hot concentrated sulphuric acid gradually dissolves animal fibres (wool and silk) with brown coloration.

Hydrochloric acid, if concentrated, dissolves both silk and wool, but, if applied diluted, silk dissolves, while wool is insoluble.

ALCOHOLIC SOLUTION OF NAPHTHOL AND SULPHURIC ACID.

Cellulose, the chief constituent of vegetable fibres, when treated with acids, is partly changed into sugar, giving it the property of producing fine colorings with an alcoholic solution of naphthol and sulphuric acid. This characteristic can be made use of to detect animal from vegetable fibres, thus: Prepare the sample to be tested by boiling it several times in water so as to remove any size, etc., adhering to it, also remove any

vegetable impurities, such as burrs, etc. Add several drops of an alcoholic solution of naphthol to 1 c.c. of water, and increase this liquid by its own volume of concentrated sulphuric acid.

Immerse the sample in this solution, then, if any vegetable fibres are present, they are dissolved, and the liquid, after shaking, is colored deep violet; if the sample consists only of animal fibres the liquid is colored a more or less intense yellow, leaning in some instances towards a brown. Since the same result is obtained whether the fibres are dyed or undyed, the presence of vegetable fibres, either in yarn or cloth, can be readily detected by this test.

The degree of solubility of the fibres also determines, to some extent, their character; thus, if the color of the liquid indicates that only animal fibres are present, silk dissolves rapidly, wool is not dissolved at all; if vegetable fibres are shown to be present, an incomplete solution indicates that wool is present, while a complete solution may be obtained though silk is present.

ZINC CHLORIDE WITH ZINC OXIDE.

A boiling solution of basic zinc chloride (at 130 deg. Tw., or 1.65 sp. gr., obtained by dissolving 100 grams of dry zinc chloride in 85 c.c. of distilled water, and adding 4 grams of zinc oxide) dissolves silk, while wool and vegetable fibres are insoluble.

This solution can also be used to detect *true* silk from *tussah* or wild silk, by noting the length of time required to dissolve the respective fibres. True silk dissolves rapidly, whereas tussah silk dissolves only after a longer immersion.

CHROMIC ACID.

A saturated solution of chromic acid, diluted with an equal bulk of water, dissolves wool and true silk if boiled for one minute, while tussah silk and adulterated silk are barely attacked, even when boiled for from two to three minutes.

Tests thus far given for distinguishing cotton, wool and silk fibres from each other are those most often used, others are:

AMMONIACAL COPPER HYDRATE.

Cotton: Dissolves slowly when cold.

Wool: No effect when cold.

Silk: No effect when cold.

The ammoniacal copper hydrate solution, and which thus distinguishes cotton from wool or silk, or both, is prepared as follows: A solution of copper sulphate is precipitated by caustic soda in the presence of ammonium chloride (sal ammoniac). The precipitate is filtered and well washed. If this precipitate is required to be kept, it must be stored under water. The ammoniacal copper solution is prepared from this precipitate by adding an excess of ammonia until it is completely dissolved, a deep blue solution being thus obtained.

SODIUM PLUMBITE.

Cotton: No effect.

Wool: Turns the latter black, owing to presence of sulphur in the fibre.

Silk: No effect.

The sodium plumbite, which recognizes wool from cotton or silk, or both, is made by heating lead oxide (litharge) with a solution of caustic soda. In doing so, care must be taken to shake the tube vigorously in order to prevent the settling of the heavy lead oxide resulting in the breaking of the tube. After boiling for a minute or two (longer is unnecessary) decant the clear liquor and with it test the fibre. If no blackening occurs cold, then heat, and if still no blackening, wool must be absent.

COPPER IN ALKALINE SOLUTION WITH GLYCERINE.

Cotton: No effect.

Wool: No effect.

Silk: Dissolves.

The alkaline solution of copper containing glycerine, and which detects silk from cotton or wool, or both, is prepared by dissolving 10 grams of copper sulphate in 100 grams of

water, adding 5 grams of pure glycerine and then enough caustic potash solution to re-dissolve the precipitate first formed.

MADDER TINCTURE.

Cotton: Colors yellow.

Wool: No effect.

Silk: No effect.

Madder tincture is obtained by extracting 1 gram of ground madder with 50 c.c. of alcohol and filtering from undissolved matter.

FUCHSINE SOLUTION MAGENTA.

Cotton: No effect.

Wool: Colors red.

Silk: Colors red.

Fuch sine solution is obtained by dissolving 1 gram of fuch sine (magenta) in 100 c.c. of water, then add caustic soda solution drop by drop until the fuch sine solution is discolored: filter and preserve in a well-stoppered bottle. In applying the test with this reagent the mixed fibres are treated with the hot solution, then well rinsed, when the animal fibres will be dyed red and the vegetable fibres remain colorless.

NITRIC ACID.

Cotton: No effect.

Wool: Colors yellow and dissolves slowly.

Silk: Colors yellow and dissolves rapidly.

Distinguishing Shoddy from New Wool.

Shoddy, Mungo or Extract mixed with new wool is hard to be distinguished in yarns and fabrics. The best test is to boil a sample in dilute hydrochloric acid, which, by removing the dyestuff and dressing from the yarn or fabric, will show if the individual fibres have been previously dyed. Provided the color of the fibres is not uniform, it may be assumed that the material consists of re-manufactured fibres; also under the microscope the latter fibres will appear torn, with the scales partly or entirely removed or very much damaged (more particularly if referring to mungo or extract).

Analysis of Raw Silk.

On account of the high cost of silk and the fact that some of the silks, more particularly those from China, are at times found to be adulterated with quantities of fat, the examination of raw silk may in some instances be found very desirable. The commercial value of such an examination will be easily realized when it is stated that we are informed that lately a lot of silk thus examined was found to contain 9 per cent of fat in place of the 1 to 2 per cent usually met with in raw silk.

A typical analysis of a white mulberry silk is thus:

Water	11.00	per cent
Salts	0.30	" "
Wax and Fat	1.36	" "
Sericin	22.01	" "
Fibroin	76.20	" "
Ash of Fibroin	0.09	" "

Moisture is determined in the raw silk by drying a weighted sample at 105 deg. C. to constant weight.

Salts soluble in water, and which the silk contains, are ascertained by steeping a weighted portion of the dried silk sample for half an hour in water, at a temperature of 50 deg. C. It is then rinsed in warm water, dried at 105 deg. C. and reweighted, the difference, *i. e.*, loss in weight giving us the amount of salts present.

For the purpose of obtaining the percentage of *Wax* and *Fat*, the sample left from the previous test, and of which the weight is known, is then extracted for about 5 hours in a Soxhlet apparatus with ethyl-ether, or with C. P. benzene. The solvent in the flask is then evaporated by a current of warm air on a steam bath and the residue in the flask weighted. The difference between this weight and the original weight of the flask with its contents indicates the amount of wax and fat the sample contains.

In order to ascertain the amount of *Sericin* the sample contains, the silk residue, after the salt test has been made and the weight marked down, is now boiled-off in a bath containing 10 grams of perfectly neutral olive oil soap per liter of distilled water. After boiling for one hour the sample is washed in distilled water and dried at 105 deg. C., and weighed. The difference in the two weighings represents the amount (per cent) of silk gum or sericin the silk contains.

The residue left after all the tests quoted have been made, then means almost pure *Fibroin*, the percentage obtained varying from 70 in Canton and 76 in Italian silk to 84 in Japan silk.

Tests for True, Wild and Artificial Silk.

TESTS FOR TRUE SILK.

Silk is dissolved by strong alkalies, whereas dilute alkalies, although affecting it, do not dissolve it. Ammonia has no action on silk; the latter also dissolves with difficulty in soda and potash solutions. Schweitzer's solution dissolves silk just as it does cotton. Sugar and sulphuric acid dissolves silk with a rose-red coloration (album reaction) and hydrochloric acid with a violet coloration. When submitted to the action of nitric acid, silk turns yellow.

A concentrated solution of zinc chloride, 138 deg. Tw. (sp. gr. 1.69), made neutral, or boiled with excess of zinc oxide will dissolve silk slowly provided the solution is cold, but rapidly if heated, in turn forming a thickened gummy liquid.

Other solvents for true silk are: ammoniacal copper oxide, ammoniacal nickel oxide and caustic potash or soda, it (the silk) being precipitated on adding water.

TO DISTINGUISH TRUE FROM WILD SILK.

Wild silk of commerce, frequently called tussah (although this is only the name of the most prominently known variety of wild silks) is less reactive chemically than true silk.

Alkaline solution of copper hydrate in glycerine: Will scarcely affect wild silk, whereas true silk is readily dissolved by it.

Hot 10 per cent sodium hydroxide solution: Dissolves true silk in 12 minutes, whereas it takes 50 minutes for dissolving wild silk.

Cold HCl (sp. gr. 1.16): Dissolves true silk very rapidly, whereas wild silk is only partly dissolved in 48 hours.

Neutral ZnCl₂ solution (sp. gr. 1.725): Dissolves true silk very rapidly whereas wild silk dissolves slowly. This test was previously referred to in connection with testing for wool, cotton and silk.

Strong chromic acid solution: Dissolves true silk very rapidly, whereas wild silk dissolves very slowly.

DISTINCTION BETWEEN ARTIFICIAL SILKS.

In outward appearance the different kinds of artificial silks are so nearly alike as to be indistinguishable, even a microscopical examination is liable to error no matter how well acquainted the observer is with the magnified characters of artificial silks.

In all cases of artificial silk, there is no test which gives a quick, definite reaction which is unmistakable, and the reason why it is so difficult to find distinguishing reactions, is that the different artificial silks behave differently within themselves to the same reagent.

Mechanical colorations are unreliable, as in making several tests of different samples of the same class of silk, the colors often differ very widely in intensity. Diphenylamine gives good results for detecting cellulose, but the strength of the fibres frequently varies greatly in different lots, some being capable of standing three times the treatment of others, hence chemical tests must be made with care.

TO DISTINGUISH ARTIFICIAL SILKS FROM EACH OTHER, AND FROM TRUE SILK.

With reference to distinguishing the various kinds of artificial silk (Cellulose, Collodion, and Gelatin) among each other and against true silk, the following data will explain subject:

Water: No action on true silk; all artificial silks swell.

Diphenylamin in Sulphuric Acid: No action on true silk; collodion silk changes slowly to a blue, the other artificial silks do not change.

Schweitzer's Reagent: Dissolves true silk; cellulose silk swells slowly, collodion silk swells and dissolves, whereas gelatin silk changes to a violet but does not dissolve.

Iodine in Sulphuric Acid: Imparts to true silk a yellow coloration; cellulose and collodion silks are turned to a pure blue, whereas gelatin silk becomes brownish-yellow.

Chlor-iodide of Zinc: Imparts to true silk a yellow coloration; cellulose silk is turned to a grey blue, collodion silk is turned to a blue violet, whereas gelatin silk becomes yellow.

Vetillard's Reagent: Imparts to true silk a yellow coloration; cellulose silk does not become colored; collodion silk changes to a reddish-blue, becoming grey on washing, whereas gelatin silk turns red, which vanishes on washing.

Caustic Potash 40%: Dissolves true silk on boiling; cellulose silk swells but does not dissolve and turns yellow in color; collodion silk swells but does not dissolve, whereas gelatin silk dissolves rapidly.

Chromic Acid: Dissolves true silk very slowly, whereas it dissolves all artificial silks rapidly.

Conc. Sulphuric Acid: Has little action on true silk; cellulose silk becomes transparent and dissolves slowly; collodion silk dissolves rapidly, whereas gelatin silk dissolves slowly when heated.

Acetic Acid: Dissolves true silk; cellulose and collodion silks swell slowly, whereas gelatin silk dissolves completely when heated.

Alcohol: No action on true silk; the fibres of all artificial silks contract.

Conc. Hydrochloric Acid: Has little action on true, cellulose and collodion silks, but dissolves gelatin silk rapidly.

To Distinguish Silk, Cotton and Wool.

TO DISTINGUISH SILK FROM COTTON.

Silk can be distinguished from cotton by alkalizing a solution of fuchsin, adding drop by drop a liquor of potash or caustic soda. The moment the liquor gets discolored, the threads to be tested are immersed and lifted after half an hour and carefully washed. Under this treatment silk fibres become red, whereas cotton fibres remain colorless.

TO SEPARATE SILK, COTTON AND WOOL.

To separate silk, cotton and wool in a sample containing these three fibres, remove first size and dye, and in turn treat the sample with ammoniacal nickel oxide, which dissolves the silk at once. The cotton in turn is then dissolved from the remaining portion of the sample by means of ammoniacal copper oxide, leaving the wool behind.

In connection with another test the sample is then boiled in an aqueous solution containing 10 per cent of hydrate of soda, and when wool and silk will dissolve, while the vegetable fibres remain unacted upon. The whole is then thrown upon a cotton filter, and the undissolved matter washed with hot water and afterwards acidulated with 5 per cent of hydrochloric acid, to which, if the residue is black or dark colored, a few drops of chlorine water are added.

Meantime, the original alkaline filtrate can be tested for wool with acetate of lead. If a white precipitate is formed, which dissolves on stirring, silk alone is present. A black precipitate indicates wool. The nitro-prusside of sodium gives a violet color if wool is present.

If the tissue is deeply colored it may be cut up and steeped for from fifteen to twenty minutes in a mixture of two measures of concentrated sulphuric and one of fuming nitric acid. Wool, silk and coloring matters are destroyed, while the cellulose is converted into gun-cotton.

White and pale mixed tissues may be tested by their affinity for colors. They must be cleansed and rinsed thoroughly in water to remove starch and similar dressings; soaked for ten minutes at 50 to 60 deg. C. in water containing 2 per cent of sulphuric acid, and washed again. In the meantime the color bath must be prepared by dissolving a few decigrammes of magenta in 28 to 30 cubic centimeters of water, and heated to boiling. During ebullition, caustic soda must be added to it drop by drop, till a pale rose color only remains in the liquid. The liquid must be removed from the fire, and the sample immersed in it for some minutes, after which it must be removed and dried. Silk and wool are dyed by this treatment, while the vegetable fibres remain colorless.

Wool may be detected in silk by the presence of sulphur. If it is immersed for a time in a plumbate of soda prepared by dissolving lead hydroxide in caustic soda, the silk will be colorless and the wool black; or a piece of the tissue 2 centimeters square may be boiled in 10 to 12 cubic centimeters of Schweitzer's solution. In from five to ten minutes the silk will be dissolved. If the silk is black, double the volume of Schweitzer's solution should be added, and the mixture soaked from ten to twelve minutes. The undissolved wool should be then removed and the liquid quickly neutralized with nitric acid. Silk will remain in solution, while cellulose will be precipitated.

Hydrochloric acid is a solvent of silk, while it leaves wool and cotton unacted upon for a lengthened period.

(To be continued.)

SILK THROWING.

What Silk to Use.

China's Silks.

(Continued from May issue.)

As a further step in its efforts to expand the sources of supply of raw silk by improving the reeling of Chinese silk skeins, so that much more of China's raw silk supply may become available for the American market, the Silk Association of America has lately suggested to the raw silk producers and merchants of the Chinese Empire, the possibility of establishing a direct means of conducting silk transactions between China and America.

The Association cites that this might be accomplished by forming a China-American Corporation for the purpose of preparing silk for reeling in Canton and marketing it in America. In addition, it suggests establishing a raw silk house under Chinese management in New York, as well as establishing an American house with Chinese associates in Canton.

The possibility of founding a Sericultural Institute under the Chinese Empire for the development of Chinese sericulture along European lines, and the extension of the Chinese raw silk industry, is also proposed, as well as the possibility of the government establishing in Canton and the Shanghai districts conditioning houses where the silk can be accurately tested and certified.

A further possibility suggested is that of securing a government subsidy for the opening of modern equipped filatures, and the payment of a bonus upon properly reeled silks, until the modern methods become thoroughly established. The income to the government on the increased foreign trade, it is believed, would justify an endeavor of this kind.

Among other propositions under consideration is the possibility of introducing into the various silk districts of China, the European methods of cocoon reeling by sending a number of Chinese reelers to Italy to learn the methods, and by inducing a number of Italian or French reelers to go to China and work as teachers or superintendents.

Also, the establishment in the Canton district of at least one filature, equipped with European basins and reels, for trial and example. This filature could be established and maintained, the Silk Association claims, by means of Chinese capital, or through a joint organization of Chinese reelers, with government support.

The great advantages of a properly formed, laced and packed skein for the American trade, the Association points out, have been thoroughly demonstrated since the adoption by Japan, and parts of China, of the American Standard Skein.

The defects which cause Chinese raw silks to wind poorly are thus:

A raw silk thread containing many fine and coarse parts will break in the fine places, consequently reducing production.

Insufficient and irregular crossing of the thread in the reeling from the cocoon or in the rereeling, will cause the thread to become tangled and break, adding to the waste produced in throwing as well as reduction in output.

The lacing should be laced back and forward through the skein several times and tied with short knots to avoid being tangled in the silk, by handling.

When the silk has been reeled so as to form masses of gum where the skein rests on the reel arms, it will