MANUFACTURING OF BLENDED YARN USING CHICKEN FEATHER FIBER

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report **"MANUFACTURING OF BLENDED YARN USING CHICKEN FEATHER FIBER"** is the bonafide work of **"M.BATHRINATHAN,T.CHANDRASEKARAN, R.DINESHKUMAR,O.C.SIVASUBRAMANIAM"** who carried out the project work under my supervision.

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Viva- voce examination is conducted on 30/04/09.

(INTERNAL EXAMINER) **(EXTERNAL EXAMINER)**

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ABSTRACT

The objective of our project is to manufacture blended yarns using cock feather fiber with cotton and polyester in the ratio of 80:20 respectively.

The chicken feather was collected and then the separation of **Barb** and **Quill** was done. The centre stem is called quill and side protruding fiber is called barb.

The cock fiber was mixed with cotton and polyester separately. Then the mixtures were passed through the preparatory processes of Carding and Drawing to obtain a draw frame Sliver. The Sliver was then processed through the open end spinning machine to produce a yarn.

Various tests were carried out for the produced yarn, such as single yarn strength test, hairiness test, evenness test, scanning electron microscopy and FT-IR.

Evenness testing was done to know about the Thick place, Thin place and Neps per unit length.

Beyond this we also going to do the dyeing treatment to analyze the yield of color in the cock feather.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

1. INTRODUCTION

What happens when an industry's waste product turns out to be valuable as its primary product. One such waste product is chicken feathers from poultry Industries and the challenge is to turn the white plumes into valuable new product. That add to the company's bottom line. This idea kindled us to do the project on "MANUFACTURING OF BLENDED YARN USING CHICKEN FEATHER FIBER"

At present between two to four billion pounds of feathers are produced Annually by the poultry processing industry these feathers present a disposal problem, and are usually converted to animal feed by hydrolyzation in an attempt to recycle it rather than disposing in landfills. However, this method may result in bacteria or diseases being passed along to the ingestors of the feather meal. Thus this idea got ruled out and developing valuable product using chicken feather fiber have been emerged in the world .

Walter schmidt[2], a research chemist at the Beltsville(USDA), from his Research progress on chicken feathers says, Feathers are keratin just like wool, but the surface area is much larger because the diameter of the fiber is much smaller. So the fiber can absorb more than wool or cellulose fibers. The crystal from filling in beddings to composites in higher end structure of the feather fiber makes them naturally stable and durable. Thanks to these properties, feathers can be put to good use in the manufacture of consumer goods, replacing wood pulp and other expensive fibers. Walter schmidt's research confirms that, once considered waste feathers can be effectively utilized for the production of textilematerials ranging applications.

1.1. ABOUT THE CHICKEN FIBER

The structure and properties of chicken feather barbs makes them unique fibers preferable for several applications. The presence of hollow honeycomb structures, their low density, high flexibility and possible structural interaction with other fibers when made into products such as textiles provides them unique properties unlike any other natural or synthetic fibers. No literature is available on the physical structure and tensile properties of chicken feather barbs. In this study, we report the physical and morphological structure and the properties of chicken feather barbs for potential use as natural protein fibers. The morphological structure of chicken feather barbs is similar to that of the rachis but the physical structure of the protein crystals in chicken feather barbs is different than that reported for feather rachis keratin. The tensile properties of barbs in terms of their strength and modulus are similar but the elongation is lower than that of wool. Using the cheap and abundant feathers as protein fibers will conserve the energy, benefit the environment and also make the fiber industry more sustainable.

Normally chicken fibers have high specific strength and modulus materials, low priced, recyclable and easily available.

Chicken feather fiber has a Length of 22mm and Strength of 32.24gms, Elongation of about 16.13%, and Fineness of 3653m.tex.

2. CHICKEN FEATHER FIBER

2.1 FEATHER STRUCTURES

Feathers' quills and fibers are both made of the protein keratin, the stuff of hair, nails, and wool. But the quill is hard and has a disorganized microscopic structure, while the fibers are soft and posses a very orderly microsture

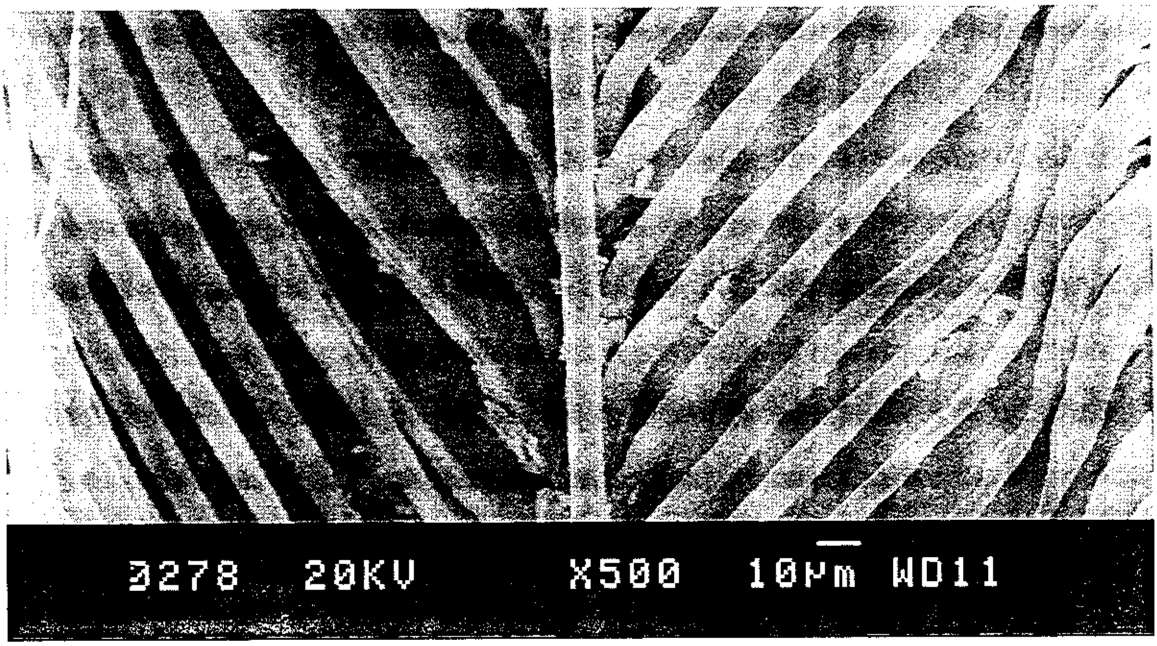


Fig 2.1 Scanning electron micrographs showing chicken feather fiber.

Feathers are extremely light, and they're hollow, yet very strong. That makes them ideal." Feathers are made of the protein keratin, which in fiber form is both light and tough enough to withstand mechanical and thermal stresses. The hollow fiber is of very low density, providing strength without sacrificing weight.

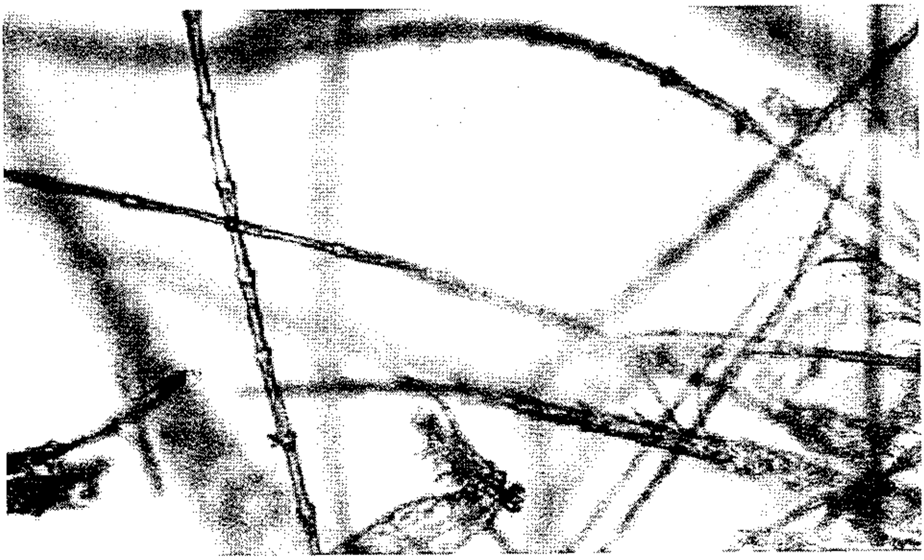


Fig 2.2 A micrograph of feathers (above) shows hollow keratin fibers, a light & tough material

2.2 CHICKEN FIBER FACTS

2.2.1 CHEMISTRY OF CHICKEN FEATHER FIBER

Chicken feather fiber primarily consists of α-helical conformations, and some β-sheet conformations are present. Chicken feather outer quill consists almost entirely of β-sheet conformations, and few α-helical conformations are present. Hard β-sheet keratins have a much higher cystine content than soft α-helix keratins and thus a much greater presence of disulfide (S-S) chemical bonds which link adjacent keratin proteins (Figure 2.3). These strong covalent bonds stabilize the three-dimensional protein structure and are very difficult to break. This suggests that chicken feather outer quill would be stronger than chicken feather fiber. However, a study of the thermal properties of chicken feather fractions suggests that outer quill is weaker than fiber and inner quill.

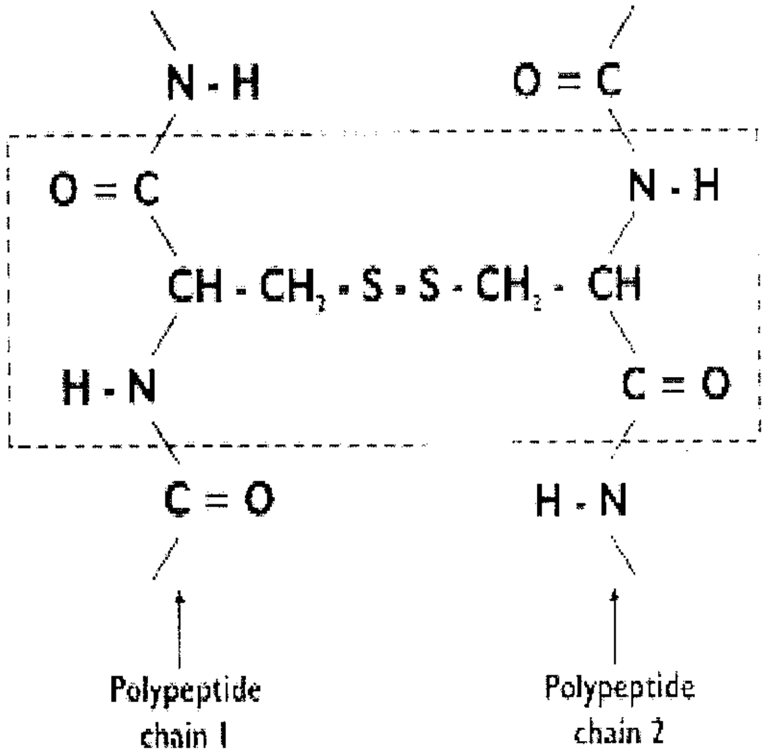


Figure 2.3 Diagrammatic representation of the diamino-acid cystine residue linking two polypeptide chains by covalent bonding

2.2.2 COMPOSITION OF CHICKEN FEATHER FIBER

Chicken feathers are approximately 91% protein (keratin), 1% lipids, and 8% water. The amino acid sequence of a chicken feather is very similar to that of other feathers and also has a great deal in common with reptilian keratins from claws. The sequence is largely composed of cystine, glycine, proline, and serine, and contains almost no histidine, lysine, or methionine.

2.2.3 ELEMENTAL ANALYSIS OF CHICKEN FEATHER FIBER

Table 2A Elemental Analysis of chicken feather fiber

Element	%
Carbon	47.83
Nitrogen	13.72
Hydrogen	6.48
Sulphur	2.16
Others	29.81

2.3 THE PHYSICAL PROPERTIES OF CHICKEN FEATHER FIBRE

2.3.1 Moisture Content

Keratin can be considered to have both hydrophilic and hydrophobic properties. While 39 of the 95 amino acids in the keratin monomer are hydrophilic, serine, the most abundant amino acid, gives chicken feathers the ability to attract moisture from the air, because of the free OH^- group on the surface of each serine molecule. Thus, it may be considered to be hygroscopic.

2.3.2 Aspect Ratio

Fiber diameters were found to be in the range of 5-50 μm by scanning electron microscopy.

The other examination of fibers were reported to have diameters of 6-8 μm and lengths of 3-13 mm. These values correspond to aspect ratios of 400-2200. It is found that fibers had a constant diameter of approximately 5 μm and lengths between 3.2 and 13 mm. These values correspond to aspect ratios of 600-2600.

2.3.3 Apparent Specific Gravity

The density of chicken feather fiber, obtained from Featherfiber Corporation, by displacing a known volume and weight of for the density of solid keratin. It is reported fiber lengths of 3.2-13 mm. ethanol with an equivalent amount of fiber. They reported a value of 0.89 g/cm^3 for the chicken feather fiber.

The value may be higher due to the presence of shorter fibers (as short as 3.2 mm in length). The hollows, or voids, inside chicken feather fibers may become more accessible to ethanol as fiber length decreases. For a fiber of some critical length, the void inside of this fiber acts as a part of its surface, and as a result only the solid matter of this fiber will be accounted for by a measurement of apparent density. Assuming a density of 1.3 g/cm^3 for the solid matter of chicken feather fiber (keratin), apparent density results will approach 1.3 g/cm^3 as fiber length decreases.

2.3.4 Chemical Durability

The structure of keratin, the primary constituent of chicken feathers, affects its chemical durability. Because of extensive cross-linking and strong covalent bonding
within its structure, keratin shows good durability and resistance to degradation. Efforts to extract keratin proteins from feathers illustrate this point. Extraction is a difficult task because it can only be achieved if the disulfide and hydrogen

bonds are broken. Schrooyen found keratin to be insoluble in polar solvents, such as water, as well as in non polar solvents.

The most common method for dissolving feather keratins is solubilization with concomitant peptide bond scission via acid and alkali hydrolysis, reduction of disulfide bonds with alkaline sodium sulfide solutions, or a combination of enzymatic and chemical treatment. Although these techniques are effective for extracting keratin (75% yield), they require extremely high reagent concentrations that are much higher than keratin fibers would ever be exposed to in nature. One can deduce from this that keratin is a relatively sturdy, stable protein.

3. COTTON

Is a vegetable fiber obtained from the mature capsule of the cotton plant, a shrub about 40 cm high, with leaves and flowers of a red or yellow color. When the flower is fecundated it loses its petals and within 25 days a capsule surrounded by a leaf called bract grows. The capsule is sustained by a cup and has a drop shape rounded at the lower extremity. Inside the capsule there are from five to eight seeds on which the fiber developed. When the capsule is mature it opens into four parts showing the cotton ball. On the same plant the maturation of the capsules does not occur simultaneously, therefore more passages are required for the harvest of the cotton. The harvest is carried out a week after maturation. The first operation after harvesting is husking, which permits the removal of the fibers from the seeds. Then the cotton is carded and combed so as to eliminate all the impurities. 4000 fibers is the seed average. Staple length = 1/8" - 2.5" (0.32 - 6.35cm) - for manufacturing yarns, fabrics, 7/8" - 11/4" (2.22 - 3.18cm) is standard

The grade is given by the external appearance of the cotton and is determined on the basis of the major or minor brightness of the fibers, by its more or less white color, by the major or minor presence of particles of the leaf or other extraneous substances.

3.1. Fiber length

Fiber length is defined as the average length of the longer one-half of the fiber (upper half mean length). Fiber length is basically an inherited/genetically character of the seed variety. However, weather, nutrient deficiencies, as well as excessive cleaning and/or drying at the gin may also affect the fiber length. By affecting yarn strength and evenness, and the efficiency of the spinning process, the length of the fiber has a great influence on quality and price. According to USDA's classing methodology, length measurement of American upland cotton is performed by HVI in accordance with standard test methods. The length of staple, measured in inches and fractions of an inch, is classed according to the following codes:

TABLE 3A: REPRESENTATION OF FIBRE LENGTH

Length (inches)	Code	Length (inches)	Code
< 13/16	24	1-3/16	38
13/16	26	1-7/32	39
7/8	28	1-1/4	40
29/32	29	1-9/32	41
15/16	30	1-5/16	42
31/32	31	1-11/32	43
1	32	1-3/8	44
1-1/32	33	1-13/32	45
1-1/16	34	1-7/16	46
1-3/32	35	1-15/32	47
1-1/8	36	1-1/2	48
1-5/32	37		

3.2.Uniformity

Length uniformity is the ratio between the mean length and the upper half mean length of the cotton fibers within a sample. It is measured on the same beards of cotton that are used for measuring fiber length and is reported as a percentage. The higher the percentage, the greater the uniformity. If all the fibers in the would be the same, and the uniformity index would be 100. The following tabulation can be used as a guide in interpreting length uniformity results. Measurements are performed by HVI. Cotton with a low uniformity index is likely to have a high percentage of short fibers and may be difficult to process

Length uniformity index

TABLE3B:UNIFORMITY INDEX

Descriptive Designation	Length Uniformity
Very Low	Below 77
Low	77 – 79
Average	80 – 82
High	83 – 85
Very High	Above 85

Source: **Cotton** Classification - Understanding the Data, USDA, July 2004

3.3.STRENGTH

The fiber strength measurement is made by clamping and breaking a bundle of fibers from the same beards of cotton that are used for measuring fiber length. Results are reported in terms of grams per tex (a tex unit is equal to the weight in grams of 1,000 meters of fiber). It expresses the force required to break a bundle of fibers one tex unit in size. Fiber strength is largely determined by variety. Strength measurements are performed by HVI in accordance with standard test methods. The descriptive terms listed below may be helpful in explaining the measurement results.

FIBER STRENGTH TABLE

TABLE 3C: STRENGTH TABLE

Descriptive Designation	Strength (grams per tex)
Weak	23 & below
Intermediate	24 – 25
Average	26 – 28
Strong	29 – 30
Very Strong	31 & above

Source: Cotton Classification - Understanding the Data, USDA, July 2004

Other properties that are of great importance in the industrial uses of cotton, including fiber fineness and maturity, are measured in accordance with standard test methods. Classing methodology is constantly updated to include state-of-the-art methods and equipment. Fiber properties are also measured for American pima cotton.

The character is the attribute determined with more difficulty. It is in part connected with the origin, variety and maturity, but at the end a cotton of good character is that whose fibers are the most strong and robust, so as to resist traction and breakage, homogenous and uniform, so as to produce few losses in working, and have a complete physical-chemical constitution, so as to give the cotton mass notable solidity and compactness, smoothness and silkiness. The biggest cultivations of cotton are to be found in America, India, China, Egypt, Pakistan, Sudan and Eastern Europe.

Properties

Cotton, as a natural cellulose fiber, has a lot of characteristics, such as:

- Comfortable Soft hand
- Good absorbency
- Color retention
- Prints well
- Machine-washable
- Dry-cleanable
- Good strength
- Drapes well
- Easy to handle and sew

Fiber Properties

Fiber properties of a Cotton are

TABLE 3D: FIBER PROPERTIES

Specific gravity	1.54
Strength (Tenacity)	3.0 - 4.9 g/d (cotton is 20% stronger when wet) fiber elongation is almost linear to the stress imposed
Elasticity	Relatively low
Absorbency and Moisture Regain	7-8% at standard conditions
Birefringence	0.046
Dielectric constant	3.9-7.5
Resistivity	Order of 10^9 ohm/cm^3
Micronaire	2.0 - 6.5 (upland cotton)
Denier	0.7 - 2.3 (upland cotton)
Length	0.9 - 1.2 in (upland cotton)
Diameter	9.77 - 27.26
Coefficient of friction	0.25 (for raw dry cotton, otherwise strongly changes for treated and/or wet fiber)
Thermal Properties	Decomposes when exposed at the temperatures about 300^{o}F

3.4. MICRONAIRE

Micronaire measurements reflect fiber fineness and maturity. A constant mass (2.34 grams) of cotton fibers is compressed into a space of known volume and air permeability measurements of this compressed sample are taken. These, when converted to appropriate number, denote micronaire values.

3.5.COLOR

The color of cotton samples is determined from two parameters: degree of reflectance (Rd) and yellowness (+b). Degree of reflectance shows the brightness of the sample and yellowness depicts the degree of cotton pigmentation. The color of the fibers is affected by climatic conditions, impact of insects and fungi, type of soil, storage conditions etc. There are five recognized groups of color: white, gray, spotted, tinged, and yellow stained. As the color of cotton deteriorates, the processability of the fibers decreases.

3.6.TRASH

A trash measurement describes the amount of non-lint materials (such as parts of cotton plant) in the fiber. Trash content is assessed from scanning the cotton sample surface with a video-camera and calculating the percentage of the surface area occupied by trash particles. The values of trash content should be within the range from 0 to 1.6%. Trash content is highly correlated to leaf grade of the sample.

3.7. CHEMICAL PROPERTIES OF COTTON

Cotton swells in a high humidity environment, in water and in concentrated solutions of certain acids, salts and bases. The swelling effect is usually attributed to the sorption of highly hydrated ions. The moisture regain for cotton is about 7.1~8.5% and the moisture absorption is 7~8%.

Cotton is attacked by hot dilute or cold concentrated acid solutions. Acid hydrolysis of cellulose produces hydro-celluloses. It is not affected by cold weak acids. The fibers show excellent resistance to alkalis. There are a few other solvents that will dissolve cotton completely. One of them is a copper complex of cupramonium hydroxide and cupriethylene diamine

Cotton degradation is usually attributed to oxidation, hydrolysis or both. Oxidation of cellulose can lead to two types of so-called oxy-cellulose, depending on the environment, in which the oxidation takes place. Cotton can also degrade by exposure to visible and ultraviolet light, especially in the presence of high temperatures around 250~397° C and humidity. Cotton fibers are extremely susceptible to any biological degradation (microorganisms, fungi etc.)

3.8. OPTICAL PROPERTIES OF COTTON

Cotton fibers show double refraction when observed in polarized light. Even though various effects can be observed, second order yellow and second order blue are characteristic colors of cellulose fibers.

3.9.RAWCOTTON COMPONENTS:

TABLE 3E: COTTON COMPONENTS

80-90%	Cellulose
6-8%	Water
0.5 - 1%	Waxes and fats
0 - 1.5%	Proteins
4 - 6%	Hemicelluloses and pectin's
1 - 1.8%	Ash

During scouring (treatment of the fiber with caustic soda), natural waxes and fats in the fiber are saponified and pectin's and other non-cellulose materials are released, so that the impurities can be removed by just rinsing away. After scouring, a bleaching solution (consisting of a stabilized oxidizing agent) interacts with the fiber and the natural color is removed. Bleaching takes place at elevated temperature for a fixed period of time [1]. Mercerization is another process of improving sorption properties of cotton. Cotton fiber is immersed into 18- 25% solution of sodium hydroxide often under tension [9]. The fiber obtains better luster and sorption during mercerization.

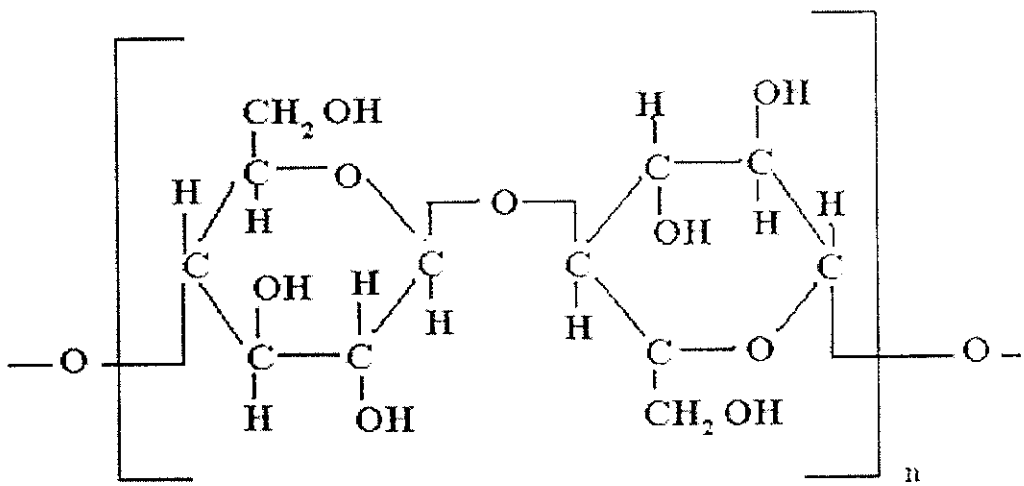
After scouring and bleaching, the fiber is 99% cellulose. Cellulose is a polymer consisting of an hydro glucose units connected with 1,4 oxygen bridges in the beta position. The hydroxyl groups on the cellulose units enable hydrogen bonding between two adjacent polymer chains. The degree of polymerization of cotton is 9,000-15,000 [1]. Cellulose shows approximately 66% crystallinity, which can be determined by X-ray diffraction, infrared spectroscopy and density methods.

Each crystal unit consists of five chains of an hydro glucose units, parallel to the fibril axis. One chain is located at each of the corners of the cell and one runs through the center of the cell. The dimensions of the cell are a = 0.835nm, b = 1.03 nm and c = 0.79 nm. The angle between ab and BC planes is 84° for normal cellulose, i.e., Cellulose I [8].

REPEAT UNIT OF CELLULOSE

The current consensus regarding cellulose crystallinity (X-ray diffraction) is that fibers are essentially 100% crystalline and that very small crystalline units imperfectly packed together cause the observed disorder.

The density method used to determine cellulose crystallinity is based on the density gradient column, where two solvents of different densities are partially mixed. Degree of Crystallinity is, then, determined from the density of the sample, while densities of crystalline and amorphous cellulose forms are known (1.505 and 1.556 respectively). Orientation of untreated cotton fiber is poor because the crystallites are contained in the micro fibrils of the secondary wall, oriented in the steep spiral (25-30°) to the fiber axis.



Applications

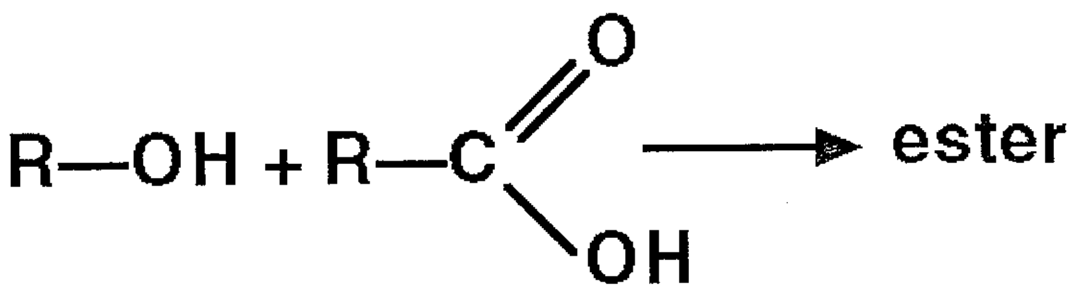
The major end-uses of cotton include:

- Apparel - in a wide range of wearing apparel: blouses, shirts, dresses, children wear, active wear, separates, swimwear, suits, jackets, skirts, pants, sweaters, hosiery, neckwear.
- Home Fashion - curtains, draperies, bedspreads, comforters, throws, sheets, towels, table cloths, table mats, napkins
- Medical and cosmetic applications - bandages, wound plasters
- Technical applications -

White cotton articles should be washed in the washing machine at 60° C, whilst colored cloths, especially if dark, should be washed at lower temperatures. Normally it should be ironed on the right side. Dark articles should be first ironed on the inside and then on the outside, with a cloth, to avoid that the heat of the iron shine the cloth. White articles can be starched to give more consistency to the cloth and avoid it creasing easily.

4. POLYESTER

Polyester is currently defined as: "Long-chain polymers chemically composed of at least 85 percent by weight of an ester and a dihydric alcohol and a terephthalic acid."The name "polyester" refers to the linkage of several monomers (esters) within the fiber. Esters are formed when alcohol reacts with a carboxylic acid:



(R is any hydrocarbon chemical group)

Polyethylene terephthalate polyester (PETP) is the most common thermoplastic polyester and is often called just "polyester". This often causes confusion - not only is the chemically similar polybutylene terephthalate (PBT) also a (thermoplastic) polyester, the most common resin system used in

GRP is also a polyester system - and also often called just "polyester". (In this latter case, however, the polyesters are chemically unsaturated and are "free-radical polymerized" into a thermo set).

4.1.GENERAL PROPERTIES

Polyethylene terepthalate (PET) is a hard, stiff, strong, dimensionally stable material that absorbs very little water. It has good gas barrier properties and good chemical resistance except to alkalis (which hydrolyze it). Its crystalline varies from amorphous to fairly high crystalline. It can be highly transparent and colorless but thicker sections are usually opaque and off-white.

PROPERTIES

Chemical Resistance	
Acids – concentrated	Good
Acids – dilute	Good
Alcohols	Good
Alkalis	Poor
Aromatic hydrocarbons	Fair
Greases and Oils	Good
Halogens	Good
Ketones	Good
Electrical Properties	
Dielectric constant @1MHz	3.0
Dielectric strength ($kV.mm^{-1}$)	17
Dissipation factor @ 1kHz	0.002
Surface resistivity (Ohm/sq)	10^{13}
Volume resistivity (Ohm.cm)	$>10^{14}$

Mechanical Properties	
Coefficient of friction	0.2-0.4
Hardness – Rockwell	M94-101
Izod impact strength ($J.m^{-1}$)	13-35
Poisson's ratio	0.37-0.44(oriented)
Tensile modulus (GPa)	2-4
Tensile strength (MPa)	80, for biax film 190-260
Physical Properties	
Density ($g.cm^{-3}$)	1.3-1.4
Flammability	Self Extinguishing
Limiting oxygen index (%)	21
Refractive index	1.58-1.64
Resistance to Ultra-violet	Good
Water absorption - equilibrium (%)	<0.7
Water absorption - over 24 hours (%)	0.1
Thermal Properties	
Coefficient of thermal expansion ($x10^{-6}\ K^{-1}$)	20-80
Heat-deflection temperature - 0.45MPa (°C)	115
Heat-deflection temperature - 1.8MPa (°C)	80
Lower working temperature (°C)	-40 to -60
Specific heat ($J.K^{-1}.kg^{-1}$)	1200 - 1350
Thermal conductivity ($W.m^{-1}.K^{-1}$)	0.15-0.4 @ 23
Upper working temperature (°C)	115-170

Properties Polyethylene Terephthalate Fibre			
Property		Value	
Material		Medium	High tenacity
Specific Modulus	cN/tex	·	700-800
Specific Tenacity	cN/tex	36	70-80
Density	$g.cm^{-3}$	1.39	1.39
Extension to break	%	36	13-16
Modulus	GPa		9-11
Shrinkage @100°C	%	4	1.5-6
Tenacity	GPa	0.5	0.9-1.1

4.2. APPLICATIONS

These "Mylar®-type" films are used for capacitors, graphics, film base and recording tapes etc. PET is also used for fibers for a very wide range of textile and industrial uses (Dacron®, Trevira®, Terylene®). Other applications include bottles and electrical components

5. LITERATURE REVIEW

Among synthetic fiber derivatives, polyester fiber consumption is the highest not only due to its tensile parameters but also due its blending susceptibility. When polyester properly combined with cotton, it adds strength, provides smoothness, silkiness and dirt rejection. It also reduces the weight of the fabrics and increases its wrinkle resistance. Whereas, cotton gives body to the yarn softness and essential moisture absorption. Nowadays, fabrics knitted from cotton/acrylic blended yarns are very popular. In comparison with classic cotton outwear knits manufactured from blended yarns have better quality characteristics, such as strength, elongation at break, elasticity, flexibility, used in clothing textiles may have a beneficial influence on human organisms. Such a user-friendly influence can be achieved by introducing biological active substances into the fibers. Investigations into developing a technology aimed at manufacturing yarns from antimicrobial and antifungal fibers were carried out. An analysis was carried out of parameters characterizing fibers half-finished products, cotton yarns and cotton/polyester yarn blends spun with the use of a R1 rotor spinning frame from Rieter . The influence of polyester fibers share in the blends on their structural yarn parameters was analyzed. Cotton yarns combed and carded with linear densities of 20 tex & 30 tex and with a constant twist factor of α = 140 were spun by means of the R1 spinning frame. A two-factor variance analysis was carried out which proved the significant influence of the blends' content on the basic quality yarn parameters Sulphonated jute fibers were blended with cotton at three different ratios for eg. 50:50, 60:40 and 70:30 for production of fine yarn and comparatively better ratio have been investigated. The plain woven fabric were prepared by sulphonated jute-cotton yarn. The set of warp and weft blended yarns was done on the one up and one down principle. The physico-mechanical properties of blended yarn and fabrics were studied and compared with that of jute yarn, cotton yarn and fabrics. In a previous work (Chollakup *et al* 2002) the physical properties of different types of Thai silk waste - outer, middle and mixed portion of filaments of the cocoon- were studied and it was found that the fiber characteristics were different, especially the fiber fineness and the cut length distribution. These characteristics were also different of those of cotton fibers. The feasibilities of spinning some blending proportions of cotton and one type of silk waste -mixed layer- has also been carried out in the cotton micro-spinning system. This study aims to predict the strength and elongation properties of cotton/polyester blended rotor yarns, using blend ratios and yarn count as predictors. A simplex lattice design with two replications at each design point is constructed to determine the slivers were used to produce rotor yarns with five different counts on a laboratory-type rotor spinning machine (quick spin). Based on experimental observations, mixture-process crossed regression models with two mixture components and one process variable (yarn count) are constructed to predict strength and elongation properties. All statistical analysis steps are performed on Design-Expert statistical software. In this work, 0.133 - 0.166 tex and 38 mm of fiber length of polyester and viscose roving of 591 tex (α_{tex} 8) were blended variously (polyester/viscose 35/65%; polyester/viscose 50/50%; polyester/viscose 65/35%; polyester 100% and viscose 100%) and the yarns were produced at spindle speed of 18000 rev/min with 48 mm of ring diameter and C type of traveller 50 mg (No.1/0) in ring frames. Later, the resulted 20 tex yarns were examined by measuring its tenacity, elongation, irregularity and hairiness. The aim of this study is to investigate the hairiness of ring-spun polyester/viscose blends, which are commonly used in the textile industry, by using three different test methods. The pilling values of these produced samples were also determined. The outcomes have been assessed according to the blend ratios and fiber locations which were scanned on the scanning electron microscope; the observations were concluded both on the hairiness and pilling values depending on the blend proportions. As a result, within the produced yarns the worse hairiness was obtained on the viscose (100%) yarns and the worse pilling values were existed on the knitted fabrics which are formed from these spun yarns. The influences of drafting system parameters of a ring frame and yarn parameters on the hairiness of polyester-viscose blended yarns are examined. Samples of 80/20 polyester/ viscose blended yarns were produced by a SKF Lab Spinner and the hairiness was measured by a Shirley Yarn Friction/Hairiness Meter. Statistical analysis of the results show that yarn hairiness is significantly influenced by the drafting system angle, the overhang of the top delivery roller , the covering of the top delivery roller, the back zone observed that the distance clips and top roller pressure do not have a significant effect on the yarn hairiness cotton is very compatible with linen. It spins well with it to provide good quality yarn and fabrics, the cost is lower than it would be all-linen material it also provides body and improved drapeablity linen adds greater strength and absorbency according to the study done at CIRCOT. Ramie/Cotton blends (60:40 to 50:50) are of interest for woven or knitted leisure clothing lyocell being a cellulosic fiber is bio-degradable.it will degraded if disposed in a landfill products grade from lyocell can be recycled for digested in sewage. The fiber will degrade in 8 days polynosic fibers had good strength and smooth round cross section, but cost of production is very high, prove to fibrillation and was difficult to dye these fibers were good as a blend with cotton. A study on the physical properties of jute: cotton blended curtain (60:40,50:50 and 40:60) 100% and blended curtain is performed in this work. Among the three types of blended curtains it is observed that weight/sq.m of 50:50 blended curtain is nearer to the weight/sq.m of 100% cotton curtain the warp wise strength of blended curtain is very nearer to the 100% cotton curtain before washing after washing the strength of blended curtain decreased a less than the 100% cotton curtain. The bending length of 50:50 blended curtain is also satisfactory and comparable to 100% cotton curtain after single washing.

6. OBJECTIVES

The following Objectives are:

- To collect the chicken feather, separate the fiber and purification.
- To analyze the chicken feather fiber structure and properties.
- To produce chicken feather fiber and cotton, polyester blended web and produce yarn .
- To study evenness, hairiness tester and single yarn tester

6.1. FIBER COLLECTION, SEPARATION AND PURIFICATION

The chicken feathers from the poultry units are collected and cleaned the stiff central core of the feather (the quill) must be stripped of the flexible, interconnected strands of material that emerge from it (the barbs).it is only this soft barb material that is useful as feather fiber.

Although the whole feather is made up of keratin, the crystal structure of the protein in the brittle central quill is different from that in the soft but durable barbs; only the barbs have the desirable properties. Then the fibers are sterilized in autoclave at high temperature.

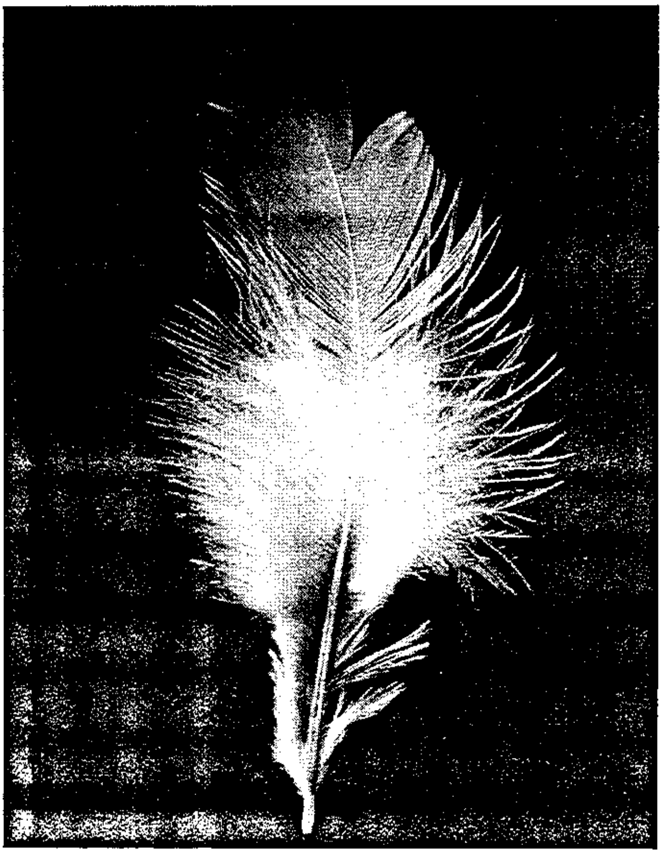


FIGURE 6.1:Chicken feather

6.2. PROPERTIES OF CHICKEN FIBER

Length :22mm

Strength :32.24 gms

Fineness :3653 m.tex

Elongation :16.13%

METHODOLOGY

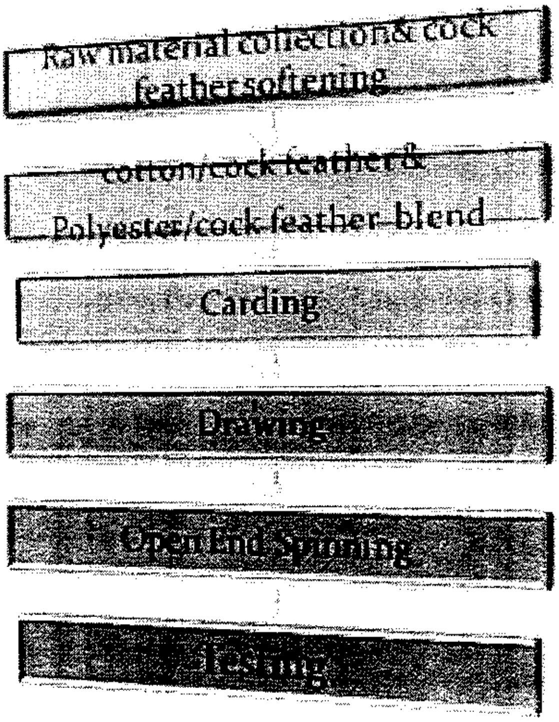
7. METHODOLOGY.

The objective of our project is to manufacture a blended yarn using chicken feather. The reason for selecting chicken feather is, it is a waste material so that the industry can earn more by using the waste material (chicken feather). We can get chicken feather at zero cost. The consumption of cotton is reduced for about 10%-20% so we can able to produce yarn at very competitive price. We are going to blend cotton and polyester along with the chicken feather in 80:20 blending ratio respectively. The reason for choosing 80/20 blend is, by increasing the proportion of cock fiber we were not able to process in carding and the web formation is impossible. So we found that 80/20 blend is suitable for producing web.

The various steps followed are below

- Raw material collection
- cock feather softening
- cotton/cock feather & Polyester/cock feather blending
- Carding
- Drawing
- Open End Spinning
- Testing

7.1. Process Sequence



7.1.1. Raw material collection

To manufacture yarn, the necessary thing that we need to have is the raw material. Cotton is a popular material that is easily available in the market. But the collection of chicken fiber is very difficult. The stem like chicken feather is collected from butcher shop. Then the separation of **Barb** and **Quill** is done. The centre stem is called Quill and side protruding fiber is called Barb. The separation of Barb and Quill is done manually.

7.1.2. Cock Feather Softening

The fiber which is collected from the chicken feather is highly rigid compared to cotton, so it will not get twisted along the axis of the yarn. There will be a lot of protruding fibers which will appear on the surface of the yarn. For this reason we decided to soften the fiber using **solu soft** as recipe.

Procedure for Softening

Solution : Solu soft

Time : 20-30 min

Temperature : Room

PH : 5

Concentration : 2gpl

The recipe is completely dissolved in cold water at a concentration of 2gpl. Then the sample is impregnated in to the recipe at a room temperature for about 20-30 minutes. The ph of the solution is maintained about 5. After that the sample is dried.

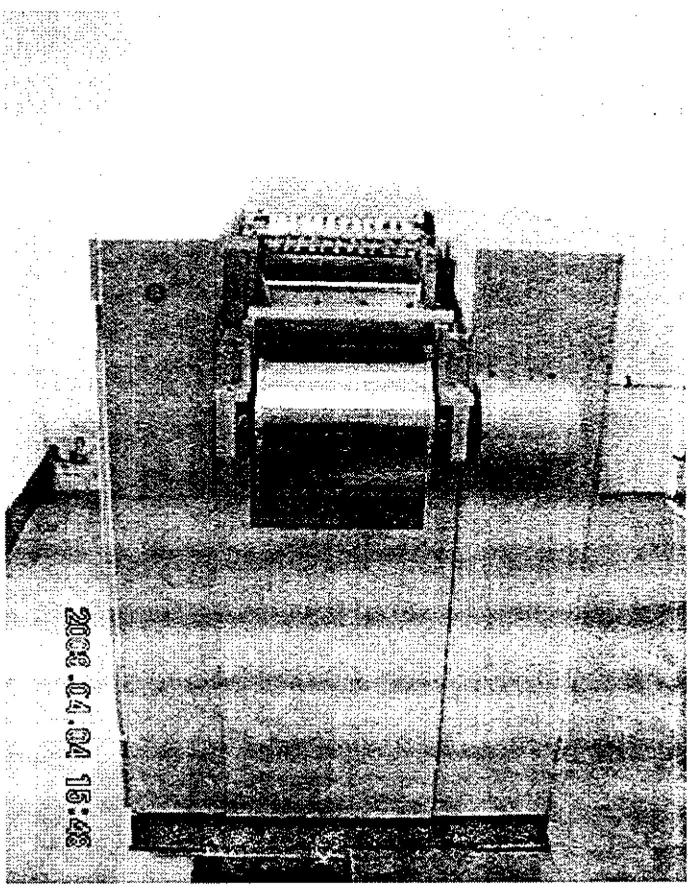
7.1.3. COTTON/COCK FEATHER & POLYESTER/COCK FEATHER FIBER BLENDING

Processed chicken feather and cotton are mixed in appropriate blending ratio as mentioned earlier. Chicken feather will have a average length of about 22mm. So we chose cotton of about 22mm and we mixed manually. Similarly for polyester also we had followed the same method, the length we chose for polyester is 34mm. These mixtures are then processed through carding.

7.1.4. Carding

The Laps from Blow Room are fed into the carding machines to get uniform Slivers which are in the form of loose continuous strands of cotton staple.

FIGURE7.1:CARDING MACHINE



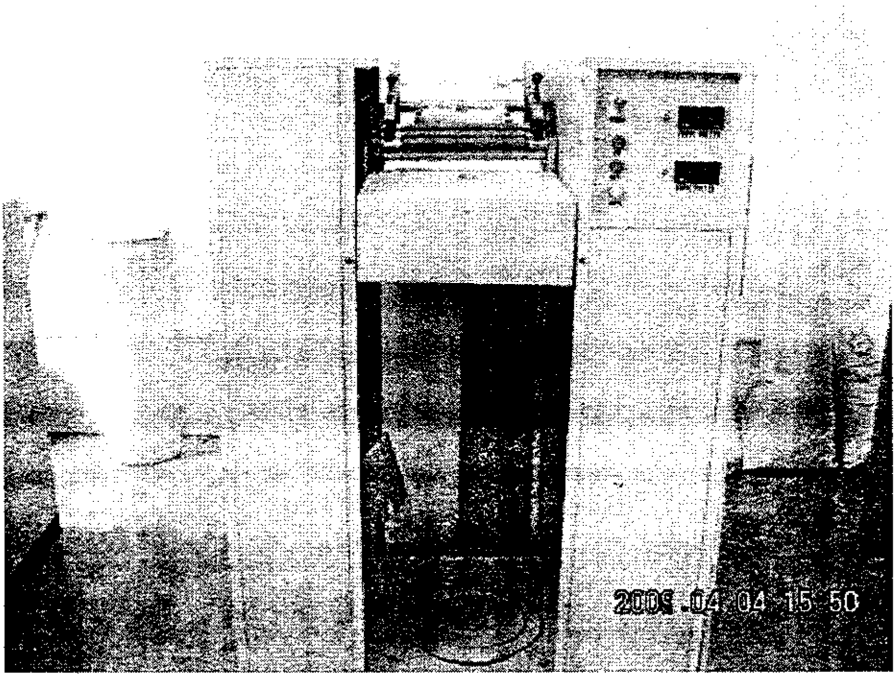
Another purpose of carding is to further clean the impurities that are left during the blow room operations. The short fibers and other foreign matters are also removed in the process. The slivers are kept in specially made lightweight drums.

Slivers from carding section can go either directly to Finisher Drawing through Breaker Drawing or through Uni Lap/Comber to Finisher Drawing.

7.1.5. Drawing

Purpose of Drawing is to straighten the fibers and remove any curls. This takes place by passing the slivers through different sets of rollers that are revolving at 5 different speeds. The speeds of the rollers increase as the sliver moves from one stage to the next. The progressive attenuation reduces the size and weight of single sliver that has been fed. The final sliver that comes out of drawing is of the same weight and size as

FIGURE 7.2 : DRAWING MACHINE



the number of slivers which are fed compensate for the attenuation of the individual slivers.

In the Drawing section, it is first passed through Breaker Drawing process to mix Sliver from different Laps, again to achieve homogeneity. The same process is repeated at the Finisher drawing stage.

7.1.6. Open end spinning

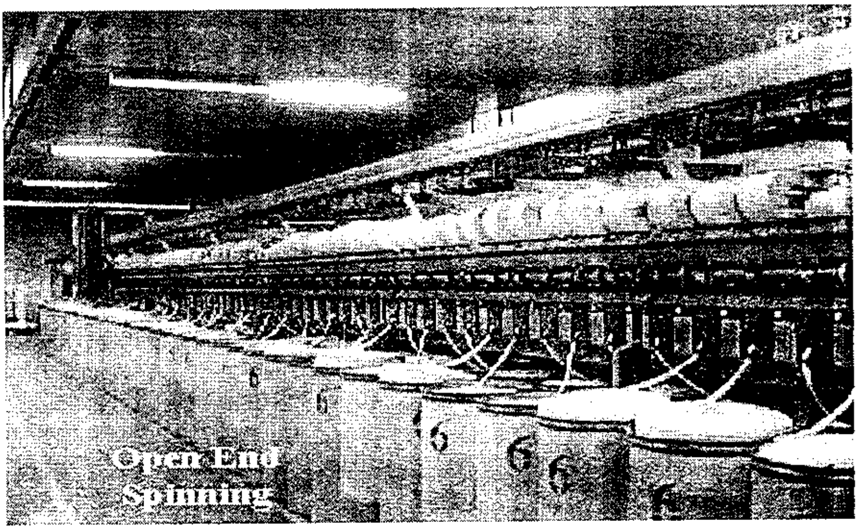


FIGURE 7.3

In this spinning the individualized fibers carried by air current are deposited continuously on the internal peripheral surface of a rapidly rotating drum, called the rotor the rotation of rotor imparts twist to the fibrous ring which is then peeled off and withdrawn along axis of the rotor the first rotor spinning machine , the KS 200 was demonstrated publicly at Brno in 1965 and the commercial machine , the BD 200 appeared in 1967.since then the rotor spinning has established very well in the coarse and medium count sector.

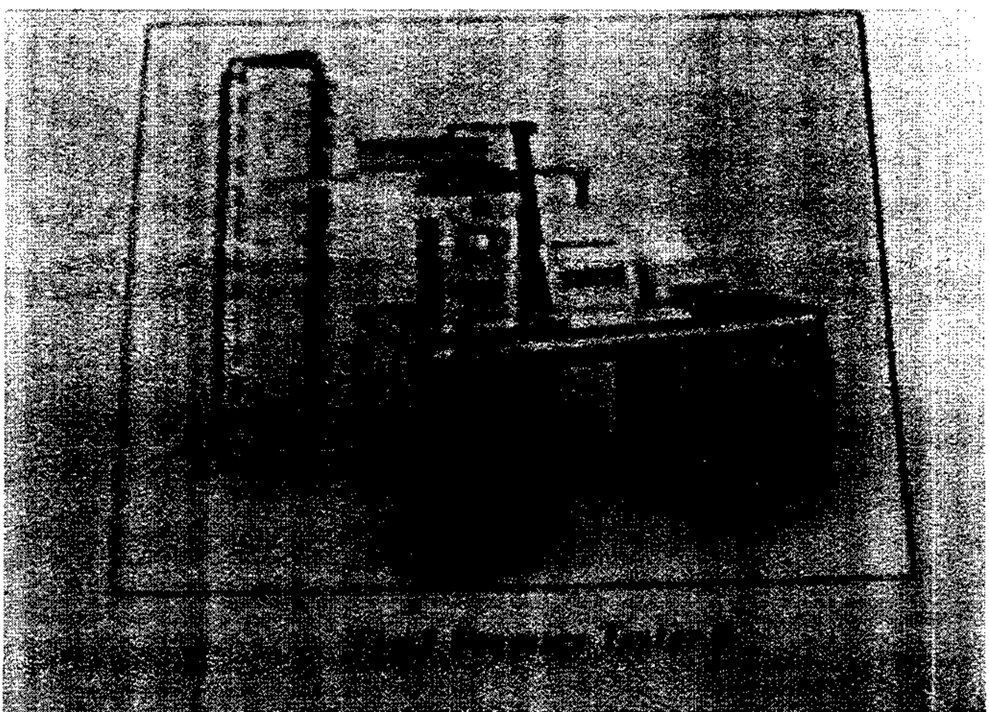
8. TESTING

8.1. SINGLE YARN STRENGTH TESTER

Single thread pulling force from the fabric specimen was determined using Instron tensile tester at a cross-head speed of 500 mm/min. During the experiment, the upper jaw only gripped the upper portion of the pulling thread, whereas, the lower jaw gripped all the 2 threads expect the lower portion of the pulling thread. Illustrates a schematic representation of the experimental set up for single thread pulling force measurement. Rothschild tensiometer-2000 was used to measure the input and out put tensions for determining the yarn-to-yarn coefficient of friction. A schematic diagram of the measurement of yarn-to yarn coefficient of friction. Three different levels of input tensions were taken and in each case the yarn withdrawal
speed was 500 mm/min.

8.2. HAIRINESS AND EVENESS TESTER

FIGURE 8.1 : PREMIER TESTER 4



PT 7000 TECHNICAL DATA

Basic Installation

Module to test evenness properties

Additional Option

Module to measure hairiness(Hi) index

MH 120: 12 to 40 k tex to measure coarse sliver

Application range

Spun yarn, roving, &sliver

(cotton, polyester, viscose, acrylic& its blends)

4tex to 12 k tex(normal)

Measuring Principle

Evenness: capacitance principle

Hairiness: optical principle

Testing Condition

Time upto 20 min

Speed upto 400m/min

Sample Presentation

Manual Feeding Arrangement

Output Parameters

Numerical Results

Evenness Module

Unevenness & Co-Efficient Of Variation

Um% & CVm%

Imperfections - Thick, Thin, & Neps

Ambient Condition

Relative Humidity - 65+2% OR 65-2%

Temperature- 21+1OR 21-1 C

Power Consumption

Single phase-1000va; 1kva ups

Compressed air consumption

10 m cube/hr at 6kg/cm square

8.3. Fourier Transform Infrared Spectroscopy (FTIR)

8.3.1 FTIR - Introduction

FTIR is most useful for identifying chemicals that are either organic or inorganic. It can be utilized to quantitative some components of an unknown mixture. It can be applied to the analysis of solids, liquids, and gasses. The term Fourier Transform Infrared Spectroscopy (FTIR) refers to a fairly recent development in the manner in which the data is collected and converted from an interference pattern to a spectrum. Today's FTIR instruments are computerized which makes them faster and more sensitive than the older dispersive instruments.

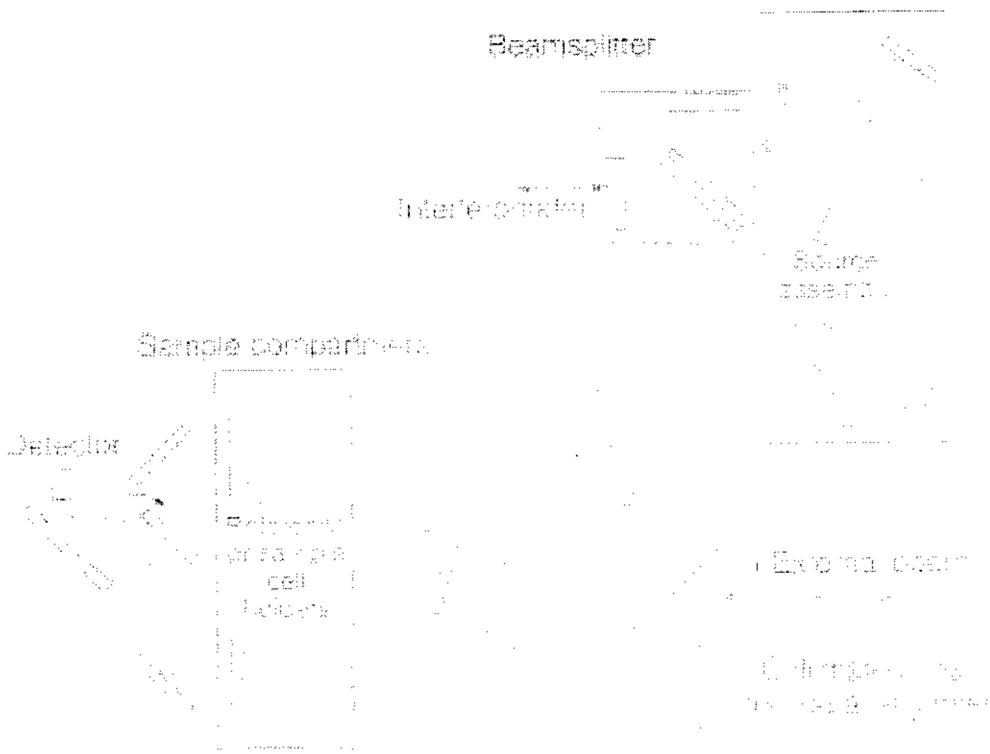


Fig 8.2: Optical Diagram of FTIR spectroscopy

8.3.2. Qualitative Analysis

FTIR can be used to identify chemicals from spills, paints, polymers, coatings, drugs, and contaminants. FTIR is perhaps the most powerful tool for identifying types of chemical bonds (functional groups). The wavelength of light absorbed is characteristic of the chemical bond as can be seen in this annotated spectrum. By interpreting the infrared absorption spectrum, the chemical bonds in a molecule can be determined. FTIR spectra of pure compounds are generally so unique that they are like a molecular "fingerprint". While organic compounds have very rich, detailed spectra, inorganic compounds are usually much simpler. For most common materials, the spectrum of an unknown can be identified by comparison to a library of known compounds. WCAS has several infrared materials, IR will need to be combined with nuclear magnetic resonance, mass spectrometry, emission spectroscopy, X-ray diffraction, and/or other techniques.

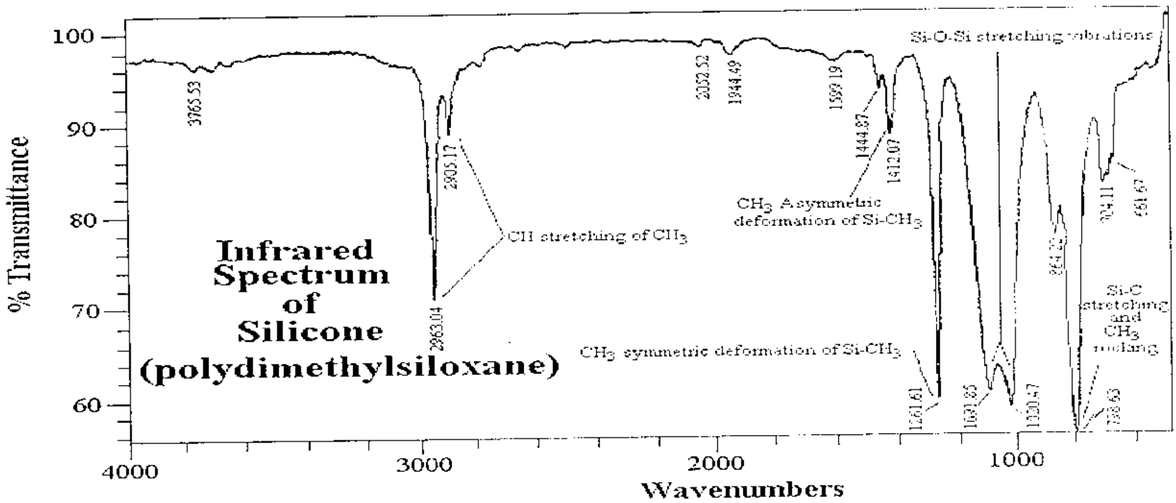


Fig 8.3: INFRARED SPECTRUM OF SILICONE

8.3.3. Quantitative Analysis

Because the strength of the absorption is proportional to the concentration, FTIR can be used for some quantitative analyses. Usually these are rather simple types of tests in the concentration range of a few ppm up to the percent level. For example, EPA test methods 418.1 and 413.2 measure the C-H absorption for either petroleum or total hydrocarbons. The amount of silica trapped on an industrial hygiene filter is determined by FTIR using NIOSH method 7602.

8.3.4. Physical Principles

Molecular bonds vibrate at various frequencies depending on the elements and the type of bonds. For any given bond, there are several specific frequencies at which it can vibrate. According to quantum mechanics, these frequencies correspond to the ground state (lowest frequency) and several excited states (higher frequencies). One way to cause the frequency of a molecular vibration to increase is to excite the bond by having it absorb light energy. For any given transition between two states the light energy (determined by the wavelength) must exactly equal the difference in the energy between the two states [usually ground state (E_0) and the first excited state (E_1)].

Difference in Energy States = Energy of Light Absorbed

$E1 - E0 = h\ c\ /\ l$

Where

h = Planks constant

c = speed of light, and

l= the wavelength of light.

The energy corresponding to these transitions between molecular vibrational states is generally 1-10 kilocalories/mole which corresponds to the infrared portion of the electromagnetic spectrum.

8.3.5. Sample Preparation

Samples for FTIR can be prepared in a number of ways. For liquid samples, the easiest is to place one drop of sample between two plates of sodium chloride (salt). Salt is transparent to infrared light. The drop forms a thin film between the plates. Solid samples can be milled with potassium bromide (KBr) to form a very fine powder. This powder is then compressed into a thin pellet which can be analyzed. KBr is also transparent in the IR. Alternatively, solid samples can be dissolved in a solvent such as methylene chloride, and the solution placed onto a single salt plate. The solvent is then evaporated off, leaving a thin film of the original material on the plate. This is called a cast film, and is frequently used for polymer identification. Solutions can also be analyzed in a liquid cell. This is a cell container made from NaCl (or other IR transparent material) which can be filled with liquid, such as the extract for EPA 418.1 analysis. This creates a longer path length for the sample, which leads to increased sensitivity. Sampling methods include making a mull of a powder with hydrocarbon oil (Nujol) or pyrolyzing insoluble polymers and using the distilled pyrolyzate to cast a film. Films can be placed in an Attenuated Total Reflectance cell and gases in gas cells.

RESULTS AND DISCUSSION

9. RESULTS AND DISCUSSION

9.1. SCANNING ELECTRON MICROSCOPY

The photos of scanning electron microscopy are shown below

FIG 9.1: COTTON/COCK FEATHER BLEND

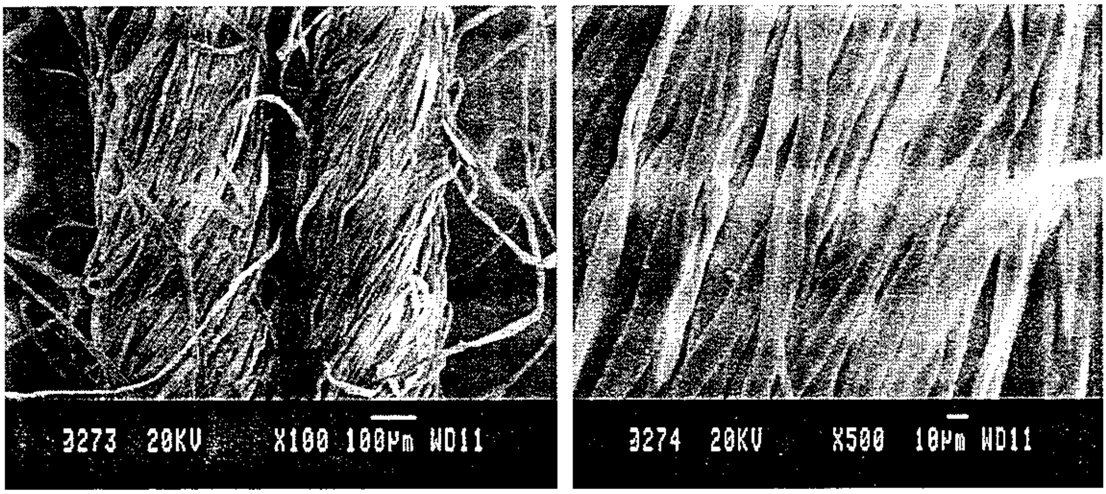
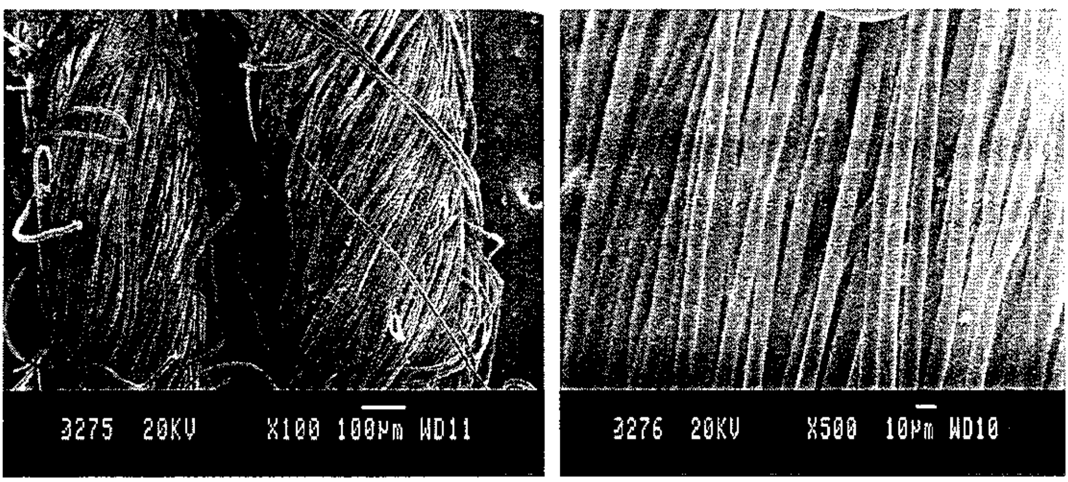


FIG 9.2: POLYESTER/COCK FEATHER BLEND



In the above figure, the white colored thread like structure represents the cock feather fiber. This shows that the cock feather fibers are mixed well

STRUCTURE OF COCK FEATHER

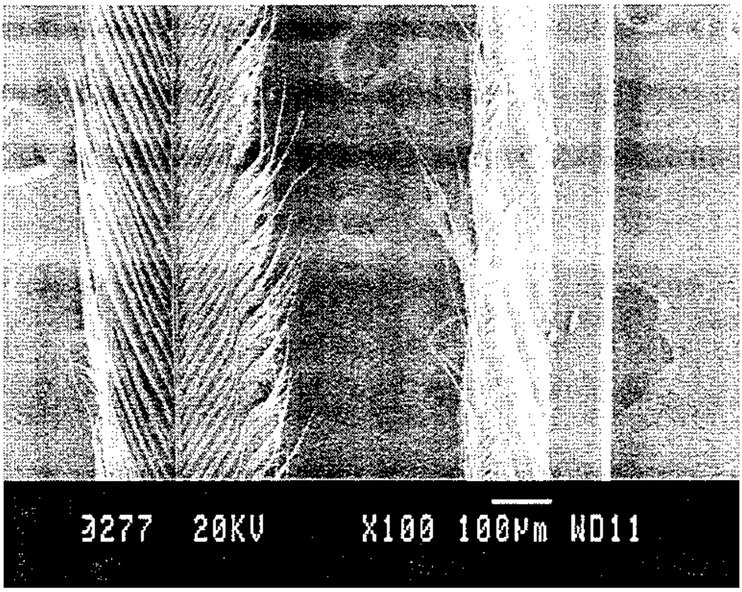
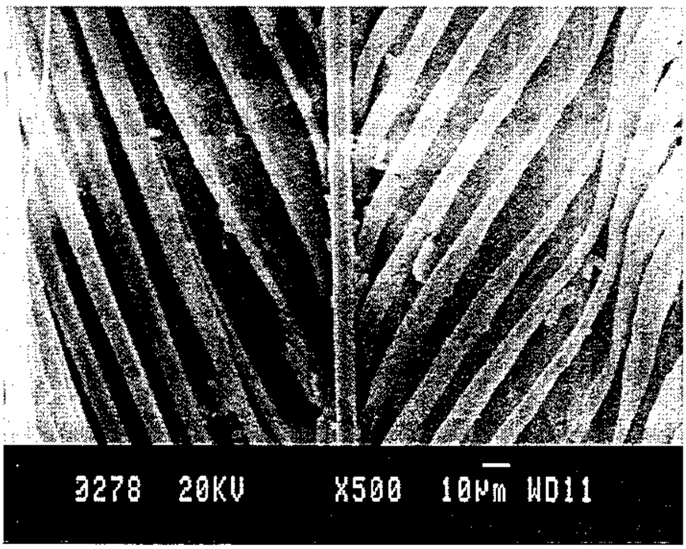


FIG 9.3:CHICKEN FIBRE STRUCTURE



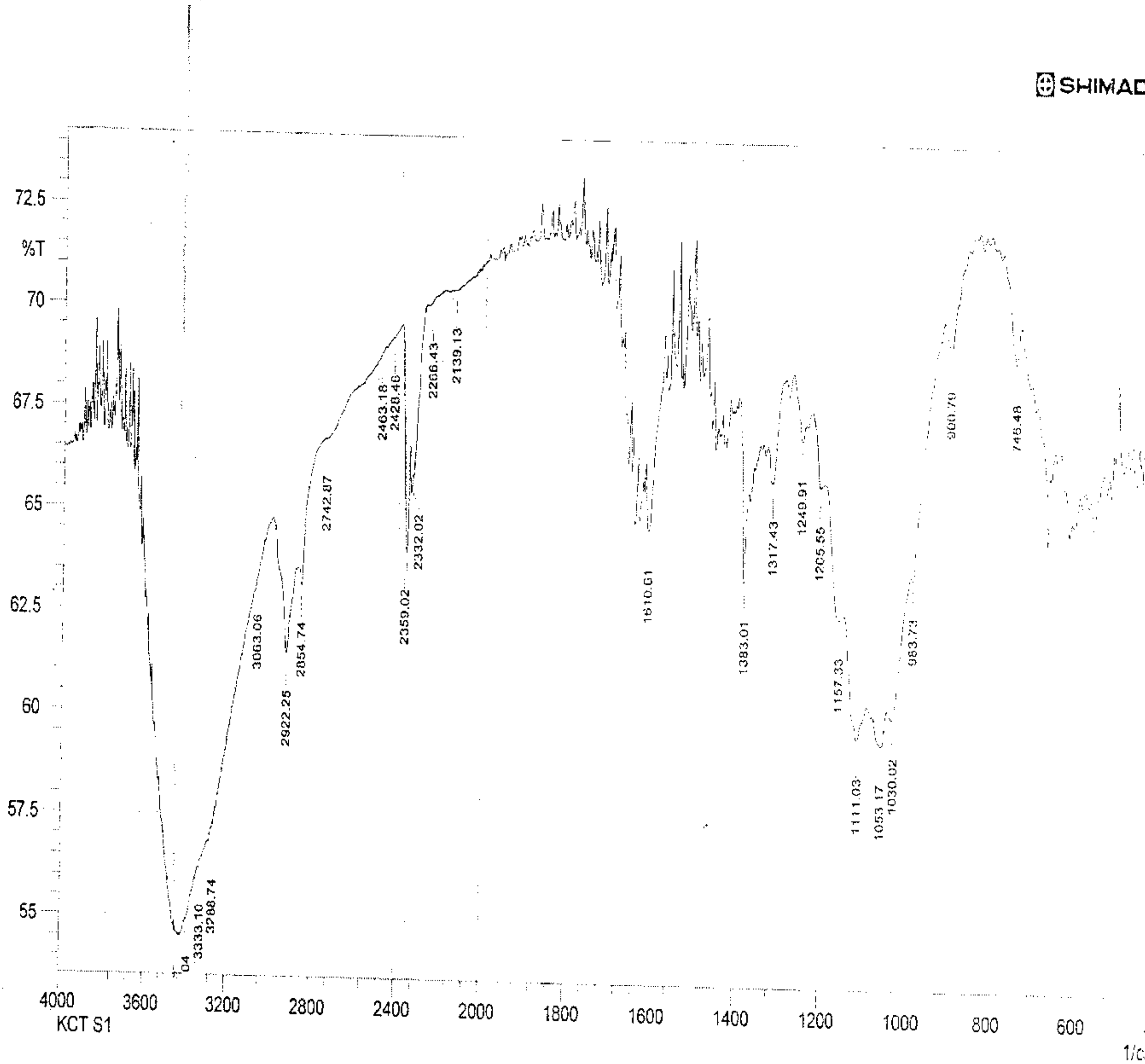
CHICKEN FIBER STRUCTURE

The above figure shows the Barb and Quill sections of the chicken feather.It is observed that again from each barb there are various branches

9.2. FT-IR

COTTON/COCK FEATHER BLEND

FIGURE 9.4:GRAPHICAL INFERENCE



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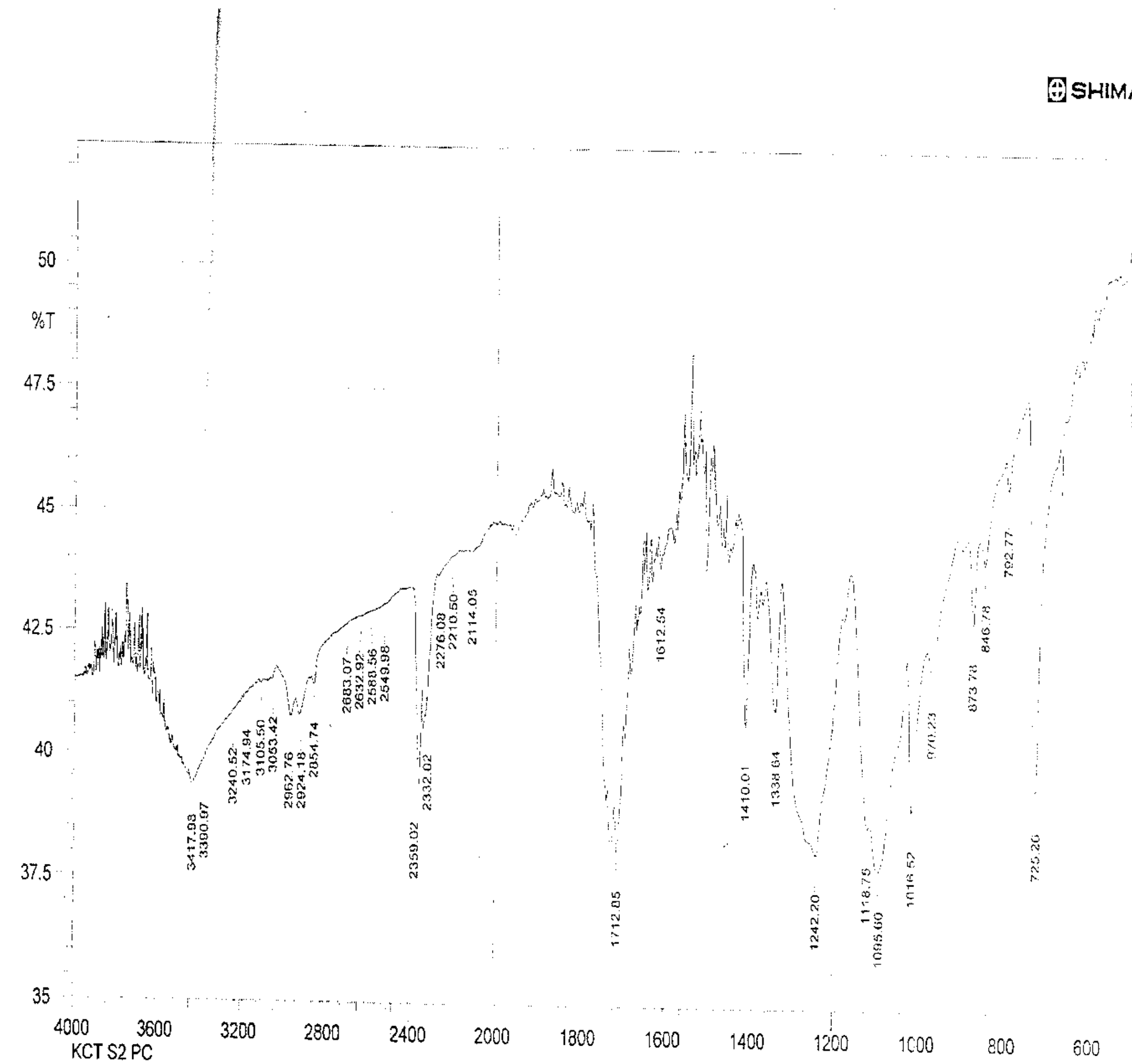
FIQURE9.5. POLYESTER/COCK FEATHER BLEND



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FT-IR INFERENCE

By comparing the results of 100% cotton & 100% polyester with 80/20 Cotton/Chicken Feather & 80/20 Polyester/Chicken Feather we observed that there is a shift in the frequency for both cotton and polyester. Due to this shift in the frequency it is proved that Chicken Feather fibre is distributed in the cross-section of yarn.

9.3. YARN EVENNESS AND HAIRINESS PROPERTY

The evenness property of cotton and chicken feather blended yarn is tested using premier evenness tester the results of the test are tabulated as follows.

TABLE 9A:COMPARISON OF RESULTS

For Cotton and Cock Feather Blend Yarns

S.No	Property	Results for 80/20 blend	Results for 100% cotton
1	U%	17.79	11.5
2	CVm(1m)	15.03	10.4
3	Thin/km(-50%)	110	23
4	Thick/km(+50%)	743	140
5	Neps/km(+280%)	329	140
6	Hairiness	4.36	4.1

INFERENCE

1. Breaking strength for both cotton and cock feather blend and polyester and cock feather blend yarns are very good

2. Tenacity for both cotton and cock feather blend and polyester and cock feather blend yarns are very good.

3. Cv% for cotton and cock feather blend is not good this is due to poor fiber cohesion between cotton and cock feather.

4. Cv% for polyester and cock feather blend is good this is due to better fiber cohesion between polyester and cock feather.

9.5. LEA STRENGTH TESTER

TABLE 9C:LEA STRENGTH COMPARISON(ASTM D-2216)

S.NO	PARTICULARS	LEA STRENGTH KG/CM
1	100% COTTON	56
2	80/20 COTTON/COCKFEATHER BLEND	64
3	100% POLYESTER	75
4	80/20 POLYESTER/COCKFEATHER BLEND	88

10. CONCLUSION

1. By comparing cotton\cock feather yarn along with 100% cotton yarn it was observed that breaking strength and tenacity is better for former.
2. By comparing polyester\cock feather yarn along with 100% polyester yarn it was observed that hairiness is high for the former.
3. Imperfections are more for both the blended yarns when compared with 100%cotton & 100% polyester.
4. The reason for more hairiness is fiber length between cock feather and polyester is not matching i.e cock feather -22mm and polyester -34mm.
5. So, we conclude that cotton/cock feather yarn showing better result as compared to polyester/cock feather.

FUTURE SCOPE OF THE PROJECT

1. In future different materials like viscose, nylon, wool etc. Can be tried
2. The blend ratio can be varied
3. The web can be prepared in roller carding machine
4. The yarn can be weaved into fabric and its characters can be analysed.
5. Different types of softening treatements can be carried out to make the chicken feather more flexibile.

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email r.cholakup@uha.fr

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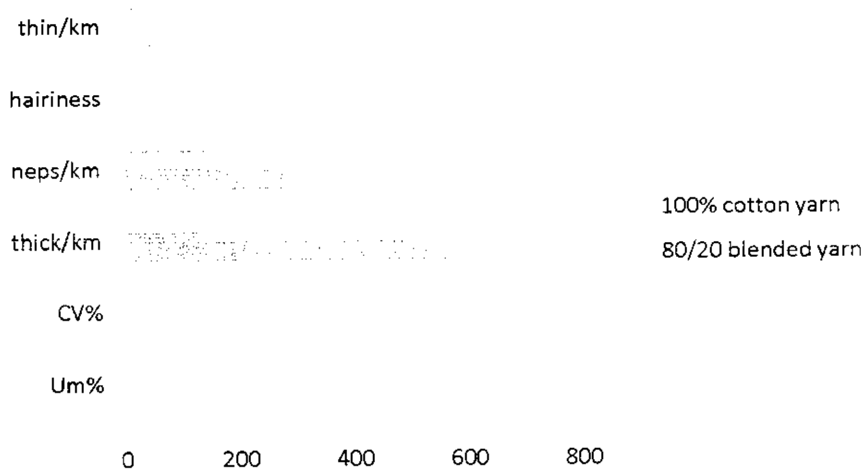
APPENDIX

FIGURE 9.5: COMPARISON OF 100% COTTON YARN WITH 80/20 BLENDED YARN



INFERENCE

- The Cv% was normal for cotton and cock feather blend yarns(USTER standards for 20s count 100% cotton yarn is 10.4%)
- The thin/km was higher for cotton and cock feather blend yarns (USTER standards for 20s count 100% cotton yarn is 6 to 30)
- The thick/km was higher for cotton and cock feather blend yarns (USTER standards for 20s count 100% cotton yarn is 140)
- The Neps/km was higher for cotton and cock feather blend yarns(USTER standards for 20s count 100% cotton yarn is 140)
- The hairiness was normal for cotton and cock feather blend yarns (USTER standards for 20s count 100% cotton yarn is 4 to 6.8)

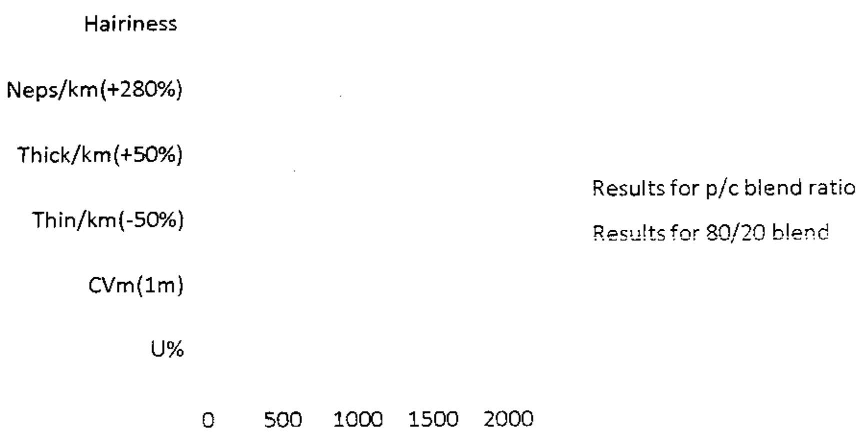
TABLE 9B: COMPARISON OF RESULTS

For Polyester and Cock Feather Blend Yarns

S.No	Property	Results for 80/20 blend	Results for 100%polyester
1	U%	24.27	12.4
2	CVm(1m)	20.69	15
3	Thin/km(-50%)	595	25
4	Thick/km(+50%)	1010	90
5	Neps/km(+280%)	1485	95
6	Hairiness	4.60	4.25

By comparing the above results with the USTER standards we absorbed that the following

FIGURE 9.6: GRAPHICAL COMPARISON OF POLYESTER/COCK FIBER BLEND WITH 100% POLYESTER



- The Cv% was normal for polyester and cock feather blend yarns (USTER standards for 20s count p/c blended yarn is 15%)

- The thin/km was higher for polyester and cock feather blend yarns (USTER standards for 20s count p/c blended yarn is 6 to 30)

- The thick/km was higher for polyester and cock feather blend yarns (USTER standards for 20s count p/c blended yarn is 25 to100)

- The Neps/km was higher for polyester and cock feather blend yarns(USTER standards for 20s count p/c blended yarn is 7 to 100)

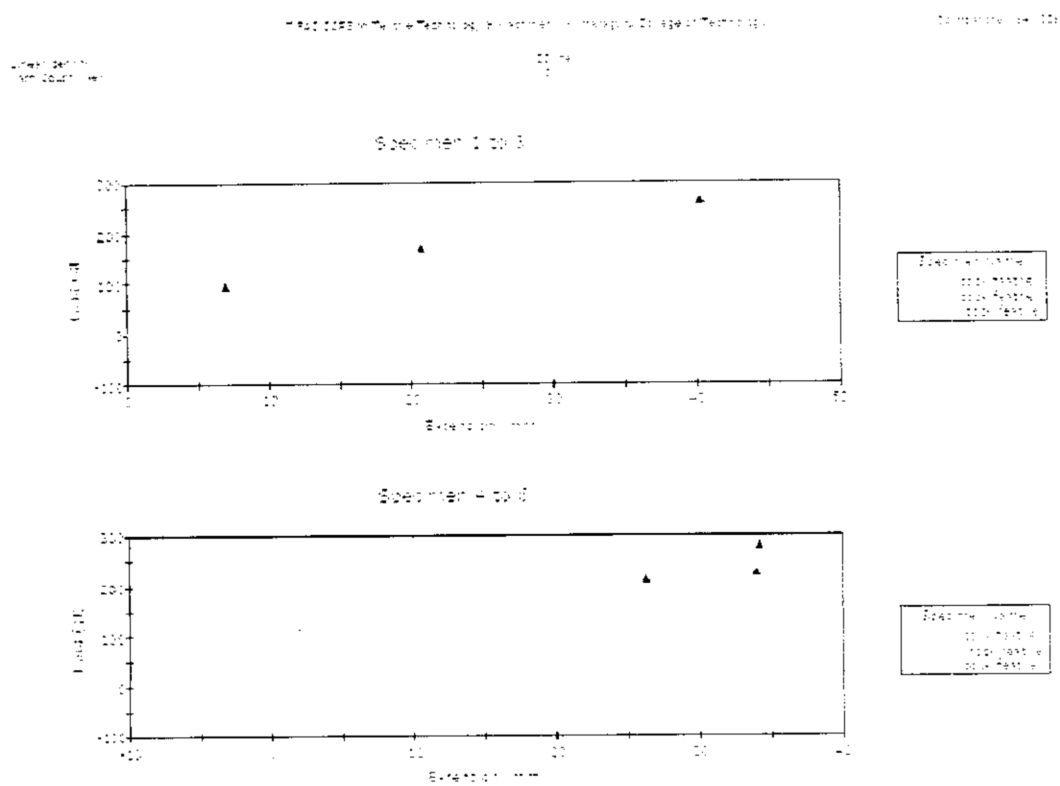
- The hairiness was normal for polyester and cock feather blend yarns (USTER standards for 20s count p/c blended yarn is 4 to 6.8)

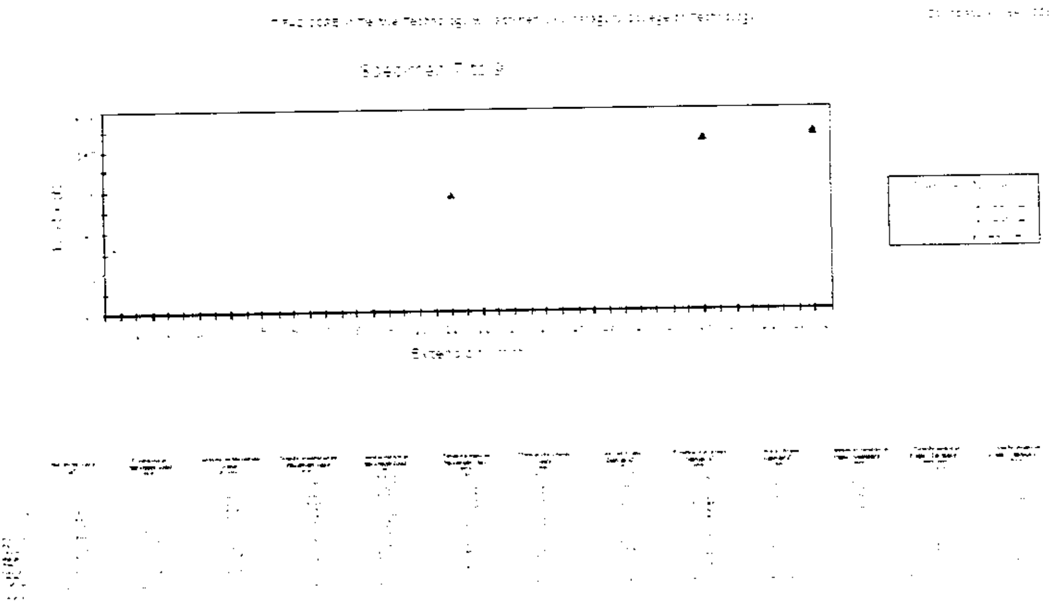
-

9.4. SINGLE YARN STRENGTH TESTER

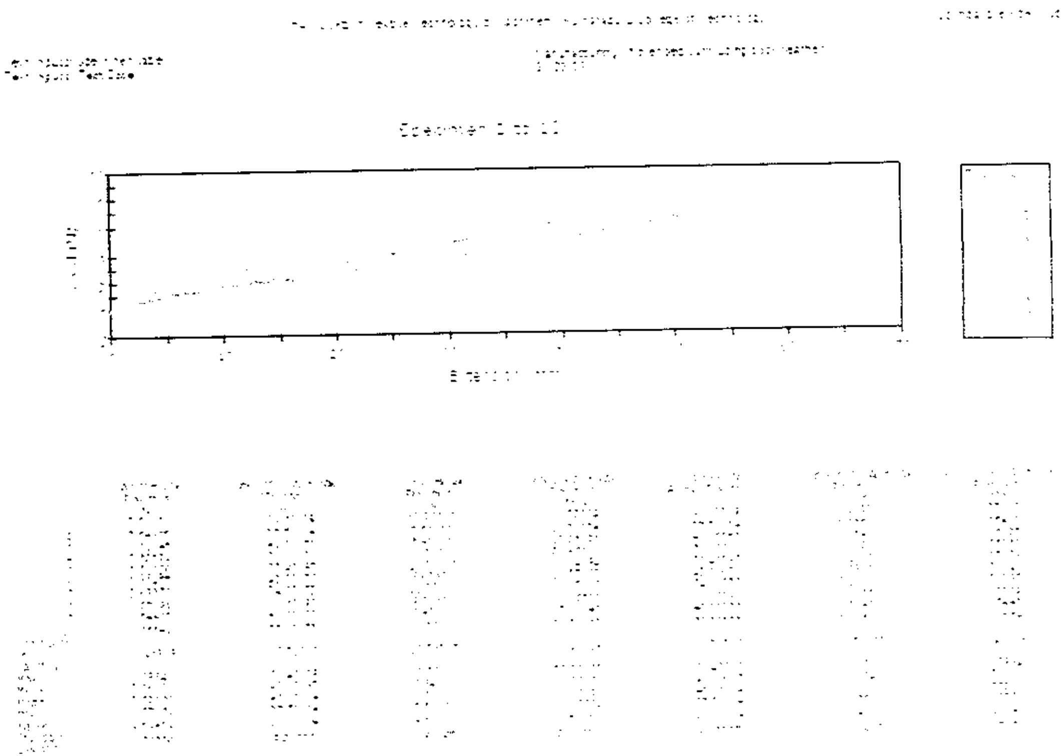
Standards are followed by ASTM D-2256

FIGURE 9.7:





For cotton/Cock Feather Blend



For polyester/Cock Feather Blend