Coloration Process of Textile Fibers

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Abstract:

Textile coloration is a wet process that uses dyes, chemicals, and large volume of water. The chemical wet processing of textiles continues to expand each year using new technologies. The driving force being the need of because the quality of fabric depends on the Coloration of textile fiber mostly. There are many technologies in coloration of textile fiber but in this article the total idea of coloration of textile fiber is given.

Introduction:

Coloration is the aqueous application of color, mostly with synthetic organic dyes, to fiber, yarn or fabric. In this process, dye and auxiliary processing chemicals are introduced to the textile to obtain a uniform depth of coloration with color fastness properties suitable to the end use. Different fastness requirements may apply depending on the intended end use of the textile. Examples might include swimsuits that must not bleed in water and automotive fabrics that should not be faded following prolonged exposure to sunlight. Different types of dyes and chemical additives are used to obtain these properties . Dyes can be applied to textiles by various forms of continuous pad applications, or exhaust dyed in batch processing equipment. Knit fabrics are dyed by exhaust techniques in batch equipment and woven fabrics are most often dyed continuously. The chemical wet processing of textiles continue to expand each year as older products and processes are replaced by the technological diffusion of novel products and innovative processes. The driving force being the need for cleaner, cost-effective, and value- added textile production

Objective:

This article paves the way to the readers to understand the effect of new technologies in coloration of textile fibers. Effects of bleaching in coloration . Effects of nanotechnologies , Effects of ultrasonic waves etc are discussed here. Using this technique production of color fiber can be increased. Using coloration technique the cost will be reduced in processing of color fabric. It can decrease the environmental pollution in using of water in wet process. The dyeability increases due to using this technologies. Durability of fabric and color fastness will be increased if we use these techniques. Global world is warming day by day.The percentage of carbon di oxide is increasing day by day. But if we use super critical carbon di oxide in processing of coloration of fibers, the amount of carbon di oxide will be decreased from environment.So the processes or techniques of coloration of textile fiber are environment friendly . In fine we can say that temperature and pollution don’t effect these techniques. So we can use these techniques in industrial sectors.

Keyword:nanotechonoligies,matrix, Carbon Black,Nanocompositities,Nanosized pigment,hydrogenation,super critical carbon di oxide,oxidization, reduction. Electrocatalytic,plasma technology,Nanodispersion.

Materials and Methods:

Bleaching in coloration of textile fiber:

At first, we can start the pretreatment procedure of wet processes. Effect of bleaching in coloration varies to the fiber to fiber. Let, we can measure about jute fiber and cotton fiber.

In case of Jute fiber we can use hydrogen peroxide and per acetic acid. The fiber is pre modified with ferrous sulphate , copper sulphate, alam etc.Some natural dyes can be used to coloration of jute fiber.They are madder , eucalyptus leave, Indian Almond leave, Tumeric etc. Effect of bleaching in coloration of jute fiber is, it losses its weight, tensile strength, whiteness, yellowness and brightness. In Case of cotton fiber we can say that, hydrogen peroxide also use in bleaching of cotton.Hydrogen peroxide is a colorless liquid. It is soluble in water. It is really stable under the PH of 7 but it tries to go unstable. The bleaching liquor must be alkaline, otherwise it would be too stable. Like other cellulosic fiber effect of bleaching is , it losses weight, tensile strength, whiteness, yellowness and brightness. So, bleaching creates weight losses of cellulosic fiber and that’s why it creates great impact on coloration of textile fibers due to loss of weight .It also affects the reflectance of fibers. Below Figure is shown to the effects of bleaching agent (NaOH) in reflectance of fiber.

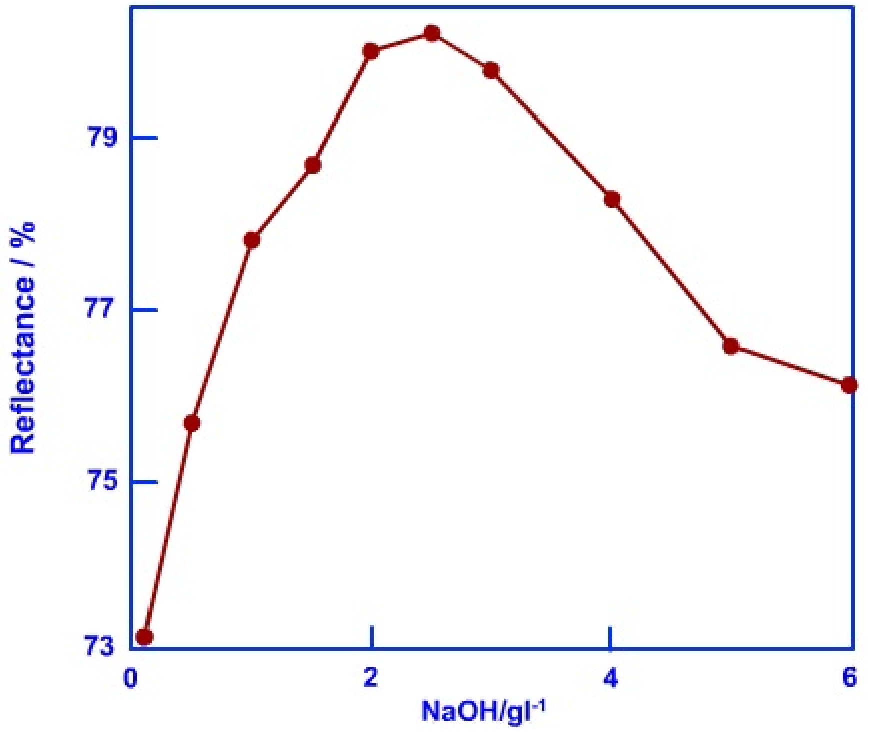


Fig:1 Reflectance % vs NaOH /gl-1

Here graph shows that reflectance increases due to the NaOH/gl-1 solution. But few times later it decreases when amount of NaOH/gl-1 is increased.

Nanotechnology:

Nanotechnology is the important method for coloration in textile fiber. Textile fiber composites are basically bound in various types of molecules . After coloring the textile fiber, nanoparticles are vibrated and makes deposition from its actual position. So dye molecules penetrate the fiber axis and change the phase of material. The various types of nanoparticles and nanofabrics are given below:

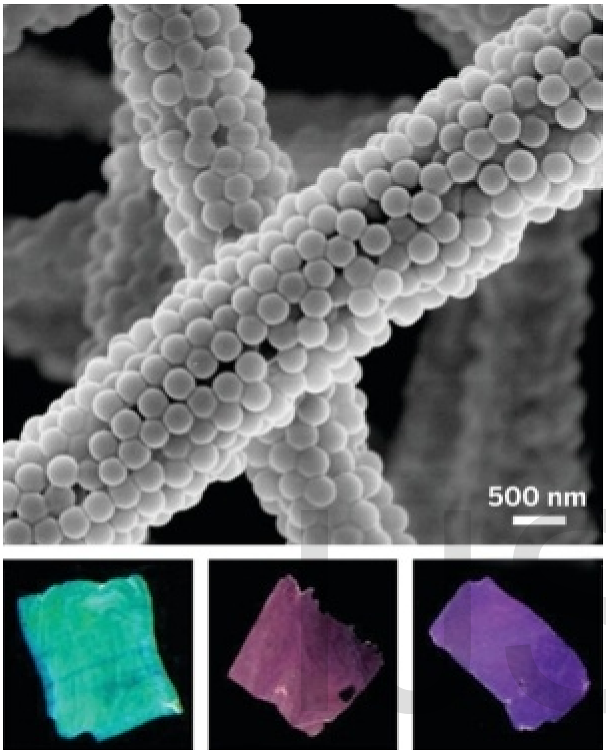
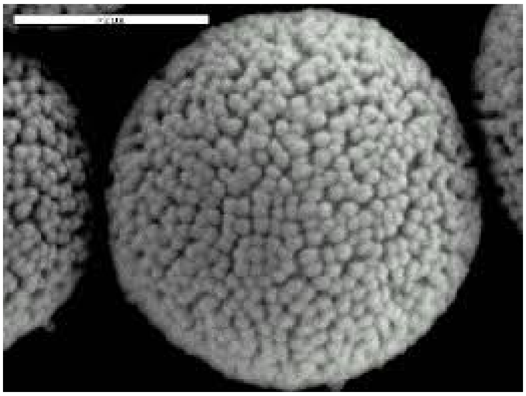
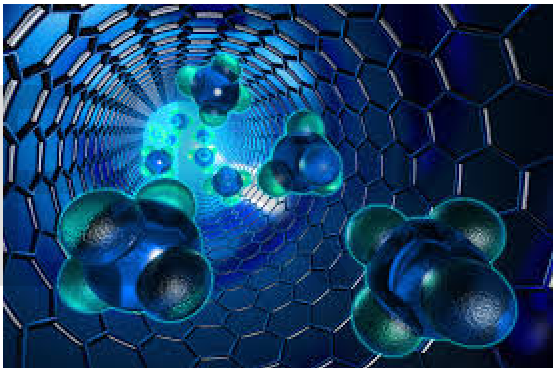


Fig1(a): various types of Nanoparticles and Nanofabrics .





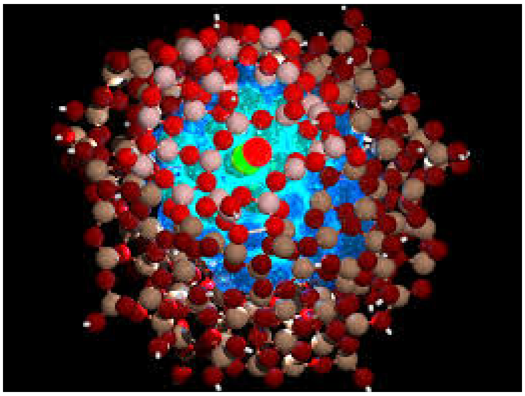


Fig:1(b):various types of nanomaterials after coloration

Particles which are used in commercial products are in the range of 1–100 nm are called nanoparticles. Nanotechnology is increasingly attracting worldwide attention because it is widely perceived as offering huge potential in a wide range of end uses. The unique and new properties of nanomaterials have attracted not only scientists and researchers but also business holders due to their huge economical potential.

Nanotechnology has real commercial impact for the textile industry. This is mainly due to the fact that conventional methods used to impart different properties to fabrics often do not lead to permanent effects, and will lose their functions after laundering or wearing. Nanotechnology can provide high durability for fabrics because nanoparticles have a large surface area to volume ratio and high surface energy, thus presenting a better affinity for fabrics and leading to an increase in durability of the function. In addition, a coating of nanoparticles on fabrics will not affect their breathability or hand feel. Therefore, the interest in using nanotechnologies in the textile industry is upgrowing .

The first study on nanotechnology in textiles was undertaken by Nano-Tex, a minor of the US-based Burlington Industries . For next, more and more textile companies began to invest in the development of nanotechnologies. Coating is a common technique which is used to apply nanoparticles onto textiles. Several methods can apply coating onto fabrics, including transfer printing, washing, rinsing, and padding. Of all methods, padding is a must.The nanoparticles are attached to the fabrics with the use of a padder adjusted to suitable pressure and velocity, followed by drying , curing and cooling. The properties imparted to textiles using nanotechnology include water repellence, soil resistance, wrinkle resistance, anti-bacteria, anti-static and UV-protection, flame retardation, improvement of dyeability, and more. As there are various potential applications of nanotechnology in the textile industry, only those related to textile coloration are critically highlighted below.

Nano-sized pigment components in textile coloration:

The development of nanotechnologies have stimulated research on applications of nano-sized pigment components in textile processing. One possible application is to directly employ pigment nanoparticles in textile coloration. Such an idea could be achieved if the nanoparticles can be reduced to a small sufficient size and the components can be dispersed well to avoid aggregation of the nanoparticles in dye baths .

Exhaust dyeing of cationized cotton with nanoscale component dispersion has recently been achieved and the results indicated that the dyeings obtained have better soft handle and more brilliant shade with reduced pigment requirement than those obtained with a conventional pigment dispersion .

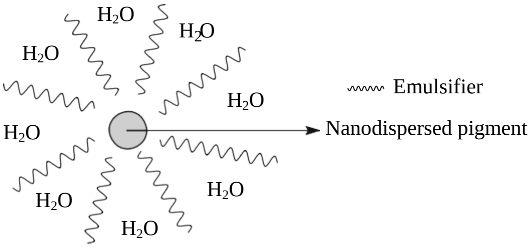


Fig.2: Nano dispersion of an organic pigment

Langhals has recently reported the possibility of getting nanodispersion of lipophilic perylene bisimide pigments through studying the information about the direct environment of the pigment molecules in the nanoparticles using UV/Vis spectroscopy. The UV/Vis spectra of the nanodispersion of the pigment were identical with the spectra in homogeneous lipophilic solution such as in chloroform indicating the completely cover the chromophore in its nano-size by the dispersant. The coloration of cellulose fiber with such dispersions was also demonstrated .

Previous research has shown that surfactant dispersed carbon black nanoparticles in nominal size of 8 nm were able to diffuse slowly into polyester and acrylic fibers at temperatures above their glass-transition temperatures in a thermal coloration process . However, in exhaustion coloration of cotton, wool, acrylic, and nylon fabrics, dispersion of that nanoparticles in aqueous solutions and adsorption of the particles onto surface of the fibers was only achieved after modifying Carbon Black by oxidation process to render it hydrophilic due to the formation of carboxyl groups on the surface of the components and leading itself dispersible without the help of dispersing agent .

Dyeability of nanocomposite fibers:

Nanocomposites are materials that are created by familiar to nanoparticles into a macroscopic sample material that is known as matrix . This is part of the growing field of nanotechnology. After adding nanoparticles to the matrix material, the resulting nanocomposite may open rapidly increasing properties .

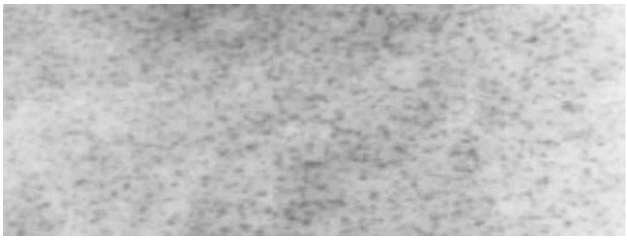


Fig. 3: Nanocomposite fiber

Polypropylene is cheaper than nylon and polyester and polyethylene, but its dyeability is a problem. There are few conventional processes which can improve the dyeability of copolymerization, blending, and graftination.; however, all these processes are costly and in turn raise the overall cost of that fiber. Nanotechnology has solution for this problem. Nano clays modified with quaternary ammonium salt were used to make nanocomposite polypropylene .

This novel polypropylene is dyeable with both acid and disperse dyes. The acid dyeability of the nanoPP is due to the ionic area between the negatively charged acid dye and the positively charged quaternary ammonium salts in the nanoclay. Van der Waals forces, and perhaps hydrogen bond also play vital role in acid coloration of the nanocomposite polypropeylene. For the coloration with disperse dye, it was proposed that the attraction between the disperse dye and nanoclay is mainly due to the van der waals forces and hydrogen bonds. Also the acid dyeability of nanoclay polypropeylene nanocomposites using three types of chemical structures, namely, anthraquinone, premetallized, and monoazo with three main colors, which are C.I Acid Blue 80, C.I Acid Orange 74, C.I Acid Red 266 have found recently.

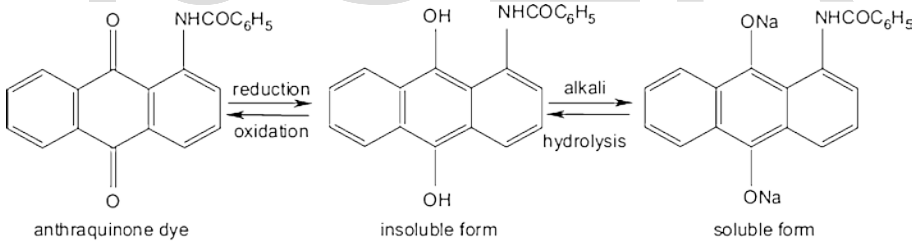
It was also reported that polyamide 6 (PA6) nanocomposite dyed yarn itself faster with disperse dyes than unfilled PA6 yarn, while it is the opposite with acid dyes and 2:1 metal complex dyes. In both later cases the nanoclay fixes on the amino sites, removing the fixation of the acid or the metal complex dyes .

Recently, polyester (PET) nanocomposite fiber was prepared from polyester and silica (SiO_2) nanoparticles aiming at getting a high value for PET and better dyeability with disperse dye. The result shows that PET/ SiO_2 nanocomposite fibers gave a greater degree of weight reduction upon alkaline hydrolysis as compared with that of pure PET fibers. Higher and tougher superfine structures, such as cracks, cavities etc were introduced, which would pave the way to the certain application-like deep coloration .

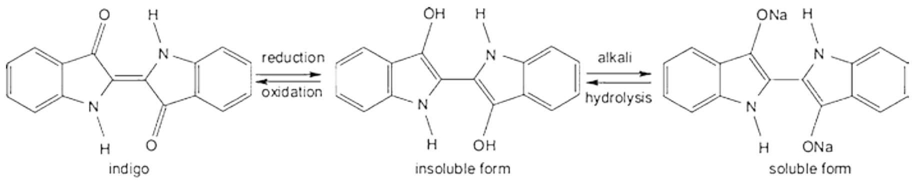
Coloration with electrochemical reaction:

In the coloration of cellulose fibers, vat dying with sulfur dyes still give a relatively maximum part of the dyestuff market . The situation will remain constant also in the upcoming future mainly because vat dyes yield colored fibers of excellent all-round rapidness, particularly to light, washing, and chlorine bleaching. Sulfur dyes are very important for the production of cheap products having average fastness requirements. The dyes are very quick to light and washing, but not to chlorine.

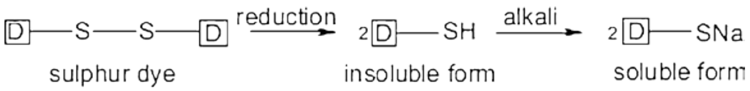
Below the figure shows these dyes have to be reduced before coloration to be transferred into the water-soluble form which have to toward fibers and which after absorption into the fibers to be dyed, must be re-oxidized to the pure water- insoluble dye pigment make the fibers .



Mechanism of reduction/oxidation of vat dyes



Mechanism of reduction/oxidation of indigo dyes



Mechanism of reduction/oxidation of sulfur dyes

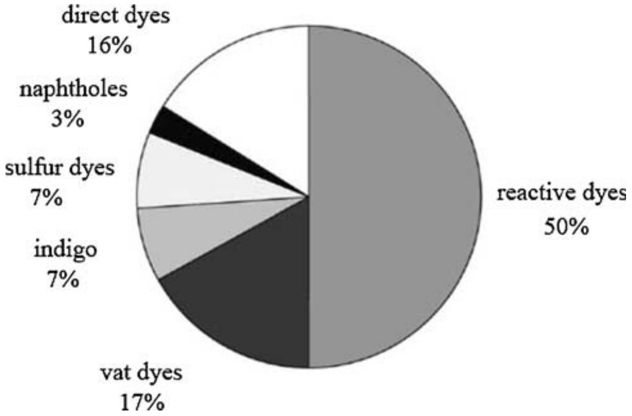


Fig. 4: Worldwide consumption of dyes for coloration of cellulose fibres .

The reducing agents required in the coloration process for vat and sulfur dyes cannot be recycled and pave the way to problematic wastages. In recent investigations to improve the biocompatibility of the vatting process even further, various electrochemical reducing methods have been described, such as indirect electrochemical reduction creating a redox mediator, direct electrochemical reduction of indigo via the indigo radical, electrocatalytic hydrogenation and direct electrochemical reduction of indigo itself on graphite. These processes offer environmental benefits, since they minimize the consumption of chemicals as well as effective load . The technology combines an electric current with a recyclable mediator. It replaces the non-regenerative-reducing agents currently used to apply vat and sulfur dyes to textiles, which often prevent recycling of the dye bath and cause contamination of production effectiveness .

Electrochemical reduction by indirect process:

The rate-reducing step of the electrochemical reduction is the electron-transfer from the cathode surface to the surface of the micro crystals of the dispersed dye pigment. If the electrons have to be transferred directly between the solid surfaces it is occurred . Therefore, an indirect electrochemical reduction process making a soluble

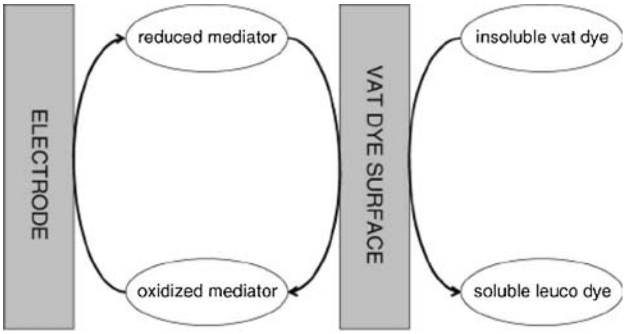


Fig 5: Principle of the mediator technique

redox mediator was developed to increase the rate of the electron-transferring process .

The mediators established in this process are regenerable iron complexes with gluconic acid as ligands. These mediators, however, are expensive and not fully harmless from a toxicological point of view. In addition, after the reduction and prior to the coloration process the mediator has to be detached from the soluble leuco dye by ultrafiltration, which increases the costs of this vatting process .

Electrochemical reduction by direct process:

Besides to the mediated electrochemical reduction, recently a novel electrochemical vatting process for vat and sulfur dyes has been explained. This reduction does not need the presence of a redox mediator. Leuco dye, playing as an electron-shuttle between the electrode and the surface of the dye pigment, has to be generated first in a small amount to initiate the reduction, which then proceeds by itself .

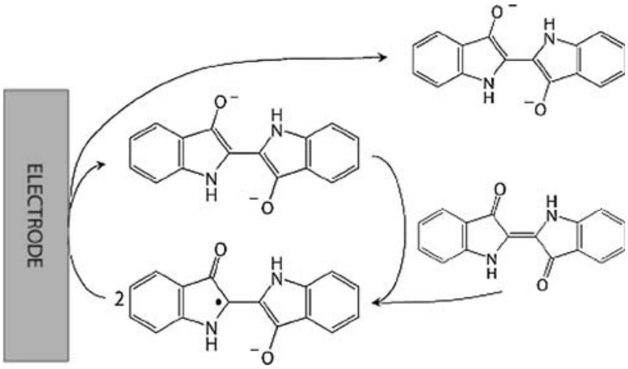


Fig. 6: Mechanism of the direct electrochemical reduction of indigo radical

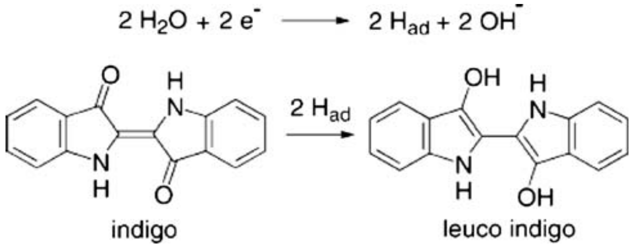


Fig7: Electrocatalytic hydrogenation of indigo

Electrocatalytic hydrogenation:

The electrocatalytic hydrogenation is promising and attractive in view of economic and ecological aspects. The electrochemical hydrogenation is a process in which adsorbed hydrogen, produced in situ by electrolysis of water, reacts with adsorbed organic substrates (e.g., vat dye) at the electrode surface .

The hydrogenation step is in competition with the hydrogen evolution reaction and the efficiency of the electrocatalytic hydrogenation is determined by this competition. The electrocatalytic hydrogenation has various advantages over the conventional catalytic hydrogenation (e.g., elevated temperatures and pressures can be avoided and the explosion risk is minimized).

In conclusion, from the point of stability, availability and costs, the latest development concerning direct electrochemical reduction on graphite granules seems to be the most attractive process and the results are obviously a promising basis for further development. The market introduction of the mediator process is imminent and the message is simple: electrochemistry in textile industry is coming our way.

Coloration with supercritical carbondioxide (ScCO2):

The application of supercritical carbon dioxide in the textile industry has recently grown an alternative technology for developing a more eco friendly Coloration process. $ScCO_2$ coloration technology has the potential to overcome several environmental and technical issues in many commercial textile applications such as yarn preparation, coloration and finishing. $ScCO_2$ gives a potentially unique media for either transporting chemical because supercritical fluids takes gas-like viscosities and diffusivities and liquid-like densities. Besides, carbon dioxide is non- toxic, non-flammable, environmentally friendly, and chemically inert under some conditions .Thus Its production is less costly.

The dissolving power of $ScCO_2$ for disperse dyes and its use as the transportation media for coloration polyester was studied from all theoretical aspects.

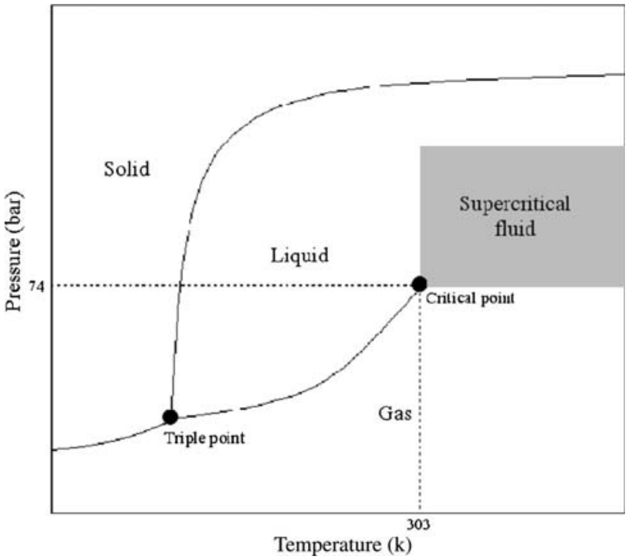


Fig 8: Phase diagram of carbon dioxide .

The presence of intramolecular hydrogen bonds or the hydrophobicity of dye molecule are positive factors for better solubility in supercritical carbon dioxide, as indicated from its improved dye-uptake .

Behind the screen of practical aspects of ScCO2:

Supercritical fluids are produced by the effects on gas and liquid changes in pressure and temperature. The phase diagram of carbon dioxide shows the interfaces between phases; at the triple point all three phases may exit in same phase. Above the triple point,increasing in temperature drives liquid to the vapor phase, it increases in pressure drives vapor back to liquid. The critical point for carbon dioxide occurs at a pressure of 73.8 bar and its temperature is 31.1 °C.

Benefits of coloration in ScCO2:

The use of $scCO_2$ as a fluid medium for coloration of textile fibers, especially polyester has been treated. The technology has taken so expecting that it has provided new chances to develop suitable dyes for this medium . The coloration is carried in a stainless steel high- pressure materials.

A technical-scale, 100-L dyeing machine was designed and built to test polyester beam dyeing in $ScCO_2$ at 300 bar

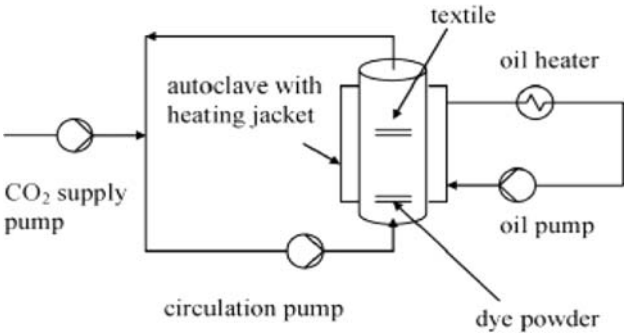


Fig9: Experimental set-up for textile coloration in CO_2

and 120 °C. A new type of pressure vessel was used, consisting of a steel liner with carbon fibers wound around to take up the radial forces and a yoke construction for the axial forces. This configuration lowers not only investment cost but also the operating cost, On account of the quantity of steam required to heat the vessel is lower than for a completely steel vessel. , because the carbon fiber vessel requires less heating due to the low heat capacity of the carbon fibers, the process time is very quick. To circulate the CO_2 with the dissolved dye through the textile, a low-pressure centrifugal pump was made for service in $ScCO_2$ and placed below the dyeing vessel.

Also a commercial-scale, 1000-L supercritical dyeing machine was made for treating 300-kg polyester while recycling all dye and 96% of the CO_2. An economical analysis showed that, although the purchase cost for a supercritical machine is higher than for an aqueous machine , the operating cost is lower (0.35 instead of 0.99 . This is caused by the higher rate of dyeing and by the simpler dye formulations that can be used in $ScCO_2$. The overall result is a 50% lower process cost for the supercritical process.

Attempts were made to modify cotton so as to be less hydrophilic and thus capacity to be dyed with disperse dyes in $ScCO_2$.

Recently, the influence of water addition in the dyeability of polyester, nylon, silk, and wool with disperse reactive dyes in supercritical carbon dioxide ($ScCO_2$) was investigated . It was found that disperse dyes containing a reactive vinyl sulphone or a dichlorotriazine groups are suitable for coloration textiles containing polyester, nylon, silk, wool, or blending of these fibers in $ScCO_2$. The dye uptake by polyester is independent of water addition. For the amino-containing textiles, the coloration increases with the concentration of water in the $ScCO_2$ and the textiles. The positive effect of water was due to its ability to swell fibers or due to an effect of water on the reactivity of the dye–fiber system. At the saturation point, deep colors were obtained with both dyes for polyester, nylon, silk, and wool, with fixation percentages lying in 75 and 94.

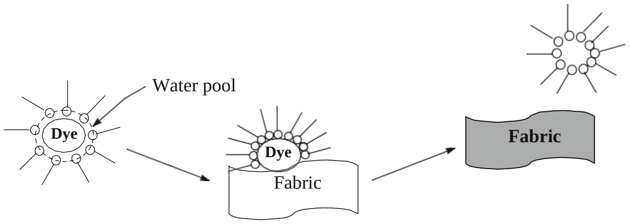


Fig.10: Dyeing of natural fibers using reverse micelle

For water-soluble dyes, however, steps were made to dye natural fibers using reverse micelle technique in which ionic dye, solubilized in the water-pool, passes into the fiber together with a small amount of water immediately after contact with it . Satisfactory results were obtained for proteinic fibers but not for cotton ones as a result of the electrostatic repulsion between the dye and the surface of the cotton fiber. Besides those coloration of textile fiber with ScCO2 is eco friendly because amount of CO2 is decreasing day by day.

Coloration with plasma technology:

Plasma is taken to be a partially ionized gas containing ions, electrons, and neutral particles produced by interaction of electromagnetic field with gas under appropriate pressure. Modern plasma-chemical techniques relate to environmentally natural technologies and superiors to chemical modification in corrosion , like acids, hydroxides, alkaline-earth metals, and other materials are used. In this context, the pretreatment and finishing of textile fabrics by plasma technologies is increasingly replacing wet chemical applications.

One of the most expecting and advanced polymer modification techniques is low-temperature plasma treatment, which allows the surface properties to be varied over a wide range and the area of application of polymeric materials to be considerably extended. This surface modification increases the hydrophilicity of the treated fiber. An important characterstics of plasma treatment is that it affects only the surface of a material subjected to treatment and a very thin near-surface layer whose thickness varies from 100 Å to several micrometers, according to different estimates. The conditions, retaining the mechanical, physicochemical and electrophysical properties of the original material . The UV photons emitted by the plasma have sufficient energy to break chemical bonds (e.g., C–C, C–H) and to create radicals which can transfer along the chain and regenerate.

Depending on plasma conditions and on the nature of the polymer, the action of the plasma results in activation (radical formation), chain scission, and cross-linking . Coloration of

Polyester textiles are usually dyed with disperse dyes by a thermosol process in high temperature and pressure. Otherwise, phenol-based carriers are needed to swell the fiber during coloration at constant pressure, which may pollute the environment. Therefore, low-temperature plasma was used instead of the chemical method for the treatment of PET fibers. An increase in color depth upon coloration was obtained after treating PET fabrics with both argon and air plasma. This was given to the plasma-induced increase of surface toughness and surface area. Also, the introduction of hydrophilic groups, induced by both reactive and chemically inert plasmas, may increase the water swelling capability and the affinity of PET fibers for dyes containing polar groups which takes to the increase of K/S values of dyed PET tools .

Starcture of nano surfaces are of great interest, since they provide a high surface area. A high functionality can thus be obtained by ultrathin coatings. Plasma polymerization of acetylene mixed with ammonia (C_2H_2/NH_3) onto PET fiber was used in a regime where both deposition processes took place yielding a nanoporous, crosslinked network with accessible functional groups .

Low-pressure plasma was used to save only polyester fiber multi-functional thin film from ammonia/ethylene or acetylene mixture. The coated polyester showed fiber was acid dyeable and showed high color strength values per film thickness. Moreover, the plasma-deposited and dyed polyester fabrics showed a good rubbing and washing fastness demonstrating the coating-functional permanency. The excellent abrasion resistance confirmed that the coating was permanently adhered to the substrate . Similarly PET fibers were treated with two plasmas (N_2, H_2 ,He) and (SO_2 , O_2). It was found that the dyeability was significantly improved for water soluble acid dyes owing to the increased surface area as well as the hydrophilicity of the PET fiber .

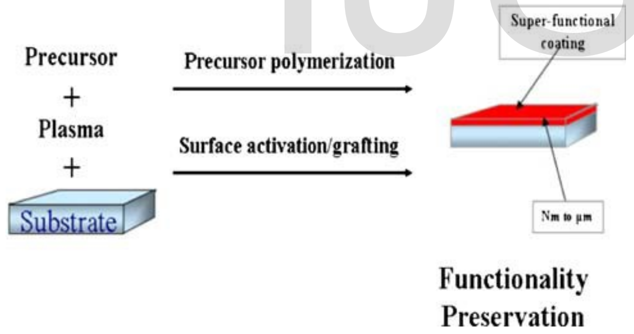


Fig. 11: Nanostructured plasma coating

Wool, unlike other natural fibers, has a complicated surface structure and it is one of the important fibers in the textile industry. However, it has some technical problems such as wet ability. The wool fiber surface is hydrophobic which is occured in the presence of a high number of disulfide cystine crosslinkages (–S–S–) in the A-layer of the exocuticle and of fatty acids on the fiber's surface. This surface morphology is thought to elect the diffusion in wool fiber .

Low-temperature plasma (LTP) was used in lieu of the chemical method for the treatment of wool. It has been confirmed that LTP treatments improve the coloration behavior of wool fibers in different coloration systems. This can be due to plasma-induced cystine oxidation and thus to the reduced number of crosslinkages in the fiber surface which in turn paves the way to a transcellular in addition to the intercellular dye diffuse.

Reactive dyes are used for the application with cotton fibers as they provide a fulfill color range and are easily applied, particularly in exhaust coloration. However, reactive dyes have only a moderate attraction for cotton fiber. Few previous attempts have been made to overcome this limitation. One of the most important methods is to increase dye–fiber interaction using cationized cotton. In this interest, plasma-treated cotton fiber in the presence of amine compounds showed improved dyeability with reactive dyes when compared to the untreated fabric .

Coloration with Ultrasonic system:

Power ultrasound can increase a wide variety of chemical and physical processes, mainly on account of the incident known as cavitation in a liquid medium that is the growth and explosive collapse of microscopic bubbles. Sudden and explosive collapse of these bubbles can make hot spots .

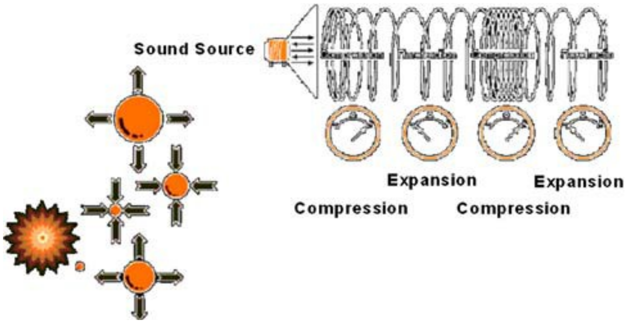


Fig. 12: Ultrasonic cavitation in a liquid medium

Therefore, many efforts have been given to spread this technique in the textile coloration as it is a major wet process, which consumes much energy and water and releases large effluent to the environment. Improvements observed in ultrasound-assisted coloration processes are generally attributed to cavitation incident and as a consequence, other mechanical and chemical effects are produced such as:

- Dispersion (breaking up of aggregates with high relative molecular mass);
- Degassing (expulsion of dissolved or entrapped air from fiber capillaries);
- Diffusion (accelerating the rate of diffusion of dye inside the fiber);
- Intense agitation between the liquid and disperse medium.

The acceleration in coloration rates observed by many workers might be the cumulative effects of the above .

Moreover, during last decade Marco Company of Korea had developed an ultrasonic retrofit module that has a generator, transducer, and electronic wire for jet-dyeing machine . Other reported attempt to produce production machines is *ultrasounds*: an industrial solution to optimize costs, environmental requests, and quality for textile finishing

The pioneering work invented by a scientist named Thakore in 1988 showed that cotton fabric could be ultrasonically dyed with direct dyes. The results indicated that the use of ultrasonic greatly reduced dyeing time, reduced dyeing temperature, reduced concentration of dyes, and electrolytes in the dyes-bath .

Ultrasonic-assisted coloration of cellulosic fabrics, the colorations were carried out conventionally and with the use of ultrasonic techniques were compared in terms of percentage exhaustion, total amount of dye transferred to the washing bath after coloration, fastness properties, and color values. Results obtained in this study indicates that ultrasound improved dye fixation and increased the percentage exhaustion for both reactive dyes, but had no effect on the fastness properties of the dyed materials.

Cotton was dyed with the direct dyes Solophenyl Blue FGL 220 and Solophenyl Scarlet BNL 200. Both dyes needed a relatively large amount of salt for exhaustion. The important facts of this study were that coloration with direct dyes at lower salt levels indicate the same final exhaustion as coloration at higher salt level without ultrasound. Ultrasound has the greatest effect on coloration at low temperatures and in addition, it can reduce the amount of salt and energy required when compared to a conventional process .

The coloration of cotton fabric using Eclipta as a natural dye has been studied in both conventional and modern methods. This modern coloration shows 7–9% efficiency higher than conventional coloration . Also, ultrasonic proved effectiveness in dye-uptake of cationized cotton fabric with natural dye and the increased effect after equilibrium coloration was about 66.5% more than the conventional heating .

The coloration process of silk using cationic, acid, and metal–complex dyes at low temperatures, with the help by a low-frequency ultrasound of 26 kHz and compared the results of dye uptake with those obtained by conventional processes was studied . The results show that silk coloration in the presence of ultrasound increases the dye uptake for all classes of dyes at lower coloration temperatures and a shorter coloration time as compared with conventional coloration. Furthermore, there was no actual fiber damage caused by cavitation corrosion method.

The coloration of wool fabrics using as a natural dye has been studied in both conventional and ultrasonic techniques. The extractability of dye from naturally origin using power ultrasonic was also evaluated in comparison with conventional heating. Ultrasonics proved effectiveness in the dye extraction and dye-uptake of wool fibers with lac dye, the enhanced effect was about 41 and 47% more than conventional heating, respectively .

A study on the effect of ultrasound on the coloration of polyester fibers with C.I. Disperse Orange 25 and C.I. Disperse Blue 79 dyes was investigated . Swollen and unswollen PBT and PET fibers were dyed with and without low-frequency ultrasound under different conditions regarding time and temperature. The results from this investigation show that ultrasound increased the diffusion of dye molecules into the fiber though the levels of coloration are not as high as in conventional commercial coloration processes. Also, a study of the influence of ultrasound on the coloration behavior of PET fibers was investigated using C.I. Disperse Red 60 which has a highly crystalline structure and C.I. Disperse Blue 56 with a low crystalline structure . The results indicated that ultrasound has a significant effect on the reduction in particle size of C.I. Disperse Red 60, but it is very interesting that there is no significant influence attributed to ultrasound on dye uptake and coloration rate for C.I. Disperse Blue 56.

The ultrasound-assisted coloration of nylon-6 fibers was first investigated by Shimizu et al. and later by Kamel et al. . It seems that nylon-6 fiber is very determinant to low-frequency ultrasound-assisted coloration with various classes of dyes at different temperatures and under different reaction condition so that ultrasound power, pH of the medium and initial dye concentration. Colorations with disperse acid, acid mordant, and reactive dyes in a low ultrasound field (27 and 38.5 kHz) were investigated and in all cases, increases in coloration rate and decreases in activation energies were observed. Furthermore, Kamel established that dye uptake isincreased in the coloration diffusion phase. These experimental results confirm the observations of other authors that the increasing effect is attributed to de-aggregation of the dye molecules, which leads to better dye diffusion and possible assistance for dye–fiber bond fixation.

Coloration with Microwave process:

Microwave promoted organic reactions as well- known as environmentally methods that can enhance a great number of chemical processes. In particular, the reaction time and energy input are supposed to be mostly reduced in the reactions that are run for a long time at high temperatures under conventional conditions . Microwave is a volumetric heating fastly whereas conventional is a surface heating slowly.

This fact has been realized in textile coloration by many scientists. In this regard, it has been reported that a short exposure time as low as 30–50 s for dichlorotriazine reactive dyes gives good result .

Using pad-batch method, the effect of batching time on coloration of cotton with mono chlorotriazine reactive dyes using microwave irradiation and conventional heating was investigated. The results show that microwave in short time

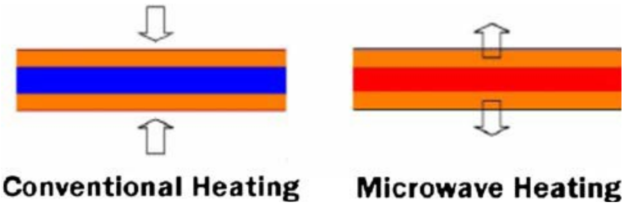


Fig. 13: Microwave heating (volumetric) vs conventional heating (surface)

Flax fiber due its poor dyeability, a recent method based on microwave treatment of flax fiber with urea to improve its dyeability with reactive dyes was recently reported. It was found that the treated flax fibers had significantly improved dyeability. The causes to the improvement of the dyeability of the flax fiber were found to be the increased absorption of dye on the fiber and the increased reaction probability between the dye and the fiber .

The possibility of coloration polyester fiber using microwave irradiation was taken. A high increase in dye uptake and acceleration in the coloration rate were observed . A study on the effect of microwave irradiation on the extent of aqueous sodium hydroxide hydrolysis of PET fiber and the impact of this treatment on its coloration with disperse dyes were seen. Comparison of the results got from the microwave irradiation and the conventional heating methods showed that the rate of hydrolysis was greater using microwave irradiation. The treated fabric was then dyed using microwave irradiation to heat the dyebath. Increased levels of dye uptake were observed with increasing weight loss of the hydrolyzed polyester fabric .

Results and discussion:

1. The interest in nanotechnology is growing very rapidly as this technology offers the production of new materials with smart functions. In particular, nanostructure coating by plasma technique as well as nano composites polymer will clean fibers of certain properties and easily dyeable to meet the demands of the ever-growing market.
2. Besides, the ongoing interest for cleaner 2 production in textile industries will encourage more R&D investigation for the use of $ScCO_2$ in industrial scale for synthetic fibers using disperse reactive dyes. However, the way is yet long toward using water-soluble dyes by this technique.
3. From the point of stability, availability ,costs and purity the latest development concerning direct electrochemical reduction on graphite granules seems to be the most attractive process and it will help us.

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4. The interest of using ultrasonic and micro- wave in dying will continue with special attention towards their possible uses for small-scale level.

5:Microwave system increases the dyeability of man – made fiber.

Conclusion:

Coloration of textile fiber is very important to textile industry.It helps to make variation in fabric and further apparel products. There are many techniques in doing coloration of textile fiber. These are explained above. From the every techniques, we can say that most effective method is using nanoparticles to coloration of fibers . Using ScCO2 is eco friendly process. In using ScCO2 the watage water of is reduced. Coloration with microwave process helps to dye molecule in preventing from antibacterical activity. Production rate is also high here.

So, In fine we can say that this paper helps us to collect knowledge about coloration process of textile fiber and helps to find out the cost effective, production rate increases and environment friendly coloration process. Dyeing is an important part to textile processing . Apparel final quality depends mostly on this. Apparel quality also depends on the characterstics of fibers and fiber quality can be changed after the coloration. So coloration process of textile fiber is very important in textile sector .

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