

# SECTION OF PHYSICS AND CHEMISTRY

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## RECENT PROGRESS IN THE CHEMICAL PROCESSES OF THE TEXTILE INDUSTRY.

BY

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WHILE it is quite true that the twentieth century has brought with it a host of inventions as well as actual improvements in the way of chemical preparations, unique processes, and labor-saving machinery, we must agree that by far the most important part of the program has been the amplification and development of ideas which were conceived in the latter part of the nineteenth century. This is, however, nothing unusual, for it has been observed that valuable inventions frequently lie unnoticed for a long time, awaiting, as it were, the magic touch of a keen-witted investor.

The subject which forms the title of the lecture for this evening may be conveniently divided in four parts, viz.: (1) newer preparations; (2) modern processes; (3) improved machinery; (4) the application of chemical engineering to textile problems.

### NEWER PREPARATIONS

The preparations of known composition which have been placed at the disposal of our industry during the last ten years include fifteen materials, some of which were known in the laboratory many years previous but were inaccessible for technical processes because of their high price. The following groups may be distinguished:

*Turkey-red Oil Group.*—This includes the preparations known in trade as Monopol soap (original)—a highly sulphonated castor oil; Monopol brilliant oil—prepared from Monopol soap with addition of certain fats; Monopol oil (Schmitz), prepared from castor oil by sulphonation. The first-named material is not a

true soap and was only so designated because of its resemblance to ordinary soap. These oils have been introduced as substitutes for the older turkey-red oil as levelling, softening and brightening agents. Added to the wetting-out bath they facilitate the penetration of cotton yarn. The foaming of dyebaths can also be avoided by the addition of small quantities of the oil. Tetrapol represents a solution of Monopol soap in carbon tetrachloride which has been recommended for scouring, fulling and degreasing.

*Finishing Group.*—Under this head may be mentioned diastafor, a specially prepared infusion of malt put on the market as a thick syrup. It may be used for removing the starch from calico prints, removing sizing from warps and preparing thickenings for printing or finishing. Gum tragasol is prepared from the fruit of the Carob tree and is used for preparing sizings and thickenings. It occurs in commerce as a jelly having a slight buff tint. A small quantity of phenol is added in order to prevent fermentation.

*Hydrosulphite Group.*—This includes a series of preparations related on the one hand to hydrosulphuric acid and on the other to formaldehyde. They are used for “discharge printing” and for stripping. In some cases zinc oxide has been added to the preparation in order to produce clearer effects on the discharged places. The commercial brands include: hydrosulphite NF (Hoechst), hyraldite C (Cassella), rongalite C (Badische), blankit (Badische). Rongalite, for example, is the sodium salt of formaldehyde sulphonylic acid. This salt is quite stable, whereas the free acid is readily decomposed by air or water.

*Degreasing Agents.*—Carbon tetrachloride is the only member of this group which has attained to importance. Its present price is approximately ten cents per pound. There appears to be a large field for this substance as a degreasing agent for wool and in the cleaning of garments, as it is not inflammable.

*Bleaching Agents.*—Since the introduction of sodium peroxide by Castner more than ten years ago this substance has received increasing attention from textile bleachers, but the price at which it is offered makes it impossible to use it in the bleaching of cheaper cotton goods. One large field of usefulness is in the bleaching of tussah silk.

*Mordanting and Dyeing Agents.*—Formic acid and lactic acid

have been on the market for several years, but have not yet succeeded in displacing acetic acid and the older assistants. Formic acid is sold as a 75 per cent. and 85 per cent. solution, and is particularly valuable because of its very strong reducing power. Lactic acid is sold in concentrations of 22 per cent., 50 per cent. and 80 per cent. It is also sold in the form of the ammonium compound (Lactamine) and as the sodium or potassium salt (Lactolin). Formic acid is prepared by the action of glycerin on oxalic acid while lactic acid is prepared by the fermentation of glucose.

*Dyestuff Group.*—The most important change in the manufacture of artificial coloring matters has unquestionably been the introduction of the sulphine or sulphur colors. Vidal black which was introduced in 1893 was followed in 1896 by the first katigen brown which in turn was the forerunner of the present important group. The sulphur dyestuffs are also known in trade as thiogene-, katigen- and kryogen-colors. Another sulphur compound which proved to be a dyestuff is the thio derivative of indigo which appeared in 1907 as thio indigo red and its more recent relative thio indigo scarlet R paste (Kalle). These two last mentioned sulphur dyes are applied to the cotton or wool fibre in a manner similar to vat indigo. In the group of important modern dyes belongs one which appeared as early as 1881, but which did not attain commercial success until 1897. I refer to the synthetic indigo discovered by Adolph von Bayer and technically prepared by Heumann in the year mentioned. From 1897 up to the present time the Badische Anilin and Soda Fabrik have been working diligently in perfecting the manufacturing process for this invaluable dyestuff. About the year 1900 the Hoechst Color Works succeeded in producing artificial indigo according to Pfluger's modification of Heumann's "Benzene Method."

Having thus briefly reviewed the newer preparations we will turn our attention to the

#### MODERN PROCESSES.

A process distinctly an American achievement is *the degreasing of wool* by means of volatile solvents first proposed by Mrs. Ellen Richards in 1879 and later developed on a technical scale at the Arlington Mills by Emile Maertens (1895). The petroleum naphtha at present used for this process is an undesirable neces-

sity because of the fire hazard with which its use is accompanied. It may therefore be replaced before very long by the non-combustible carbon tetrachloride. The subject of cross-dyeing has been investigated very thoroughly during the last two years with reference to the production of "*resists on worsted yarns.*" In this process the yarn is dyed and then treated in a bath of tannic acid followed by a bath of tin crystals. The yarn so prepared may be interwoven with normal woolen yarn and then "dyed in the piece." The treated yarn has little or no affinity for acid and mordant dyes.

A German chemist named Kann has taken out a patent for a process of rendering *wool resistant to the action of alkalies*. The agent used for this purpose is formaldehyde. The idea is important as well as interesting, for by this means it may be possible to apply the sulphur colors to cotton-wool fabrics in the presence of such alkaline substances as sodium sulphide without any danger of rotting the wool.

The processes used in the preparation of *non-shrinkable wool* have up to the present time not been made public. Wool acquires this property to a small extent by treatment with a solution of chloride of lime. The fact that woollen yarn so treated acquires a silk scroop, a higher lustre and an increased affinity for dyes has been known for some time. Becke and Beil have taken out a German patent for the treatment of wool with concentrated sulphuric acid whereby its physical and chemical properties are altered. Fothergill has patented in England a process for rendering *cotton resistant to the "direct" cotton colors*. For this purpose the yarn is worked in a bath of tannic acid followed by a bath of tin crystals.

During the last decade a large number of processes have been suggested for the lustring of cotton fabrics with the object of *producing silk-like effects*. The methods of mercerizing warps and woven fabrics have been greatly improved, and, what is more important to the textile industry at large, the American patents were declared null and void by Judge Lowell of Boston in 1906. Another process of lustring and one which incidentally waterproofs the fabric is that in which a dilute solution of viscose is applied to the surface of the goods. In place of viscose another patentee has suggested a solution of cellulose in ammoniacal copper oxide. If the fabric be treated with this and subsequently passed over hot calenders and finally treated with an acid in

order to remove the excess of copper, a lustrous finish is obtained. Still more recently Dr. Schreiner of the Bemberg Factory in Barmen, Germany, has introduced a purely mechanical process for lustring cotton fabrics. The goods are passed under an engraved calender to which a pressure of 35 or 40 tons is applied. The calender is engraved with fine lines (from 5 to 20 lines per millimetre). Although the German patent was taken out in 1894 it was fully ten years before the process was taken up in foreign countries.

The manufacture of fabrics with a "*fur finish*" is distinctly a modern process, having been brought to the United States from Russia but a few years ago. The raw goods for this process may be either a pile fabric (for Persian lamb effect) or it may be a fabric containing a loose spun, long, hair fibre filling (for broadtail effect). In the first instance the fabric is embossed, and in the second instance the effect is produced by napping and brushing. The production of *color effects on tapestry carpets* by printing has been developed considerably by the introduction of modern cylinder machines, which have taken the place of the older block printing. The *paper yarns* first exhibited at the Philadelphia Centennial in 1876 were produced on a technical scale at Richmond, Virginia, about the year 1890, but the successful production of high grade *paper carpets* was begun about the year 1900 by William Scholes at Germantown, Pennsylvania. The warp is in all cases made of hard spun cotton yarn, and the filling may be totally of paper or paper yarn and woollen carpet yarn. The designs are produced either on a Jacquard machine or by means of printing. Since 1904 Schuckert & Co. of Nuernberg (Germany) have perfected an "*Electrolyseur*" by means of which a solution of sodium chloride is electrolyzed, and the resulting chlorine liquor containing about 20 grams of chlorine per litre is used directly for bleaching purposes. As this corresponds to a lime liquor of about 5 degrees Baumé it will, as a rule, be necessary to dilute the bath. In the year 1898 J. Cadgene of Lyons (France) introduced a method of *applying dyes to silk fabrics* by means of a spray (Zerstäubung). The effects produced depend on the number of spray nozzles, the pressure applied to the dye solution, and the motion given the nozzle. An ombre effect can be readily produced. The production of *artificial horsehair* by coating fine cotton yarns with solutions of viscose or pyroxilin forms the subject of a

patent by C. N. Waite (U. S. P. 791,385). The product is, of course, much stronger than the varieties of artificial horsehair made wholly of viscose or pyroxilin. Fabrics made of this material have appeared on the market during 1908. Turning to the "*quick-retting*" processes for vegetable fibres we find that many inventors have made attempts to displace the painstaking Courtrai method of river retting by a chemical treatment. The process used up to the present in the United States is the cheap and wasteful "*dew retting*." Retting in one form or another is absolutely essential in the case of the bast fibres,—flax, hemp and jute, so that it is not astounding to find a long list of inventions along this line. One of the most promising systems is what is known as the Loppens-Deswarte retting tank. Although these inventors make no use of chemicals there are some others who have suggested various additions to the bath in order to hasten the fermentation and solution of the pectic matter of the stalks. Charles Colahan in 1906 took out an American patent for treating the raw stalks with the waste of oil refineries.

About the year 1895 a new method of weighting silk (*the tin-phosphate-silicate process*) was offered to the silk industry. This consists in passing the silk through baths of stannic chloride, sodium phosphate and finally sodium silicate. Experiments show that a weighting of approximately 30 per cent. may be obtained by *one* passage. This new process had not been in use very long before it was observed that silks which had been dyed in pale shades of blue and pink and had then been handled soon developed "*red spots*." Investigation showed that these were due to the perspiration of the hands having been deposited on the fabric. In 1905 Meister took out a patent for treating silks for the *prevention of these "red spots"* by means of a bath of sulphocyanide. Silks which have been treated in baths of this salt are not sensitive to perspiration, but lack the peculiar "*feel*" of untreated silk. Of the many processes for *fireproofing* which have been patented the only one which deserves special mention is that by Perkins and Whipp in which cotton fabrics are impregnated with solutions of sodium stannate.

The methods of *waterproofing* fabrics by parchmentizing, rubberizing and Schweitzerizing are at this time too well known to warrant detailed discussion. Suffice it to say that the rubberized cloths have found extensive application for rain garments while the other fabrics are used to some extent by bookbinders.