IMPROVING COMFORT PROPERTIES OF KHADI POLYESTER FABRICS

A PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

Khadi sector is the diminishing area of the production of fabrics. There is a Modern trends among the peoples of their apparel and their tastes in clothing changes periodically. But khadi fabrics imparts a mark in the heart of the peoples and politicians who are interested in the Gandhiji's principles. It creates a sympathy about the wearer's simpleness in their clothing and his love for the country.

The main thing behind this project is to develop the khadi sector and by creating the employment by thousands and to increase the product value. The drawback of the fabric are dust absorption, lesser life, poor handle property. By the alkali treatment, we can improve the handle and comfort properties.

There are large availability of alkalies such as Potassium Hydroxide, Sodium carbonate. But we chose Sodium Hydroxide because it will not undergo harsh action against the fabric and also it produces better appearance of the fabric compared to other alkalies. As the fabric is treated with Sodium Hydroxide the cotton fibers will undergo swelling that is it will get bulged and it causes mercerization. But in the polyester the Hydrolysis reaction takes place and the surface of the fiber get ruptured.

The fabric such as drapability, crease recovery, Bending Length, air permeability and water drop absorbancy are improved . So that the comfort and handle properties are improved. But there is some weight loss due to this there is a reduction in the strength of the fabrics.

By giving these kind of treatment to the khadi fabric we can get the value addition which then increase the market price and the usage of the khadi fabric. And also the there are possibility of removing unemployment and it gives khadi sector a new birth in the competitive Indian market.

திட்டப்பணிச் சுருக்கம்

காதி ஆடை என்பது இயந்திரங்களின் துணையின்றி மனிதசக்தியால் செய்யப்படுவது. இவ்வாறு ஆடைகளை உற்பத்தி செய்து அதனை விற்பனை செய்வதுதான் காதித்துறை பணியாகும். காதி வகை ஆடைகள் இந்தியாவில் பல ஆண்டுகளாக உற்பத்தி செய்யப்பட்டு வருகின்றது. இன்றைய காலகட்டதில் பல வகையான நவநாகரிக ஆடைகள் பயன்பாட்டில் இருந்தாலும் காதி ஆடைகள் இதில் முதன்மையாக கருதப்படுகிறது. காதி ஆடைகள் காந்தியடிகளின் நினைவுச்சின்னமாக இந்திய மக்களாலும் மற்றும் தலைவர்களாலும் மதிக்கப்படுகிறது. மேலும் இவ்வகை ஆடைகளை அணிபவர்களுக்கு எளிமையான தோற்றத்தை இது அளிக்கிறது.

தற்போது உற்பத்தி செய்யப்பட்டு வருகின்ற காதி ஆடைகள் குறைந்த காலம் உழைக்கும் திறன் , அதிக அளவு மாசுக்களை உட்கொள்ளும் தன்மை மற்றும் குறைந்த அளவு கையாளும் பண்புகளைக்கொண்டவை. இந்த ஆய்வின் முக்கிய காரணம், மேலே கூறப்பட்டுள்ள குறைகளை நிவர்த்தி செய்வதாகும். அதற்கு “அல்கலின்” திரவத்தை காதி ஆடைகளின் மீது உபயோகித்து தீர்வு எட்டப்பட்டுள்ளது. இதனால் ஆடைகளில் விறைபுத்தன்மை, உராய்வு, வலிமை,நீர் இழுவை போன்ற பண்புகளில் ஏற்படும் குறைபாடுகள் குறைக்கப்படுகிறது. மேலும் இவ்வகை ஆடைகளில் பருத்தி மற்றும் பாலியஸ்டர் இழைகள் உள்ளதால் “அல்கலின்” வேதி வினைகளால் பருத்தி நூலிழைகள் மெருகேற்றப்படுகிறது. இதனால் பளபளப்புத்தன்மை மற்றும் இழைகளின் பருமனை அதிகரிக்கிறது. பாலியஸ்டரில் இழைகளின் மேற்பரப்பு அரிக்கப்படுகிறது. இதனால் காதி ஆடைகளின் சௌகரிகத்தையும் கையாளும் தன்மையும் அதிகரிக்கின்றது. இம்முறை மூலம், நலிவடைந்த இந்தத் தொழிலுக்கு புத்துயிர் கொடுத்து பலருக்கு வேலைப்பு கொடுக்க முடியும்

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1. INTRODUCTION

1.1. GENERAL

Khadi stands for Indian culture and represents a way of life as well as a model for the development of Indian villages. Khadi evokes a sense of nationalism, Peace and Simplicity among Indians as it is associated with India's freedom movement led by Mahatma Gandhi. In this project mainly deals with polyester / cotton khadi fabrics and their behaviour with alkali solution viz. sodium hydroxide in order to increase their comfort and aesthetic properties. There is a drop in the fabric strength and fabric weight and increase in the wearability.

1.2. KHADI SECTOR

Khadi has never enjoyed an identity of its own. On the contrary, it has always changed with the whims and fancies of what the wearer wants to portray. In this context, khadi is not a fabric, it is a tool in the hands of a politician to facilitate patriotic portrayal or in the hands of the elite as an issue of distinct identity and more so with a social worker as a revival episode.

The birth of khadi took place in the eventful years of the freedom struggle. With a vision to recreate an economically sufficient, craft based society, Gandhiji adopted khadi as a medium. The obvious choice of using a textile for this purpose was linked with the renewal of hand spinning and hand weaving industries. Moreover, khadi, being a fabric of no particular social and cultural implications, provided a " binding factor" for the otherwise culturally diverse India. With the establishment of the sabarmati ashram in Ahmedabad in 1915, amidst the preliminary experiments with weaving and spinning, khadi was born, with a face of swadeshi.

An exhaustive promotion of khadi started with a swadeshi label by Gandhiji himself. It popularized the fabric but little for its acceptance vis-à-vis foreign millmade fabric. This grim response towards khadi was not so much due to its coarse texture as to its price. Being hand spun and hand woven it required more time to produce and was economically less viable than millmade fabrics. The irony of economically exploited

India was to choose from swadeshi but expensive khadi and foreign but cheaper millmade fabric. Gandhiji provided a rather difficult solution to this problem: he said, " we shall confine ourselves to pure swadeshi cloth, even though we may have to remain satisfied with a mere loincloth ". His obstinacy trickled down to his own dress as he started wearing a khadi loincloth to set an example.

Khadi seemed to be a single, unique solution to all the problems of struggling India, from creating employment for the masses, providing economic independence, removing casteism, to unifying the country to drive out British rule. Gandhiji called it the " sacred cloth ". By then, khadi had many faces besides swadeshi, and thus defined the identity of the wearer. Khadi evokes a sense of nationalism, Peace and Simplicity among Indians as it is associated with India's freedom movement led by Mahatma Gandhi.

Polyester used for the blending with cotton is called "Polyvastra" Number of Hand Spinning installed all over India is 1.86 millions and its production is 211 lac kgs of yarn and the employs involved is 14.93 lacs. Where the Khadi Sector is a Decentralised Sector.

1.2.1 HAND SPINNING

The pure cotton collected from the cotton farms are first ginned and made into rolls of bale 175 kgs. These bales are then converted into rowing. In the spinning units, the cotton fiber is converted into yarns manually by using charkas. The hand spinning machine is also called as "Amber Charkha".

The simplest and oldest method of spinning is an intermittent one using the drop spindle, in India called a takli. This simple device, which has been used for thousands of years, takes the form of a short stick forming the spindle, and a weight or whori. There are many sizes and type, depending upon the type of fiber being spun, but the method of use is the same. A short length of yarn is twisted by hand, wound round the center of the spindle and carried to the tip where it is hooked round a notch. The spindle is then rotated by twisting between thumb and finger, and the yarn becomes twisted.

The twisted yarns runs back to where the sliver is held in the other hand and the spinner draws fibre from the sliver to form a yarn of required thickness and at the same time twists the spindle. Once a length of yarn has been spun, it is wound on to the spindle near the whorl and the whole process is repeated .

The quality of the yarn, in terms of evenness, thickness and strength, depends upon the skill with which the spinner can control the two actions of drawing and twisting. The type of spindle, its weight in particular, is chosen to suit the fiber being spun.

1.2.2 HAND WEAVING

Weaving normally implies the interlacement of warp and weft. In the handloom machine, during weaving all the primary motions like shedding, picking, beat up are carried out mechanically that is by means of hands. While weaving picking will not be even and we cannot expect a better fabric production because the fabric production is mainly dependent on the workers ability and their concentration. Preparatory process such as winding, warping, sizing are also performed manually. The fabric production in all over India is 89.22 million sq.meter.

1.2.3 PROPERTIES OF KHADI FABRICS

Khadi fabrics are woven on hand loom from cotton, silk and woolen yarn, which are hand spun, natural and durable and is ideal to wear in the tropical Indian climate as it provides cool comfort. They are friendly to the body and don't cause any allergies or irritations.

It is preferred by young and old alike and has recently become a new fashion statement in the sub-continent fir being comfortable and eco-friendly, khadi fabrics are elegant and come in various attractive design occupies a pre-eminent position among the fabric industries in the country. We have always known specific associations of colours, textures, motifs, etc to the beauty of a textile.

In the khadi fabric the circulation of air is more but the cover factor and durability is less due to Hand Weaving and also the surface is rough and the fabric has more whiteness in nature.

1.3 ALKALI TREATMENT

Alkali treatment is nothing but treating fabrics with chemicals such as sodium hydroxide, potassium hydroxide, etc. The main thing behind the use of sodium hydroxide is that weight loss will be less compared to other alkalies. Hydrolysis of polyester with Sodium Hydroxide is a saponification reaction through elimination of -OH groups, as a result of which polyester losses its weight. From an x-ray analysis of alkali treated polyester, it was established that caustic hydrolysis initially proceeds over the whole fiber surface and then continues through enlarged surface cavitations causing higher weight loss, but no evidence was found of core cavitations in fibers to prove the weakening in the fiber interior. Sodium hydroxide can probably react only at the surface of polyester and it cannot penetrate the fiber surface. During the alkali treatment, the molecular chains in the cotton fiber get broken down due to this the fiber get swelled and mercerization takes place. So the lustre and fineness of the fiber gets improved.

1.4 COMFORT PROPERTIES

Modern consumers are interested in clothing that not only looks good, but also feels good. It has been identified, by both natural and synthetic fiber makers, that consumers increasingly involving more than their visual sense and are allowing touch, smell. Intuition and emotion to influence their decisions. As a result, greater importance is being attributed to the shopping and wearing experience interest is growing in better feeling fabrics. Comfort is being reinforced a key parameter in clothing. Comfort as a pleasant state of physiological, physchological and physical harmony between human being and the environment. Physiological comfort is related to the human body's ablilty to maintain life. Pshycological comfort to the mind's ablilty to keep itself functioning satisfactorily with external help and physical comfort to the effect of the external environments of the body. Body movement comfort is the subjective perception of clothing to the eye, hand, ear and nose, which contributes to the overall well being of the wearer. Comfort involves many aspects of human senses, such as visual (aesthetic comfort), thermal (cold and warm), pain (prickle and itch), and touch (smooth, rough, soft and stiff). External environments (physical, social and cultural) have great impaction on the comfort status of the wearer.

Fabric handle, as its name implies, is concerned with the feel of the material and so depends on the sense of touch. It will be appreciated that a term such as 'smooth' may have several connotations. The handle of cloth as a measurable quantity, observes that when the handle of a fabric is judged the sensations of stiffness or limpness, hardness or softness, and roughness or smoothness.

2. LITERATURE REVIEW

2.1. COTTON

Cotton is the oldest fiber used for textile purposes. In the tropical countries, it is the most important fiber. India was the centre for world's cotton industry as well as variety of fine fabrics till 1600 A.D. the date of origin of cotton is unknown.

2.1.1. CHEMICAL PROPERTIES

The cotton fiber is elongated cell, constructed from millions of cellulose molecules. Small amount of moisture, fatty materials, minerals are other constituents of cotton. So the chemical properties of cotton are mostly influenced by the chemical characteristics of cellulose.

ACTION OF HEAT

Cotton fiber ignites easily and it burns with a bright flame, which continues even after the fibre is removed from fire. Cotton can be heated in a dry state to 150°C without any decomposition. But if heating continues, a brown colour on cotton develops gradually. A slight brown discolouration can occur at temperatures lower than 150°C, which does not deteriorate the fiber. However, it is sufficient to spoil the effects of bleaching.

ACTION OF LIGHT

Exposure to air in presence of sunlight for a long period will have an effect on cotton like that of heat. Oxycellulose is gradually formed accompanied by tendering because of atmospheric oxygen. The tendering effect by light and air is accelerated by traces of metals like copper.

ACTION OF WATER

Raw cotton is very hard to wet because the wax is present on the surface of the fiber. Cold water swells cotton without any chemical damage. Swelling is accompanied by the disappearance of the natural twist i.e., deconvolution. The irregular cross section becomes more circular, which reappears on drying. Structurally, swelling is due to the intercrystalline areas, which means only amorphous regions are affected by swelling.

ACTION OF ACIDS

Cold dilute solutions of mineral acids at boil have no effect on cotton cellulose, provided the acid are neutralised or washed out completely before drying. Cold concentrated sulphuric acid dissolves cellulose and forms cellulose hydrate. Hydrochloric acid affects cotton much more severely than sulphuric acid.

ACTION OF ALKALI

One of the main advantages of cotton is its resistance to alkali solutions. Mild alkalies like sodium carbonate have no action on cotton in the absence of air either at low temperature or at high temperature. However, in presence of oxygen or air, oxycellulose is formed with gradual tendering of cotton.

Dilute solution of strong alkalies like sodium hydroxide with concentration of 2% - 7% can be boiled without least tendering in absence of air. Generally, dilute solution of sodium hydroxide is used for scouring. Strong alkalies with higher concentration induce structural and physical changes in cotton fiber. Sodium hydroxide as well as potassium hydroxide form different hydrated forms in association with water. The diameter of these hydrated forms depend on the concentration of the alkali used. As the concentration of alkali increases, the number of water molecules per molecule of alkali decreases for the formation of smaller hydrates. Thus the diameter of the hydrated form of alkali decreases.

2.1.2. PHYSICAL PROPERTIES

FIBER FINENESS

The wall thickness of different types of cotton ranges from 3.5 micron to 10 micron. Ribbon width is said to range from 12 micron to 25 micron. The thickness part of a fiber is not at the base but it is at the middle. The tip end is usually gently tapered. The base end is slightly finer than the middle portion.

FIBER UNIFORMITY

It has been observed that the longer cotton tends to become uniform in length than the shorter ones. The varying percentage of immature fiber also indicates non-uniformity of wall thickness for the same variety of fibers. Also, there are considerable differences between cotton grown from the same seed in the same location from time to time. Unless like other fibers will not possess same fiber properties because the cotton properties will change periodically according to the monsoon changes.

POROSITY

Cotton fibers is porous and exhibits capillary effects to a higher degree. The fibrils themselves are dense as a result of the higher packing density of the molecules and so non porus. This part of the structure constitute approximately 70% or more of the fiber.

LUSTRE

The natural lustre of cotton fiber is determined by two factor s i.e., fiber shape and fiber polish. The lustre does not depend upon hair weight , length, diameter, fineness or convolutions. It depends upon the ratio of semi- major and semi-minor axes of the elliptical fibre cross section. If the ratio is be low, the lustre will be high. The highest lustre is noticed in the fiber with circular cross section. So the dominating influence in lustre is the external fiber surface and the exact geometric shape is of secondary importance.

DENSITY

Cotton fiber has a density of 1.54 gm/cc, which corresponds to a specific volume of 0.64 cc/gm.

STRENGTH

The load required tom break i.e., tensile strength of single cotton fiber varies widely. It depends upon the thickness of the wall, prior damage to the fiber and cellulose degradation. Matured fibers with coarse and heavy wall are the strongest fibers. Their strength ranges from 9 gm to 13 gm per fiber. The strength of fiber increases at higher humidity or at higher moisture. In general, the tensile strength increases upto a relative humidity of 60% and then remains mostly constant.

ELONGATION

When load is applied, the length increases, the change in length with respect to the original length is defined as extension or elongation or strain. Average fiber elongation at break is about 5% to 10%, exactly around 6% to 8%. In the structure of cotton fibers, the fibrils spiral round at an angle of about 20° to 30° to the fiber axis. In general, increasing the helix angle reduces the resistance for extension.

MODULUS

Modulus is generally related to the resistance to deformation. Upto a certain limit of deformation, the stress and strain follow Hooke's law i.e., strain is proportional to stress. The stress-strain relation for a single fiber is roughly a straight line when the fiber contains little moisture and in this case, hooke's law is valid upto the breaking point.

TORSIONAL RIGIDITY

The mean rigidity of cotton fiber is about 7.9×10^{-4} g.wt.sq.cm.sq.tex. rigidity varies with the shape, conditions of growth and wall thickness of the fiber. The high rigidity of thick walled fibers suggests why coarse cottons must be more highly twisted than fine cottons to produce yarns of the same size.

2.1.3. MODIFICATIONS OF COTTON WITH ALKALI

The cotton fabric immersed in aqueous solutions of caustic soda (NaOH) exhibited swelling and shrinkage. Changes in fine structure, morphology and conformation of the cellulose chains occur with mercerization. More specifically, treatment of cellulosic fibers with aqueous solutions of sodium hydroxide at various temperatures produces a polymeric change in the cellulose (known as cellulose II).

The hydrodynamic diameter of various hydrates of NaOH decreases with increasing concentration of the alkali in water. Formation of cellulosate anion and the different sizes of $NaOH.xH_2O$ have been offered as explanations why certain concentrations of alkali metal hydroxides are effective in penetrating between cellulose chains to cause maximum swelling, cleavage of hydrogen bonds, and a change in the conformation of native cellulose to cellulose II. Historical development of these observations and the composition and identification of five different soda celluloses (Na-Cell I through Na-cell V) that are consistent with x-ray diffraction data have been reviewed. A phase diagram of the different soda celluloses shows the relationship between NaOH concentration and temperature for each of the phases. Sarko and co-authors have proposed elaborate pathways by which native cellulose is converted to each of the soda celluloses that ultimately lead to the thermodynamically stable and irreversible cellulose II structure. However, these pathways are based on the premise that cellulose II exists in antiparallel chain conformations.

The most popular view that has been held for the past fifty years is that cellulose I exists in a parallel chain conformation while cellulose II exists in an antiparallel chain conformation. A more recent and simpler explanation of how cellulose I is converted into cellulose II and what the arrangements of the cellulose chains are in the unit cell is given by Turbak et al. computer- generated models (consistent with x-ray diffraction and other experimental data) indicate that cellulose II exists in a parallel-up chain conformation that can be achieved by initially breaking intramolecular hydrogen bonds between 6-OH and 2-OH on the adjacent glucose residue (trans/gauche or "tg" conformation). The formation of new and stronger intermolecular hydrogen bonds occurs on conversion to cellulose II.

Moreover, the computer-generated models indicate that substantial amounts of energy would be required to convert the parallel-up chains in native cellulose into the antiparallel chain conformations of cellulose II. Although these investigators have not specifically discussed " soda cellulose intermediates", their cellulose II structural model is consistent with the presence of different degrees of salvation/hydration of sodium hydroxide between cellulose chains at various degrees of chain separation, swelling and deswelling as well as equilibria in the conversion of cellulose to cellulosate ions.

2.2. POLYESTER

The work of W.H.Carothers, on linear fiber forming polymers put this initial foots on polyesters by polycondensation method. The polyester were aliphatic polyesters, made from dibasic acids like adipic acids and glycols. The melting point of the polyester were below 100°C having molecular weights in the range of 2500-5000. it is only a short step onward from him to J.R.Whinfield and J.T.Dickson, who prepared the first high molecular weight, high melting polyester in 1940. This polymer is poly(ethylene terephthalate) or poly(oxyethylene oxy terephthaloyl) or simply PET. Polyester fiber is defined as " a manufactured fiber in which the fiber forming substance is any long chain synthetic polymer composed of at least 85 % weight of an ester of dihydric alcohol and terephthalic acid. So this may include pure polyester or polyester–ether fiber. Generally polyester fibers are produced from spinnerets. Polyester polymer is produced commercially in a two step polymerization process, i.e., monomer formation by ester interchange of dimethyl terephthalate with glycol or esterification of terephthalic acid with glycol followed by polycondensation by removing excess glycol.

Monomer formation [step 1] by the catalyzed ester interchange reaction between molten dimethyl terephthalate and glycol takes place at about 200°C. The product is a mixture of monomer, very low molecular weight polymer, and as a methanol by product, which distills at 150°C. Ester interchange catalysts are divalent salts of manganese, cobalt, magnesium, zinc, or calcium. An alternative monomer formation system involves terephthalicphthalate and an catalysed direct esterification rather than ester interchange. The monomer which is the same from both methods expect for some end groups, usually is polymerized in the presence of antimony catalyst. Chain extension is promoted by removal of excess glycol from the various viscous melt at about 280°C,with carefully controlled agitation and a progressive reduction of pressure to about 200 Pa. heating is continued about 280°C until the desired degree of condensation is obtained

2.2.1. STRUCTURE OF POLYESTER

The length of the repeated unit in poly (ethylene terephthalate) along the chain is 10.75°A, a value only slightly less the expected for a fully extended chain with one chemical unit to the geometric repeating unit, and successive ester groups in the trans configuration to each other (10.9°A). The chains are therefore nearly planar. The unit cell is triclinic, the atomic positions in the crystalline indicate that no special forces of attraction exist between the molecules. The spacings between atoms of neighbouring molecules is of order expect if Van der Waals forces operate.

Drawn polyester fibers may be considered to be composed of crystalline and non crystalline regions. The theoretical density of pure crystalline material can be determined mathematically from the dimensions of the unit cell. Percentage crystallinity and molecular orientation relate to tensile strength and shrinkage; however the various methods of measurement are problematic.

Polyester fibers have many favourable properties, such as high strength and resilience, resistance to many chemicals and resistance to abrasion, stretching, shrinking and wrinkling. It has certain disadvantages, such as tendency to pill, static charges, and high luster, as well as being unbreathable difficult to dye and resistant to oily stain removal, due to its hydrophobic nature and inactive surface. improving the undesirable properties of polyester fibers is done under harsh conditions, since the fibers are resistant to most chemicals. In order to modify the surface of the polyester enzymes are used. The enzyme, polyesterase, is a serine esterase that acts by cleaving the polymer chain through hydrolysis of ester bonds of the polyester fibers

2.2.2 CHEMICAL PROPERTIES:

EFFECT OF ALKALIES:

polyester fibers have good resistance to weak alkalies at high temperatures. It exhibits only moderate resistance to strong alkalies at room temperature and degraded at elevated temperature.

EFFECT OF ACIDS:

Weak acids, even at the boiling point, have no effect on the polyester fibers are exposed for several days. Polyester fibers have good resistance to strong acids at room temperature. Prolonged exposure to boiling hydrochloric acid destroys the fibers, and 96% sulphuric acid and causes disintegration of the fibers.

EFFECT OF SOLVENTS:

Polyester fibers are generally resistant to organic solvents. Chemical used in cleaning and stain removal do not damage it, but hot m-cresol destroys the fibers, and certain mixtures of phenol with trichloromethane dissolve polyester fibers. Oxidising agents and blechers do not damage polyester fibers.

MISCELLANEOUS PROPERTIES:

Polyester fibers exhibit good resistance to sunlight, and it also resists abrasion very well. Soaps, synthetic detergents, and other laundry aids do not damage it. One of the most serious faults with polyester is its oleophilic quality. It absorbs oily materials easily and holds the oil tenaciously.

2.2.3 PHYSICAL PROPERTIES:

MOISTURE REGAIN:

The moisture regain of polyester is low, ranges between 0.2 to0.8 percent. Although polyesters are non absorbent, they do not have wicking ability. In wicking, moisture can be carried on the surface of the fiber without absorption.

SPECIFIC GRAVITY:

The specific gravity 1.38 or 1.22 depending on the type of polyester fibers is moderate. Polyester fibers have a density greater than polyamide fibers and lower than rayon. Fabrics made from polyester fibers are medium in weight.

HEAT EFFECT:

The melting point of polyester is close to polyamide, ranging from 250 to 300°C. polyester fibers shrink from flame and melt, leaving a hard black residue. The fabric burns with strong , pungent odour. Heat setting of polyester fibers, not only stabilizes size and shape, but also enhances wrinkle resistance of the fibers.

2.2.4 MECHANICAL PROPERTIES:

A wide of polyester fibers properties is possible depending on the method of manufacture. Generally, as the degree of stretch is increased, which yields higher crystallinity and greater molecular orientation, so are the properties, e.g., tensile strength and initial young's modulus. At the same time, elongation normally decreases. An increase in molecular weight further increase tensile strength, modulus and extensibility.

Shrinkage of the fibers also varies with the mode of treatment. If relaxation of stress and strain in the oriented fiber occurs, shrinkage decreases but the initial modulus may be also reduced. Yarns maintained at a fixed length and constant tension during heat setting are less affected with respect to changes in modulus , and reduced shrinkage values are still obtained.

Poly (ethylene-terephthalate) shows non linear and time – dependent elastic behaviour. Creep occurs under the load with subsequent delay in recovery on removal of the load , but compared to that of other melt-spun fibers, creep is small.

2.2.5 CHEMICAL MODIFICATION OF POLYESTER FIBERS:

Polyester fibers have taken the major position I textiles all over the world although they have many drawbacks e.g., (a) low moisture regain (0.4%), (b) the fibers has a tendancy to accumulate static electricity, (c) the cloth made up of polyester fibers pick up more soil during wear and it also difficult to clean during washing, (d) the polyester garments from pills and thus, the appearance of a garment is spoiled, (e) the polyester fiber is flammable. Thus, it has been suggested that surface modifications can have an effect on hand, thermal properties, permeability, and hydrophilicity.

Numerous research papers and patents are available and considerable amount of research works is in progress on the hydrolysis and aminolysis of polyester fibers to overcome their disadvantages.

Namboodri and Haith carried out a comparative study by treating the polyester fibers with alkalies and various alkoxides (e.g. sodium hydroxide with water, sodium methoxide in methanol, sodium ethoxide in ethanol, sodium isopropoxide in isoproponal, and potassium tertiary butoxide in tertiary butanol) at 60°C and at different concentrations. It was found that the loss in weight of the polyester fiber was in the order sodium hydroxide< tertiary butoxide < secondary propoxide < methoxide and ethoxide. It was suggested that the observed order followed the nucleophilicity of the bases and the relatively lower reactivity of the secondary propoxide and tertiary butoxide was assumed to be due to the streric retardation during the equilibrium reactions. The hydrolysis of the polyester fiber was assumed to be taking place on the surface of the fiber. It was assumed that a random attack of the base on the carboxyl groups of the surface polymer molecules took place with removal of the shorter chains from the surface, which were further hydrolyzed by the base present in the solution.

Ko Sohk Won et al. have reported that the treatment of a polyester fabric with aqueous sodium hydroxide solution caused a decrease of weight and breaking strength and improved handle with increasing sodium hydroxide concentration, treatment time and temperature. It has been reported that these effects were further enhanced in the presence of a carrier, such as palanil carrier A. the molecular weight of the fiber was also decreased, but crystallinity was not affected by the alkali treatment.

Hydrolysis improved the smoothness of the fabric and decreased the electrostatic charge fro friction. Elisson et al. observed that untreated polyester fibers have relatively smooth surface, while NaOH treatment causes pitting of the fiber surface. The pits increase in number and depth as the time of hydrolysis was lengthened.

Song and kim found that the weight loss of poly(ethylene terephthalate) fibres by alkali treatment decreased in the order of KOH > NaOH > Na_2CO_3 and increased with increasing alkali concentration and treated temperature and time. With increasing weight loss, drape and flex stiffness and tear strength decreased, and tear strength retention at weight loss 17% was >70%. At the same weight loss, handle was affected by the treatment conditions. Zhang and co-workers observed that the addition of dodecyl-dimethybenzeneammonium bromide cationic surfactant reduced the concentration of NaOH and thus lowered the degree of degradation of poly(ethylene terephthalate) fibers.

The hydroxyl ions in the solution of sodium Hydroxide attack the carboxyl group in the polymer which result in the formation of disodium terephthalate and ethylene glycol. Disodium terephthalate is soluble in alkaline solution (pH above 8) up to 13-14%. Free terephthalic acid is on the surface of the fabric which is to be washed out with alkaline water before neutralizing the fabric.

2.3. POLYESTER / COTTON BLENDS ON ALKALI

According to R.T.SHET, S.H.ZERONIAN, H.L.NEEDLES and S.A.SIDDIQUI, Alkali treatment of polyester by a continuous techniques pad-heat technique for a given length of time results in a much higher degree of hydrolysis, as indicated by weight loss, than a batch process employing a large liquor :solid ratio.The moisture related properties of polyester are essentially unaffected by the alkali treatment , and the tensile warp direction ,as indicated by yarn tests , are also not affected when the weight loss is kept below 14%.

Hot alkali treatment of polyester/cotton blend fabrics serves a dual purposes subjectively, it imparts a silk like soft hand to the polyester and brings about mercerization of the cotton.The presence of cotton improves moisture related properties while the polyester imparts dimensional stability to alkali treated blend fabrics.

The treatment of cotton with aqueous sodium hydroxide of mercerization strength is a well known process for enhancing its physical properties.It has recently been concluded that although low temperature is required to swell the cotton for mercerization,the treatment has been attributed to the limitation of the reaction mainly to the fiber surface. Cold industrial mercerization is therefore a topochemical reaction resulting in a more condensed skin around the unswollen core of the fiber. Warm sodium hydroxide on the other hand , penetrates cotton fibres rapidly, resulting in more uniform swelling of the fiber when the temperature is lowered. Hot alkali treatment of polyester/cotton blends could achieve the dual purpose of imparting a soft silky hand to the polyester fiber and improving the hydrophilicity and dyeability of the cotton fiber. The objective of this study was to examine the effect of hot alkali treatments on the physical properties of polyester and polyester/cotton blend fabrics.

According to Dr J.Hayavadhana Two groups of 67/33 blended dress materials were subjected to alkaline oxidation process.following copper sulphate padding H_2O_2 bleaching and alkaline hydrolysis the fabric was imparted high silky feeling .finished fabric were characterized by higher WT(tensile strength),greatly reduced G,2 HG (shear properties),extensively improved H,2HB (bending properties)and acceptable values of koshi,shari,fukurami,hari, and total handle value(THV),confirming the silky handle imparted by alkaline oxidation.

Bhattacharya stated that at high concentration of NaOH,the strength loss was to high because some polyester fiber get dissolved resulting in weakening the fibre.Reichstadter pointed out that for the improvement of the polyester fabric ,mild sodium hydroxide may be used .this treatment may reduce some strength loss,but improves the pilling and abrasion resistance and also the fabric handle.

3. AIM

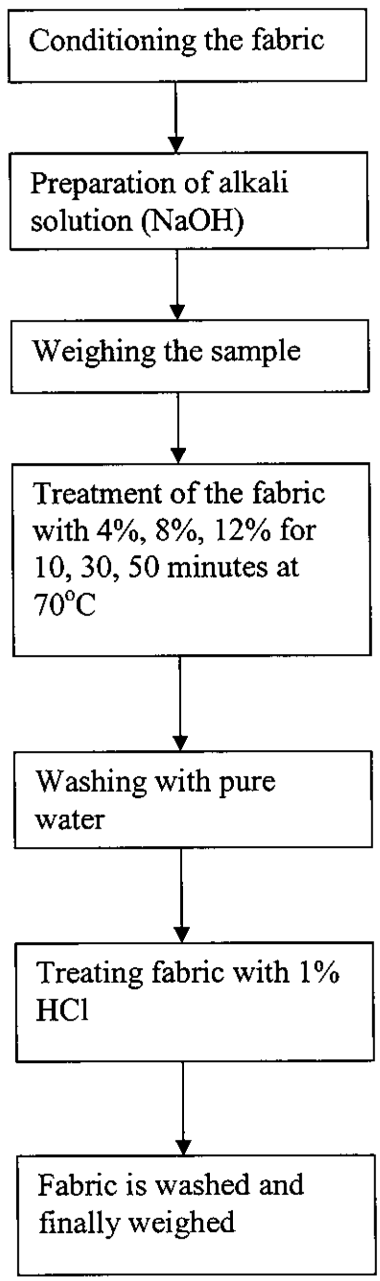
Although a very considerable work has been done on the effect of alkaline hydrolysis treatment applied on the cotton / polyester fabric, the investigation were incomplete in the sense that the dye uptake and absorbancy characteristics were only studied.In order to have the better understanding of the physical properties such as handle, drape and tailorability. Scope of this treatment is also improve the kadhi polyester and improve the performance of this fabric in kadhi sector which is decentralised sector. Only little work done on the effect of polyester / cotton blends since blends are widely used.Therefore this investigation has been undertaken. The treated samples will be investigated for drape, handle, abrasion resistance and comfort. Based on the results obtained suitable recommendation will be made.

4. METHODOLOGY

4.1. FABRIC SPECIFICATION

- Blend = polyester / cotton (67:33)
- Ends per inch = 92
- Picks per inch = 60
- Warp count = 70s
- Weft count = 70s
- Weave = plain
- Warp crimp % = 3%
- Weft crimp % = 5%

4.2. TREATMENT PROCEDURE



4.3.PROCESS SPECIFICATION

4.3.1.TIME

Weight loss was found to be directly proportional to the time of hydrolysis as the time of hydrolysis increased, weight loss also increased. Generally the time taken for the alkaline hydrolysis is 10, 30, 50 minutes. The percentage loss in weight of polyester / cotton blend fabrics for the first five minutes was very small. The loss in weight was highest during the next increment of time. The reaction appears to slow down with further increases in time of heating.

4.3.2 TEMPERATURE

When a fabric saturated with aqueous alkali is heated at constant external temperature there will be an increase in the concentration of sorbed alkali due to the evaporation of water from the fabric phase. The temperature of sorbed alkali in the fabric phase, after an initial increase with time will attain an equilibrium value once the loosely bound water is evaporated. For the improvement of luster property and comfort property of cotton hot alkali treatment is necessary for the 70°C is preferred.

4.3.3. CONCENTRATION

At the higher concentration, the surface of the fiber get ruptured and the weight loss of the fabric is increased about 25%. At lower concentration the rate of hydrolysis taken more time to attain its equilibrium so that the concentration that are selected are 4%, 8%, 12%.

4.3.4. LIQUOR RATIO

It is observed that at lower bath ratio (w/w), the fabric exhibits an excellent handle value as compared at those at higher bath ratio, thus confirming the potential of low liquor dyeing principles. The effect depends on several factors and the bath ratio is one among them influencing the mechanical properties of the fabric to a greater extent. Lower bath ratio will exhibit the properties favourable to a soft fabric so finally the liquor ratio of 1:20 is selected.

4.4. MACHINE SPECIFICATION

4.4.1. CONSTRUCTION

The machine is especially suitable for dyeing fabrics which are delicate and need to be provided with a tension free treatment to enhance silky texture effect and prevent fabric damage or distortion. Inspection window is provided to view the process. Fabric is introduced and taken out from the top of the chamber, which has hinged cover. The winch id driven through a AC motor with a fixed speed of about 17 RPM. Optionally a DC variable speed drive can be provided to run the winch between 5 to 30 RPM steplessly. The machine is fabricated from 316-quality stainless steel and electrically heated with a heating capacity of 3 kW. Machine is compact and fixed on MS angular frame and suitable to work on 230 volt single-phase AC supply.

- **Material of construction** : Stainless steel 316 quality
- **Liquor capacity** : 9.5 liters min. to 19 liters max
- **Heating medium** : Through water or glycerin or oil
- **Temperature Control** : Through thermostat ± 2°C
- **Temperature indication** : By dial thermometer 0 – 150°C
- **Speed** : 17 ± 2 RPM AC drive or 5 to 30 RPM DC drive.

4.4.2. OPERATION

Check the electrical connections. Make sure that all switches are in OFF position. Switches on the supply and the main pilot lamp will come on. Fill the out side tank of the liquor through the funnel provided for this with water if the temperature in the liquor has not to go above 95°C. If the liquor has to reach nearly 100°C, light transformer oil or glycerin should be used in place of water. Two glass gauge tubes are provided for water level indication and liquid level indication. Before filling the water, make sure that the drain cocks of both chambers are closed. Also fill some water in liquor tank. Set the timer say minutes and start the drive switch. You will observe the carrier rotating.

APPENDIX

THE SOUTH INDIA TEXTILE RESEARCH ASSOCIATION
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Address all correspondence to the Director

Fabric Test Report No.:2 Kumaraguru College of Technology,

Samples Tested at : R.H. 65% +/- 2% and Temp. 21 Degree C +/- 1 Degree C

Lab Code No.	C_971	C_972	C_973	C_974
Sample Particulars.:	FABRIC SAMPLE RAW SAMPLE	FABRIC SAMPLE 4% CONC AT 10 MIN AT 70 DEGREE C	FABRIC SAMPLE 8% CONC AT 10 MIN AT 70 DEGREE C	FABRIC SAMPLE 12% CONC AT 10 MIN AT 70 DEGREE C
Circular Bending Stiffness Tester				
Mean Bending Force (gms)	93	47	71	52

Lab Code No.	C_975	C_976	C_977	C_978
Sample Particulars.:	FABRIC SAMPLE 4% CONC AT 30 MIN AT 70 DEGREE C	FABRIC SAMPLE 8% CONC AT 30 MIN AT 70 DEGREE C	FABRIC SAMPLE 12% CONC AT 30 MIN AT 70 DEGREE C	FABRIC SAMPLE 4% CONC AT 50 MIN AT 70 DEGREE C
Circular Bending Stiffness Tester				
Mean Bending Force (gms)	44	42	52	62

Lab Code No.	C_979	C_980
Sample Particulars.:	FABRIC SAMPLE 8% CONC AT 50 MIN AT 70 DEGREE C	FABRIC SAMPLE 12% CONC AT 50 MIN AT 70 DEGREE C
Circular Bending Stiffness Tester		
Mean Bending Force (gms)	51	46

End of Report

R. Ramupathy