ZARI YARN CHARACTERIZATION

A PROJECT REPORT

Submitted by

SATHIYAMOORTHY.T

Register No: 0920201013

in partial fulfillment for the award of the degree

of

MASTER OF TECHNOLOGY

in

TEXTILE TECHNOLOGY

BONAFIDE CERTIFICATE

Certified that this project report "**ZARI YARN CHARACTERIZATION**" is the bonafide work of **SATHIYAMOORTHY.T** who carried out this project work under my supervision during the year 2010- 2011.

SIGNATURE

Dr.K.THANGAMANI
PROFESSOR AND HEAD
Department of Textile Technology
Kumaraguru College of Technology
Coimbatore - 641 049

SIGNATURE

Mr.S.SUNDARESAN
SUPERVISOR
Assistant professor
Department of Textile Technology
Kumaraguru College of Technology
Coimbatore - 641 049

ACKNOWLEDGEMENT

I express my sincere gratitude to our beloved Co-Chairman, *Dr. B.K. Krishnaraj Vanavarayar, Dr. J. Shanmugan*, Director, Kumaraguru College of Technology and *Dr. S. Ramachandran*, Principal for their support and allowing to use the facilities of the institution.

I express my whole hearted thanks to *Dr. K.Thangamani*, Professor and Head, Department of Textile Technology, Kumaraguru College of Technology, for having been a source of encouragement and for instilling the vigor to do the project.

It gives me great pleasure to express my deep sense of gratitude for my supervisor, *Mr. S.Sundaresan*, Assistant Professor (SRG), Department of Textile Technology, Kumaraguru College of Technology, for his innovative guidance, expert suggestions and constant encouragement at every step for the study.

I thank all the teaching and non-teaching staff for their help during this project. Words fail to express my thanks to my beloved parents, and friends who are my sounding board and pillar of strength.

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.

CHAPTER NO.	TITLE	PAGE NO.

ABSTRACT

India has a rich cultural tradition. Zari (or Jari as traditionally called) is basically a metallic thread meant for weaving and embroidery. Many components like silk, metals like silver, gold coating are involved in the making of these zari, there is a need for establishment of certain data regarding zari production and properties of various components of zari.

This project work deals with the different components of zari, their tensile properties and an analysis on the effect of oxygen plasma treatment on the tensile behavior of raw silk, degummed silk, and various components of zari. Fine tuning the working of online zari testing instrument is also carried out in this project work.

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

1.	PP	Poly Propylene
2.	PE	Poly Ethylene
3.	PET	Poly Ethylene Terepthalate
4.	gf/tex	Gram Force per Tex
5.	mm	Millimeter

CHAPTER 1

INTRODUCTION

Zari is a type of thread made of fine gold or silver wire. Today, in most fabrics, zari is not made of silk, real gold and silver, but has cotton or polyester yarn at its core, wrapped by golden/silver metallic yarn. Real Zari made of pure gold & silver, Imitation zari made of silver electroplated (thinly) copper wire, and Metallic zari made of slitted polyester metallised film. Imitation Zari came into existence to cut the cost of precious metals.

Zari has many components in it. Silk is the important core component in real zari. Silk is said to be the queen of textile fibres and the products made out of it are lustrous and have good handle two types of silks, namely, mulberry and tasar are produced in India. Silk is a protein fibre and unlike wool has a higher strength and low elongation. It is one of the least researched fibres and there is renewed interest in developing a number of niche products.

Although a considerable amount of work has been carried out on silk, it is saddening to note that the data regarding the zari and its properties is still at its infancy. The present study is an attempt to evaluate some important properties like tensile strength, elongation of zari and its components. As zari is composed of silk in the core, wrapped with flattened silver metal and electroplated with gold solution on the top, the tensile strength and elongation of the silk filament in the core plays an important role in determining the evenness of the wrap and thereby influencing the quality of the resultant zari.

In the previous researches conducted in zari, it has been inferred that many fault occur in the zari due to many reasons out of which the influence of the tensile strength and [...] the closeness of the wrapped silver are due factors.

1. 1 OBJECTIVE OF THE PROJECT

The present study aims at the following objectives;

- To generate data on the properties of zari and its components
- To test the zari yarn in various stages for strength, Elongation using Instron tester and prepare a statistical report for the existing process.
- To assess the effect of oxygen plasma treatment on the strength and elongation of raw silk, degummed silk, zari and its components namely red silk, silver wrapped red silk.
- To fine tune the fabricated instrument (offline zari tester) and check the level of compatibility.

CHAPTER 2

LITERATURE REVIEW

2.1 ZARI

Zari (or Jari as traditionally called) is basically a metallic thread meant for weaving and embroidery. It is manufactured by winding or wrapping (covering) a flattened metallic strip made from pure gold, silver or slitted metallised polyester film, on a core yarn, usually of pure silk, art silk, viscose, cotton, nylon, polyester, P.P., mono/multi filament, wire, etc.

Zari can broadly be divided into 3 types.

1. Real zari
2. Imitation Zari
3. Metallic zari

Real Zari made of pure gold & silver, Imitation zari made of silver electroplated (thinly) copper wire, and Metallic zari made of slitted polyester metallised film. In ancient times, when precious metals were cheaply and easily available, only Real Zari threads were produced. Due to industrial revolution and invention of electroplating process, Imitation Zari came into existence to cut the cost of precious metals.

As Copper is the most malleable and ductile metal after Gold and Silver, silver electroplated copper wire replaced pure silver. Various modern colours and chemicals are used to create/impart a golden hue instead of pure Gold. The precious metals & copper too became dearer due to huge demand in various modern industries. Thus, a cheap & durable alternative was invented with non-tarnishing properties. Metallic Zari came into vogue replacing traditional metals like Gold, Silver & Copper. This Zari is light in weight & more durable than earlier editions. Also, it had the most sought after

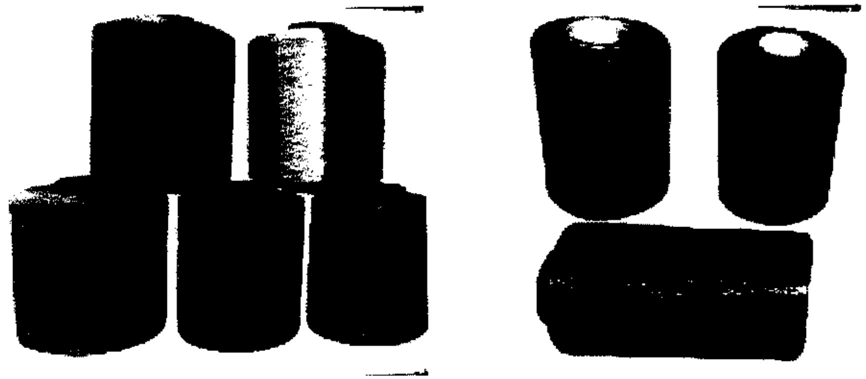
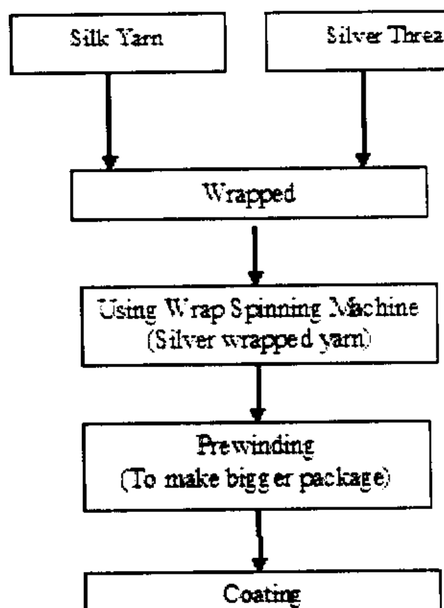


Fig. 2.2 Imitative Zari

Babu Rao (2004)[2] says that the traditional Kancheepuram silk sari still maintains its appeal, and has a significant market share. Gold-coated silver thread (zari) is used in this sari. The quality, and hence the price of the sari, is dependent on the composition of the zari. Until now there has been no qualified method of assessing this.

2.2 ZARI YARN MANUFACTURING

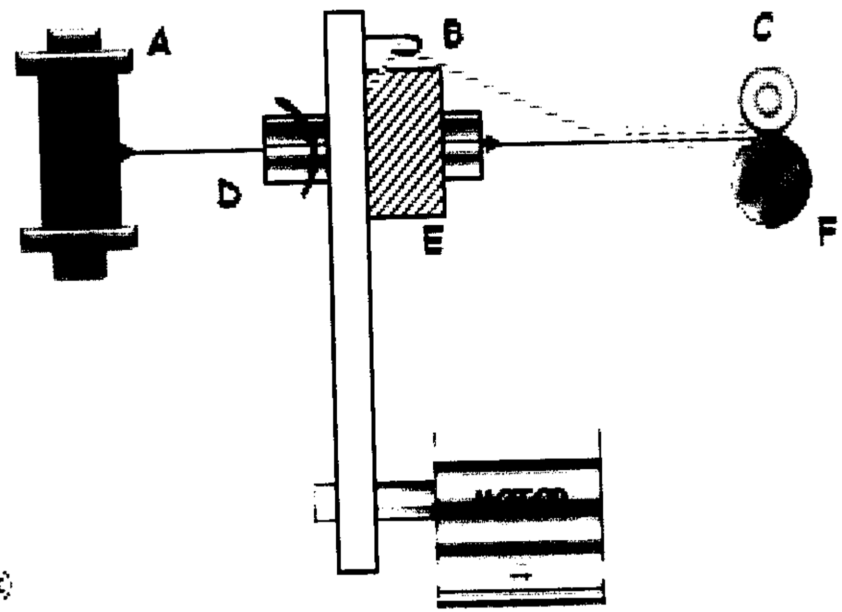


2.2.1 Preparation of raw material

The Red Silk of 14-16 Denier yarn is used as a core material. The Silver wire of 16 Micron diameter is first made flattened cross-section by using a flattening machine by applying optimum pressure and it is wound on small spools called as "Reels". Each reel contains 1000 to 1500 meter of silver wire. The sliver is being melted in a hot chimney, at a specific degree.

2.2.2 Wrap Spinning

In this wrap spinning process, silk yarn is in the form of spool is fed into the hollow spindle; the silver thread in the reel is guided through the wrapping finger and is wrapped onto the surface of the silk yarn. Then the wrapped silk yarn is wound onto the delivery package



MACHINE PARTS:

A - SPOOL (Red Silk)
B - Wrapping Finger

2.2.4 Gold coating

The prewound bobbins are now coated with gold solution by the process of electroplating.

2.2.5 Final winding & Precision winding

In the Precision winding process the final Zari yarn is wounded on flanged small wooden spools under constant tension and constant length. Each spool is of 64.8gms net weight and a package of 4 bobbins is called one mark. One mark costs more than 10,000 rupees.

2.3 SILK

Silk is said to be the queen of textile fibres and the products made out of it are lustrous and have good handle two types of silks, namely, mulberry and tasar are produced in India. Morton W.E. and Hearle J.W.S. (1993)[13] says that silk is a protein fibre and unlike wool has a higher strength and low elongation. Silk is a natural protein fiber, some forms of which can be woven into textiles. The best-known type of silk is obtained from cocoons made by the larvae of the mulberry silkworm Bombyx mori reared in captivity, known as Sericulture. The shimmering appearance of silk comes from the fibers' triangular prism-like structure which allows silk cloth to refract incoming light at different angles. Silks are produced by several other insects, but only the silk of moth caterpillars has been used for textile manufacture. There has been some research into other silks, which differ at the molecular level. Silks are mainly produced by the larvae of insects that complete metamorphosis.

2.3.1 Microscopic view

Fig: 2.6 Silk 20 micron bright longitudinal section

Fig: 2.7 Silk 20 micron bright cross section

2.3.2 Chemical structure

According to Carty P. (1996)[3], silk polymer is a linear, fibroin polymer. Silk is composed of sixteen different amino acids. Three of these sixteen amino acids, namely ... about four fifths of the silk polymers composition. The

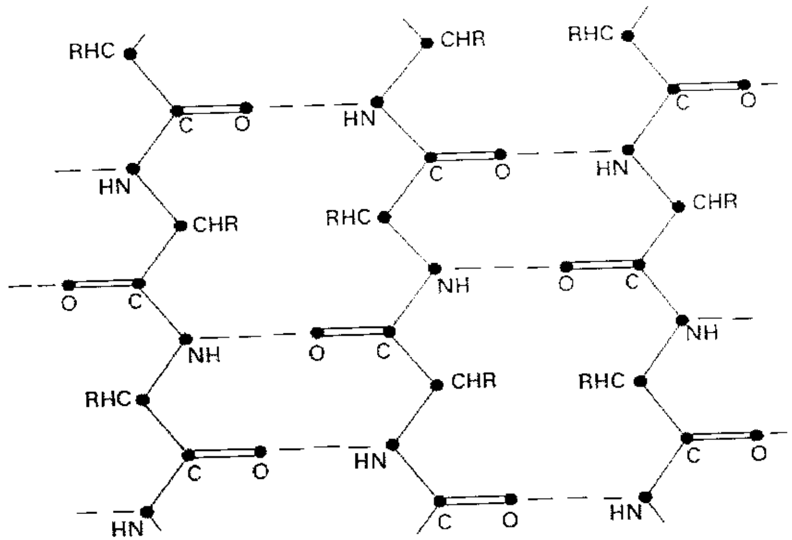


Fig: 2.8 Chemical structure of silk

2.3.3 Properties and characteristics of silk

Warner S (1995)[17] says that the silk filament is strong. This strength is due to its linear, beta-configuration polymers and very crystalline polymer system. These two factors permit many more hydrogen bonds to be formed in a much more regular manner. When wet, silk loses strength. This is due to water molecules hydrolysing a significant number of hydrogen bonds and in the process weakening the silk polymer.

Silk is considered to be more plastic than elastic because its very crystalline polymer system does not permit the amount of polymer movement which could occur in a more amorphous system. Hence, if the silk material is stretched excessively, the silk polymers, which are already in a stretched state (they have a beta-configuration) will slide past each other. The process of stretching ruptures a significant number of hydrogen bonds. When stretching ceases, the polymers do not return to their original position, but remain in their ... This disorganises the polymer system of silk, which is seen as a distortion and system allows fewer water molecules to enter than does the amorphous polymer system of wool. The other hygroscopic properties of silk are rather similar to those of wool.

Silk is more sensitive to heat than wool. This is considered to be partly due to the lack of any covalent cross links in the polymer system of silk, compared with the disulphide bonds which occur in the polymer system of wool. The existing peptide bonds, salt linkages and hydrogen bonds of the silk polymer system tend to break down once the temperature exceeds 100 degree C.

Silk is degraded more readily by acids than is wool. This is because, unlike the wool polymer system with its disulphide bonds, there are no covalent cross-links between silk polymers. Thus perspiration, which is acidic, will cause immediate breakdown of the polymer system of silk. This is usually noticed as a distinct weakning of the silk textile material.

Alkaline solutions cause the silk filament to swell. This is due to partial separation of the silk polymers by the molecules of alkali. Salt linkages, hydrogen bonds and van der Waals' forces hold the polymer system of silk together. Since these inter-polymer forces of attraction are all hydrolysed by the alkali, dissolution of the silk filament occurs readily in the alkaline solution. It is interesting to note that initially this dissolution means only a separation of the silk polymers from each other. However, prolonged exposure would result in peptide bond hydrolysis, resulting in a polymer degradation and complete destruction of the silk polymer, stated Gupta V.P. and Kothari V. K. (1997)[13].

The resistance of silk to the environment is not as good as that of wool. This lower resistance is due mainly to the lack of covalent crosslinks in the polymer system of silk.

2.3.4 Types of silk

Commercially, silk is classified into four types, obtained from different species of [illegible] food plants. Mulberry, Tasar, Muga and Eri are

Karnataka, Andhra Pradesh, West Bengal, Tamil Nadu and Jammu & Kashmir which together accounts for 92 % of country's total mulberry raw silk production.

2.3.4.2 Tasar

Tasar (Tussah) is copperish colour, coarse silk mainly used for furnishings and interiors. It is less lustrous than mulberry silk, but has its own feel and appeal. Tassar silk is generated by the silkworm, 'Antheraea mylitta' which mainly thrives on the food plants asan and arjun. The rearings are conducted in nature on the trees in the open.

Tasar silk, often referred to as wild silk, comes from the Antheraea moths. These moths live mostly on Terminalia species and Shorea robusta as well as other food plants found in South Asia. The sericulture process of tasar silk is the same as mulberry silk - the cocoons are first dried in the sun to kill the silkworm and then soaked in boiling water to soften the silk before it is reeled.

2.3.4.3 Eri

Also known as Endi or Errandi, Eri is a multivoltine silk spun from open-ended cocoons, unlike other varieties of silk. Eri silk is the product of the domesticated silkworm, 'Philosamia ricini' that feeds mainly on castor leaves. Eri culture is a household activity practiced mainly for protein rich pupae, a delicacy for the tribal. Recently, the eri cocoons are open-mouthed and are spun. The silk is used indigenously for preparation of chaddars (wraps) for own use by these tribal. In India, this culture is practiced mainly in the north-eastern states and Assam.

2.3.4.4 Muga

This golden yellow colour silk is prerogative of India and the pride of Assam state. It is obtained from semi-domesticated multivoltine silkworm, 'Antheraea assamensis'. These silkworms feed on the aromatic leaves of Som and Soalu plants and are reared on trees.

community manages to produce 100-200 kilograms of silk cocoons at a time. The cocoons are put into a heater so as to prevent moths from hatching and to ensure that the cocoons remain whole and damage free so that it can give out one single continuous filament of silk

A handful of cocoons are taken at a time and are immersed in hot water. The outer portion of the cocoons are removed and kept aside. This waste is utilized elsewhere as lower quality yarn.

The cocoons are then put into cold water. The silk strands gets extracted by hand from each cocoon and is passed through an eyelet on a machine that gets drawn onto a mechanized sectional warping drum that makes hanks of the silk. As the silk being extracted is wet, a coal fire is placed beneath the warping drum so as to dry the silk as it is being wound. It takes 8 cocoons to make a single filament of silk. The natural colour of the silk obtained is a light yellow or Badami as it would be referred to in local terms.

Doubling is the mechanical process of winding of single filament filature yarn onto bobbins. A maximum of 40 bobbins can be wound at a time. Here, 30 bobbins are wound at a time or less depending on the quantity of yarn required.

On the same machine, two/three/four of the single filament raw silk yarns are drawn together and are wound onto bobbins in order to make the yarn ready for plying. To wind four of the single filament yarns onto a bobbin takes 45 minutes whereas, winding of two of the single yarns together would require 11\2 hours. The more the number of yarns to be wound together, the faster will it get wound onto a bobbin and vice-versa. After winding, each bobbin holds a minimum of 35-40 grams of silk. The machines have wheels on one end that control the speed of rotation of the hanks and bobbins and hence one can manually decide on the speed of winding beforehand.

The individual yarns on the bobbins are plied together on a machine in a manner such is what causes the yarn to form a twist. 30-40 twists per inch are formed depending on a set diameter on the machine that can be changed.

2.4 PLASMA TREATMENT

Peter J. Hauser (2005)[15] states that plasma, often referred to as the fourth state of matter, is an ionized gas consisting of highly energetic electrons and positive ions. Plasmas are generated by high electric fields and can interact with solids to provide unique surface properties. Plasma treatments have been used to induce both surface modifications and bulk property enhancements of textile materials, resulting in improvements to textile products ranging from conventional fabrics to advanced composites. These treatments have been shown to enhance dyeing rates of polymers, to improve colorfastness and wash resistance of fabrics, to increase adhesion of coatings, and to modify the wettability of fibers and fabrics. Research has shown that improvements in toughness, tenacity, and shrink resistance can be achieved by subjecting various thermoplastic fibers to a plasma atmosphere. Recently, plasma treatments have produced increased moisture absorption in fibers, altered degradation rates of biomedical materials (such as sutures), and deposition of low friction coatings.

Plasma treatment may be performed either at low pressures (vacuum) or at atmospheric pressures. Although vacuum plasma processes and are well understood and are used extensively in the semiconductor industry, the fact that vacuum conditions are necessary makes low pressure plasma impractical to use in industries requiring high rates of throughput, e.g., the textile industry. Atmospheric plasma treatment, on the other hand, is well suited for continuous processing, but the technology is relatively new, and not completely understoodPlasma is like any other gas like oxygen, nitrogen etc. in many respects. However plasma has many more interesting and complex properties. In an ordinary gas the molecules or the atoms are electrically neutral i.e. they carry no net electric charge either positive (+) or negative (-). A neutral atom has equal number of negatively charged electrons and positively charged protons.

Electrons are very light and they move around the centre of the atom in different orbits somewhat similar to the planets in our solar system. Protons are about 2000 times heavier than electrons and they are concentrated at the centre of the nucleus. In plasma there are always some atoms where one of the electrons is removed. Such atoms thus carry one electron less and hence have one net positive charge. These atoms are said to be ionized. If such ions and electrons are present in a gas in substantial numbers the gas is said to be ionised and is called plasma. It is believed that more than 90% of the universe is in plasma state. Gas plasma treatments of materials alter their surface character without affecting their bulk properties. The depth of the surface treatment is only a few nanometres. The surface of the material is roughened and surface chemical properties may also be changed. So, for textiles, gas plasma treatment offers an alternative method of surface treatment to the coating technologies conventionally applied. The idea of treating materials with gas plasma is by no means new (gas plasmas were introduced in the 1960s!), but it is only recently that it has become possible to treat textiles in this way on a commercial scale.

The effectiveness of a plasma treatment is governed by a variety of factors: the composition of the gas, the type of textile, the pressure within the plasma chamber, the frequency and power of the electrical supply, and the temperature and duration of the treatment. The treatment process is hence highly complex; even so, several effects can be readily highlighted despite these complexities.

In general, three main effects can be identified, depending on the type of gas plasma treatment applied. Etching or cleaning, associated with changes in surface texture and wetting properties, and related to changes in surface roughness.

Surface chemical modification, whereby particular chemical groups are introduced to the textile surface. The nature of the group depends very much on the composition of the gas plasma. These groups may confer improved wetting, abrasion resistance, biocompatibility and adhesion. Alternatively, they may increase inertness at the surface. Plasma polymerisation or plasma controlled vapour deposition, which enables the deposition of very thin films of polymers onto textile surfaces. These thin polymeric coatings possess highly crosslinked structures that, although difficult to characterise, can nevertheless confer valuable technological properties.

Thus, oxygen plasma treatments enable polypropylene fibres to be wetted by water) and to be easier to glue or bond. Moreover, the biocompatibility of the fibres is, consequently, improved, given that most body fluids are aqueous-based. Cotton fabrics can be rendered water repellent by plasma treatment with a fluorocarbon. This type of treatment could be useful for outdoor wear and for hospital theatre clothing. It can be noted too that the internal structure of the fibres remains hydrophilic, and so can still allow wicking. Such a fabric could therefore also be useful for sportswear, for example.

Two types of plasma treatment system are available: treatment at low pressure and this technology has to be a batch operation; it doesn't, as the book explains! It is possible to build continuous systems using low pressure plasma technology.

Plasma treatment at atmospheric pressure is perhaps less well advanced so far, giving less uniform results. The technology is, however, advancing, not least because of its appeal for continuous processing. As the book explains, there are a number of different forms: corona treatment, dielectric barrier discharge and glow discharge. Whilst corona treatments are the most widely used overall, dielectric barrier discharges and atmospheric pressure glow discharges are arguably better suited to the constraints of treating textile fabrics, notably relatively low temperatures to prevent fabric melting or degradation.

There is still considerable debate about the relative merits and costs of installing and using low pressure and atmospheric pressure systems. Many textile fabricators are concerned, for example, at the cost of operating a process at reduced pressure, yet in the book evidence is provided that the total cost is no higher than €0.05 per square metre (less than 4p). Moreover, protagonists for low pressure treatments contend that far less gas is needed, an argument which becomes particularly cogent for expensive gases such as fluorocarbons. However, atmospheric pressure treatments, even though still less developed, will surely be preferred eventually in applications where they can match cost and performance.

Gas plasma technology originally started in the microelectronics industries, but eventually extended to metals, plastics, biomaterials, and ceramics and other inorganic materials. These industries have come to recognise that gas plasma treatments offer some real commercial advantages, and these advantages apply just as much to the textile industry. Not only does gas plasma act on the surface of a textile whilst leaving its bulk properties unchanged, there is also no need for water or an organic solvent as a medium, as is required in many conventional coating processes. Gas plasma treatment can therefore be considered a
... treatments can lead to textile

surface of a polyolefin textile is pretreated with the plasma of a noble gas, such as argon. The effect is to crosslink the polymer chains at the textile surface. In addition, the introduction of suitable chemical groups to the textile surface allows polymers to be readily grafted onto the textile. These added polymers can both stabilise the textile surface and, depending on the nature of the grafted polymer, confer other desired properties.

2.4.1 Properties of Plasma

Plasma has many interesting and useful properties. These arise due to the presence of ions, electrons, neutral atoms in higher energy states as well as neutral atoms in the ground state which form a majority in most of the man made plasma. Plasmas can be manipulated by electric and magnetic fields. As in a gas, the particles in plasma are always colliding with each other. In the process electrons and ions may recombine to form a neutral atom in an excited state or a ground state, a neutral atom may get ionised. Excited atoms loose energy and go to ground state by emitting light. This is how light is generated in fluorescent lamps (tube lights), neon tubes, sodium lamps, mercury vapour lamps, CFL's, electric arcs etc. This property makes plasma attractive to look at with various colours. Sun and stars also generate light by the same process.

2.4.2 Plasma temperature

Like an ordinary gas, plasma would also have some temperature. But in a plasma there can be more than one temperature! For example the electrons generally have an higher temperature than the ions. The ions themselves could be at a higher temperature than the neutral atoms. In other words, each species i.e. electrons, ions and neutral behave like three different gases with different temperatures. Colliding plasma particles may exchange energy. The energy lost by one would be gained by the other. Such collisions help in equalising the temperatures of the different species. This happens when plasma densities are very high and

2.4.3 Applications of Plasma Technology in Textiles

Amelia Sparavigna[1] says that, the research in the field of plasma applications for textile treatments is very wide and we will discuss some recent developments. Plasma treatment enhance mechanical properties by softening of cotton and other cellulose-based polymers, with a treatment by oxygen plasma. Reduced felting of wool with treatment by oxygen plasma. Top resistance in wool, cotton, silk fabrics with the following treatment: dipping in DMSO and subsequently N_2-plasma. Antistatic finish can be given to rayon, with chloromethyl dimethylsilane in plasma.

Improvement of surface wetting in synthetic polymers (PA, PE, PP, PET PTFE) with treatment in O_2-, air-, NH_3-plasma. Hydrophilic treatment serves also as dirt-repellent and antistatic finish. Hydrophobic finishing of cotton, cotton/PET, with treatment with siloxan- or perfluorocarbon- plasma.

Oleophobic finish for cotton/polyester, by means of grafting of perfluoroacrylat. Improvement of capillarity in wool and cotton, with treatment in oxygen plasma. Improved dyeing polyester with $SiCl_4$- plasma and for polyamide with Ar-plasma.

Metal-coated organic polymers are used for a variety of applications. If the metallised polymer is expected to fulfil its function, it is essential that metal strongly adheres to the polymer substrate. This can be obtained with a plasma pre-treatment of the polymer. Composites and Laminates.

Good adhesion between layers in laminates depends upon the surface characteristics of fibres in layers and the interactions taking place at the interface. A prerequisite condition of good adhesion remains the surface energy of fibres, which can be modified with plasma treatments.

Biology and Medicine. Fabric favouring overgrowth

2.4.4 Plasma Treatment of Textile fibres:

According to Hartwig Hocker[5], Low-temperature plasma technology both glow discharge under reduced pressure as well as barrier discharge under normal pressure are well established in different industrial applications. Since recently, however, the plasma technology is being introduced in textile industry as well. Fields of application are desizing, functionalizing, and design of surface properties of textile fibers.

Plasma technology is suitable to modify the chemical structure as well as the topography of the surface of the material. Examples of natural as well as man-made fibers prove the enormous potential of plasma treatment of textile materials. It has proven to be successful in shrink-resist treatment of wool with a simultaneously positive effect on the dyeing and printing. Not only is the chemical structure of the surface modified using different plasma gases but also the topography of the surface. A highly hydrophobic surface with a particular surface topography in contact with water is extremely dust- and dirt-repellent and hence should be also repellent to bacteria and fungi. Man-made fibers to be used under chemical stress are modified with diffusion-barrier layers on their surfaces without modifying the bulk properties; hence, the stability of those fibers is significantly improved.

The morphology of wool is very complex both at the fibre level and at its surface. Woolen and other animal hair garments are easily prone to moth attacks. Researches are undertaken to evaluate multifunctional dyes and plasma treatments so as to enhance insect control on these clothes. Wool scales that are present at the fibre surface create shrinkage, felting and barrier of diffusion. Generally, this is treated by either chemical degradation of scale or by deposition of polymers on the scale.

Authors [11][12][16], are stating that 'Plasma is a unique state of matter having several species like electrons, ions, radicals, ultra violet radiation etc. Any material exposed

According to Hartwig Hocker[5], plasma treatments on woolen fabrics give shrink resistance abilities to the fabric. Plasma treatment on wool is expected to produce felt-free wool without using chemicals that are hazardous to the environment. This in contrast to the earlier chemical treatments does not produce waste matters possessing organic halogen compounds.

Plasma treatment on cotton fibres enables it to gain wrinkle free and stain resistant abilities. Non-thermal treatment of cotton in gases containing oxygen leads to an increase of specific surface area of cotton. Plasma treated cotton fabrics show strong hydrophobic effects, leading to the formation of smooth surfaces with an increased contact angle with respect to water. Water droplets on such fabrics are able to remove the dirt from the surface of the cotton fabric. This is referred to as the 'Lotus effect'.

Inbakumar S and Anu kaliani A (2010)[10], state that the study of the morphology, aggregation structure and properties of Silk and Wool treated by low temperature glow discharge air plasma showed that slight flutes appeared on the surface of silk and wool fibers and that its surface structure changed after plasma treatment. Crystalline structure of the silk fabric also decreased after the plasma treatment. The weight of the fiber decreased after plasma treatment because of etching.

2.4.5 Advantages of the plasma technology

Applicable to most of textile materials for surface treatment. Optimization of surface properties of textile materials without any alternation of the inherent proper· ties of the textile materials. Plasma technology is dry textile treatment processing without any expenses on effluent treatment. Plasma technology is a green process without generation of chemicals, solvents or harmful substances.

The consumption of chemicals is very low due to the physical process. Plasma waste at different stages of process can be controlled and the manufacturer can increase the realization of final product.

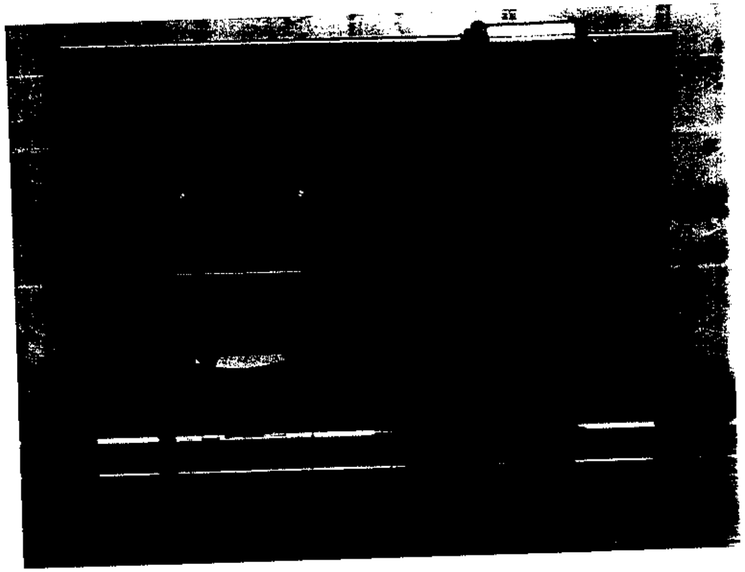
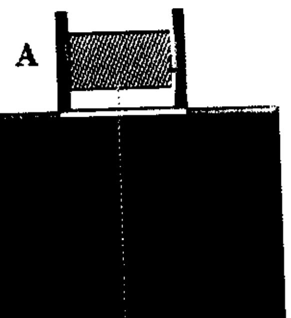


Fig: 2.10 Offline Zari Tester

The instrument can be used to count the faults in the zari yarn at three different feed speeds namely 3,6 & 9 rpm. The offline zari tester works based on light reflectance principle.

2.5.1 Design of Offline Zari Tester



PARTS

A - Supply Package

2.5.2 Block Diagram of Offline Zari Tester

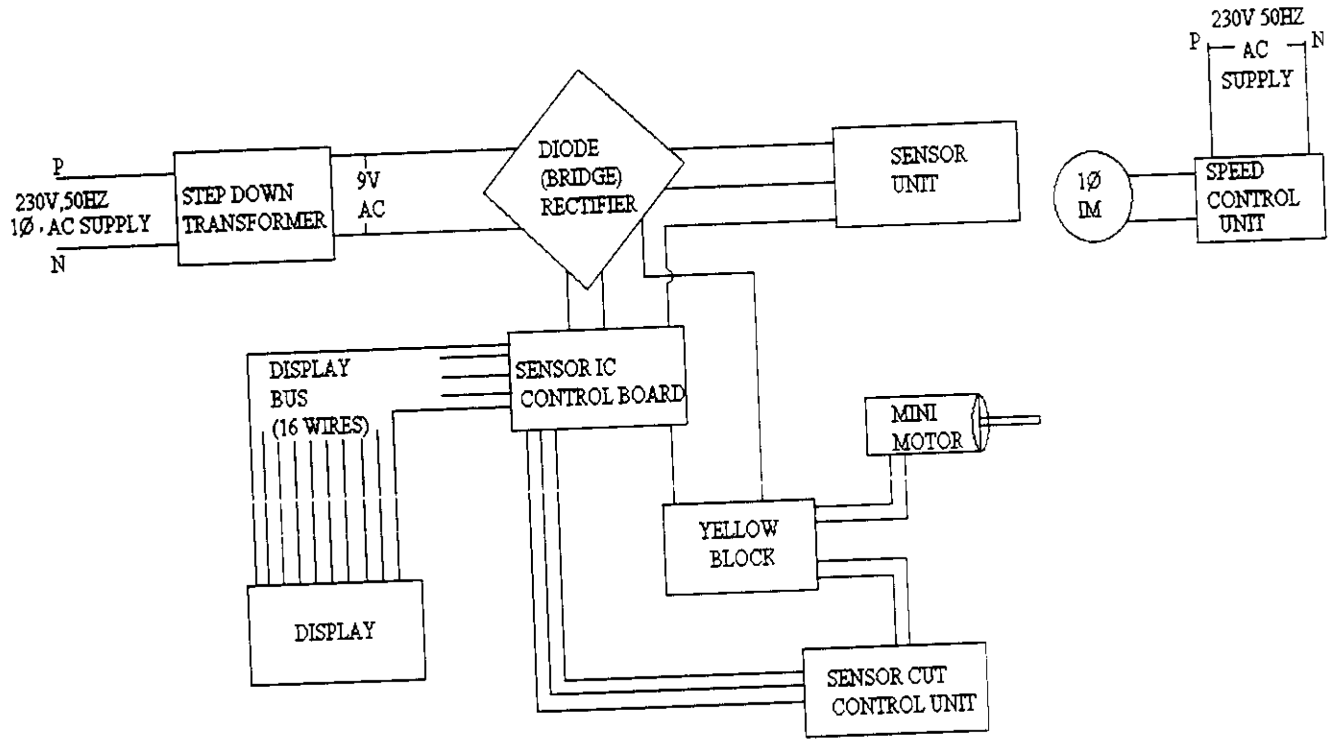
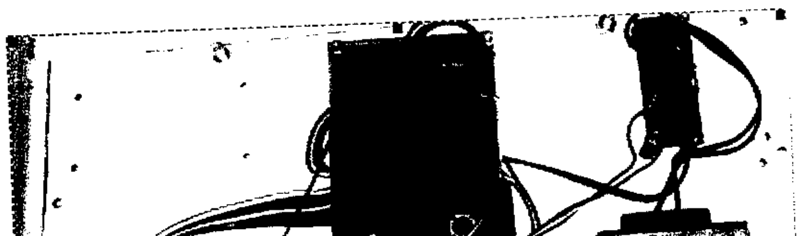


Fig: 2.12 Block Diagram of Offline Zari Tester

2.5.3 Design of PCB



CHAPTER 3

MATERIALS AND METHODS

3.1 MATERIALS

Materials used and the details are given in the table below:

S.No	Materials	Details
1	**Silk**	
	a) Raw Mulberry	57 Denier
	b) Raw Tasar	57 Denier
2	**Zari Components**	
	a) Red Silk	32 Denier
	b) Silver Wrapped Red silk	110 Denier
	c) Gold coated Zari	105 Denier

Table. 3.1. Details of Materials

3.2 METHODOLOGY

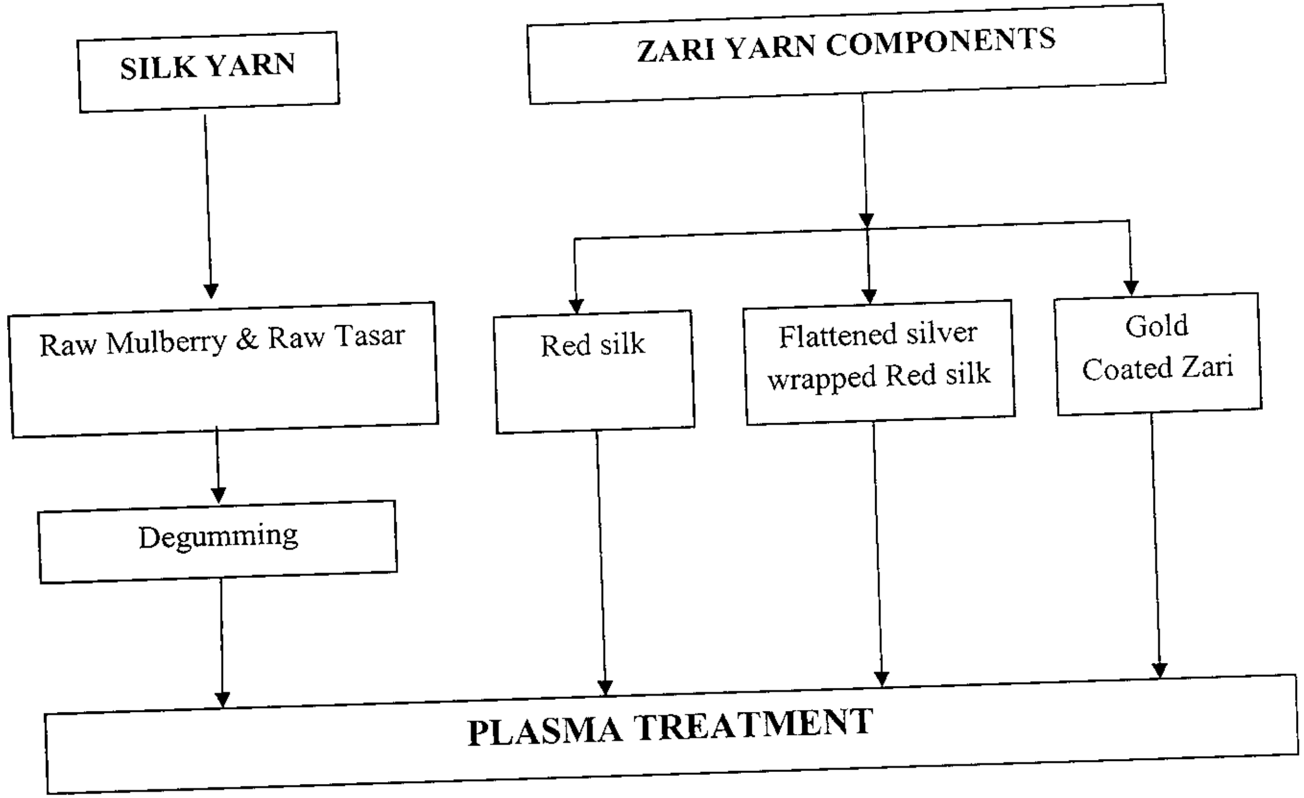
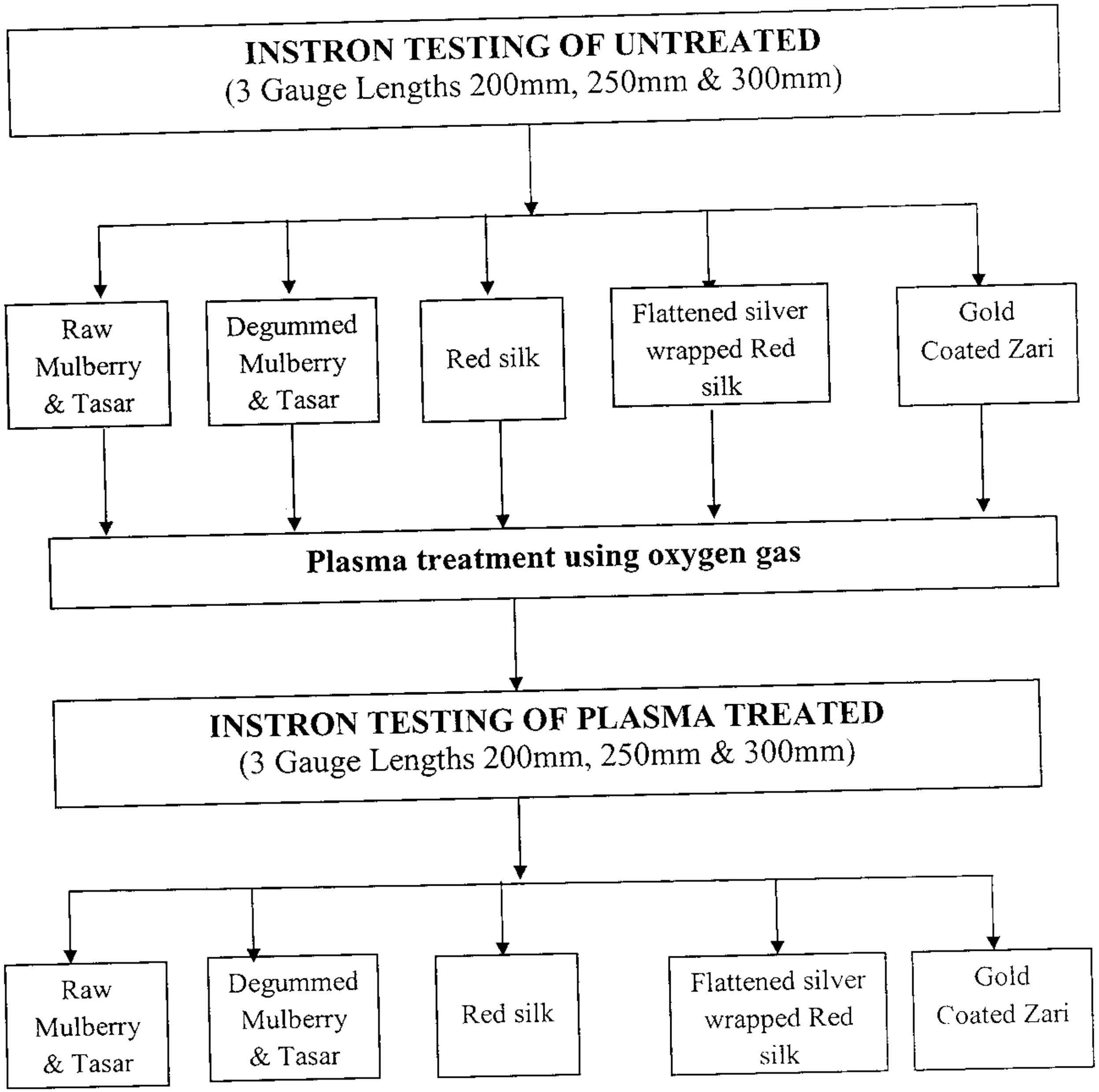


Fig. 3.1 Methodology-Flowchart

3.2.1 DEGUMMING METHODOLOGY (USING DETERGENT)

S.No	Item	Quantity
1	**Recipe:**	
	a) Commercial Detergent	4 gm./lit.

3.2.2 TESTING METHODOLOGY



3.2.3 PLASMA TREATMENT METHODOLOGY

S.No	Particulars	Details
1	Type of Machine	Plasma systems
2	Model	HPVT-PS
3	Gas to be used	Oxygen
4	Distance between plates	3 cm
5	Plasma voltage	400 Volts
6	Plasma Treatment Time	3 Minutes

Table. 3.3 Summary of Average Tensile Strength

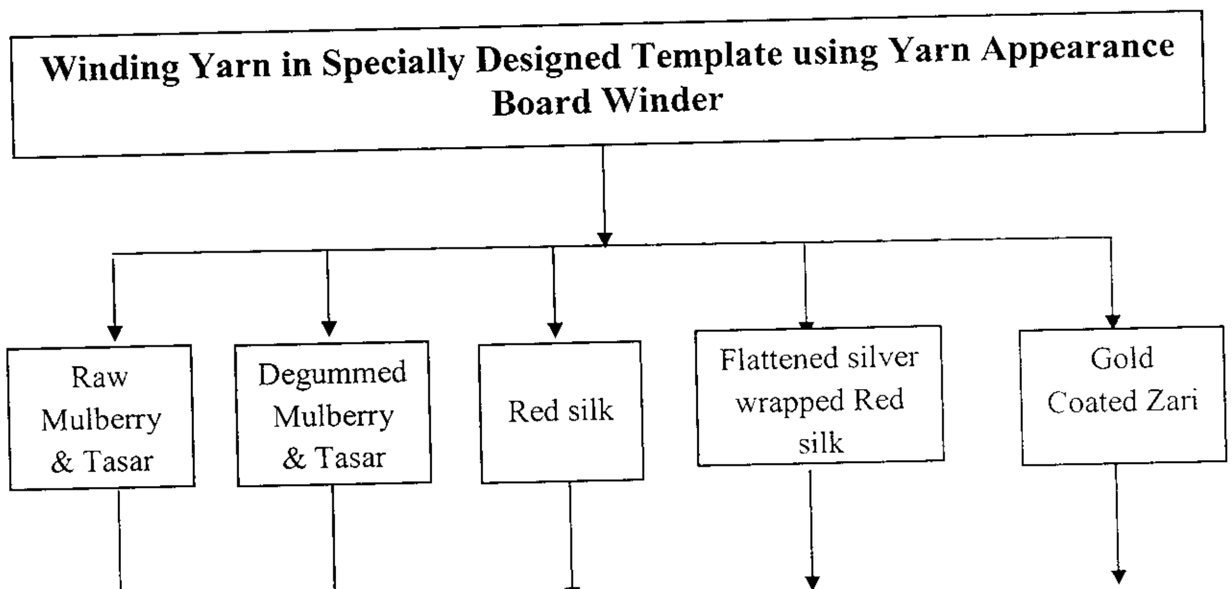


Fig. 3.4 Plasma Treatment Instrument

CHAPTER 4

RESULTS AND DISCUSSION

The test results of the studies are tabulated below. Test results of the samples both before and after plasma treatment is tabulated. Laboratory testing has been conducted in the latest Instron Tester to find out the values of tensile strength and elongation.

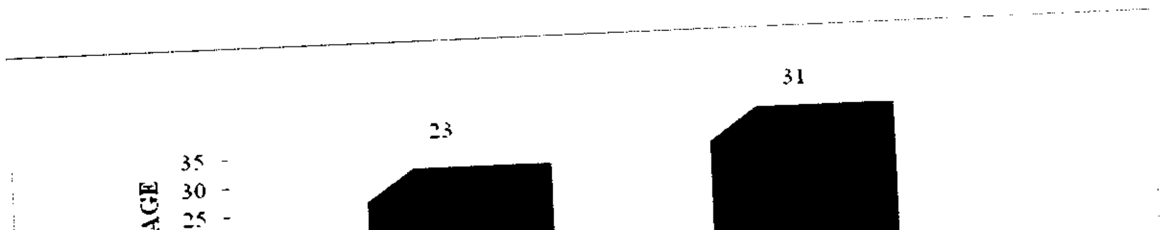
All the testing have been conducted at standard atmospheric conditions i.e, at 65% relative humidity with dry temperature 74°F and wet temperature of 66°F.

4.1 SILK YARN TEST RESULTS

4.1.1 Degumming Weight Loss

S.No	TYPE OF SILK	DEGUMMING WEIGHT LOSS (%)
1	Mulberry	23
2	Tasar	31

Table. 4.1 Degumming weight loss (%)

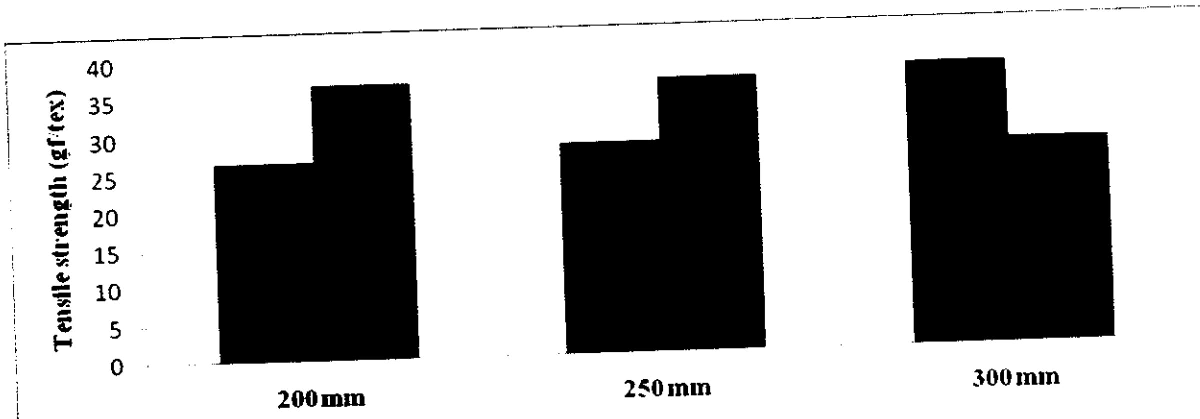


Degumming weight loss percentage of tasar silk is observed to be slightly higher than mulberry silk yarn which varies depending on the sericin content in raw silk yarns.

4.1.2 Instron test results

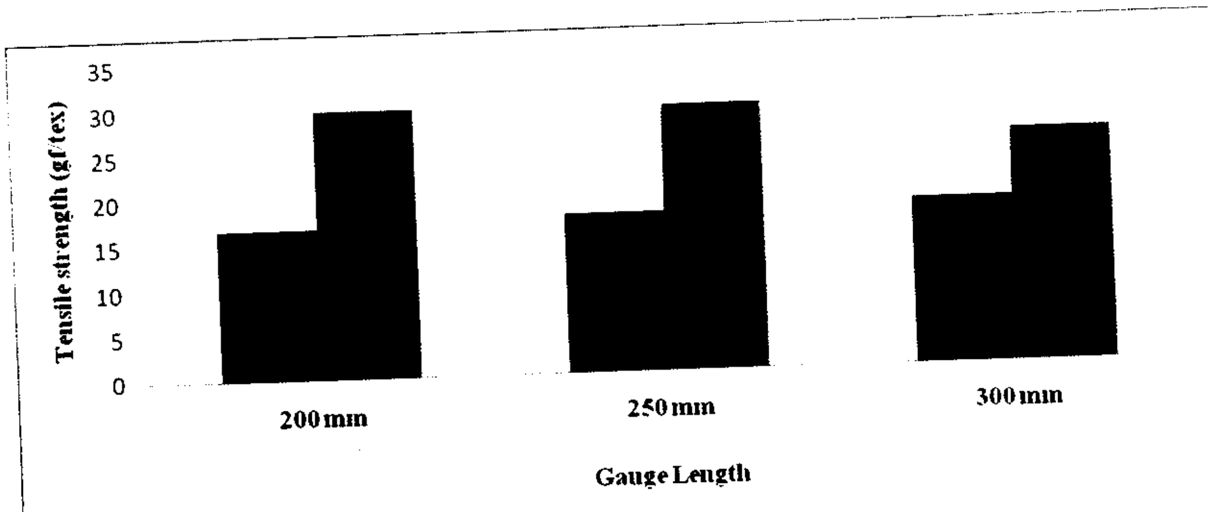
		Tensile Strength (gf/tex)		Variation (%)	
		Raw Mulberry	Raw Tasar		
Gauge Length	200 mm	26.57	36.84	28	↑
	250 mm	28.31	36.66	23	↑
	300 mm	37.89	27.45	-38	↓
	Average	**30.92**	**33.65**	**8**	↑

Table. 4.2 Tensile Strength of Raw Silk – Before Plasma Treatment



		Tensile Strength (gf/tex)		Variation (%)	
		Degummed Mulberry	Degummed Tasar		
Gauge Length	200 mm	16.61	29.78	44	↑
	250 mm	17.59	29.52	40	↑
	300 mm	18.35	25.80	29	↑
	Average	**17.52**	**28.37**	**38**	↑

Table. 4.3 Tensile Strength of Degummed Silk – Before Plasma Treatment

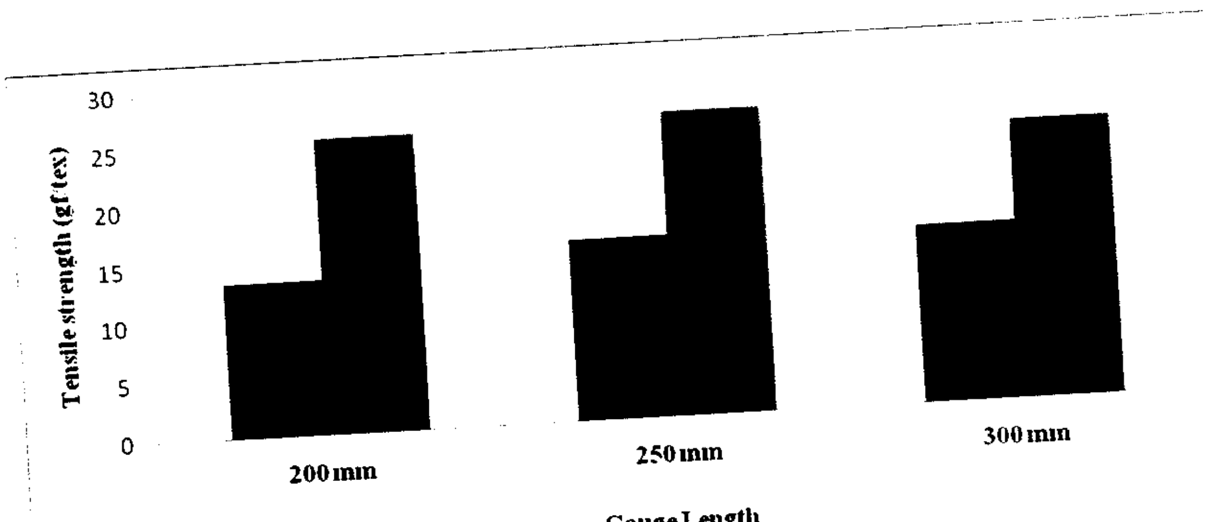


		Tensile Strength (gf/tex)		Variation (%)	
		Raw Mulberry	**Raw Tasar**		
Gauge Length	200 mm	20.95	29.15	28	↑
	250 mm	20.16	25.70	22	↑
	300 mm	22.87	25.67	11	↑
	Average	**21.33**	**26.84**	**21**	↑

Table. 4.4 Tensile Strength of Raw Silk – After Plasma Treatment

		Tensile Strength (gf/tex)		Variation (%)	
		Degummed Mulberry	Degummed Tasar		
Gauge Length	200 mm	13.41	25.62	48	↑
	250 mm	15.68	26.39	41	↑
	300 mm	15.35	24.11	36	↑
	Average	**14.81**	**25.37**	**42**	↑

Table. 4.5 Tensile Strength of Degummed Silk – After Plasma Treatment



Type of Silk	Average Tensile Strength (gf/tex)		Variation (%)	
	Before Treatment	After Treatment		
Raw Mulberry	30.92	21.33	-45	↓
Raw Tussar	33.65	26.84	-25	↓

Table. 4.6 Average Tensile Strength of Raw Silk – Before & After Plasma Treatment

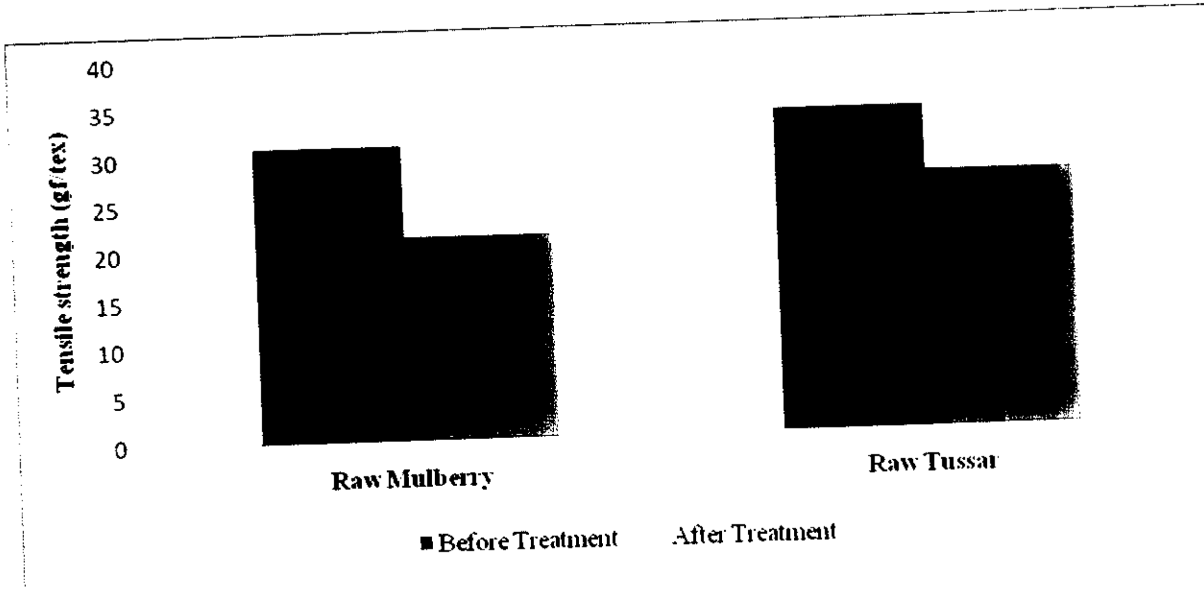
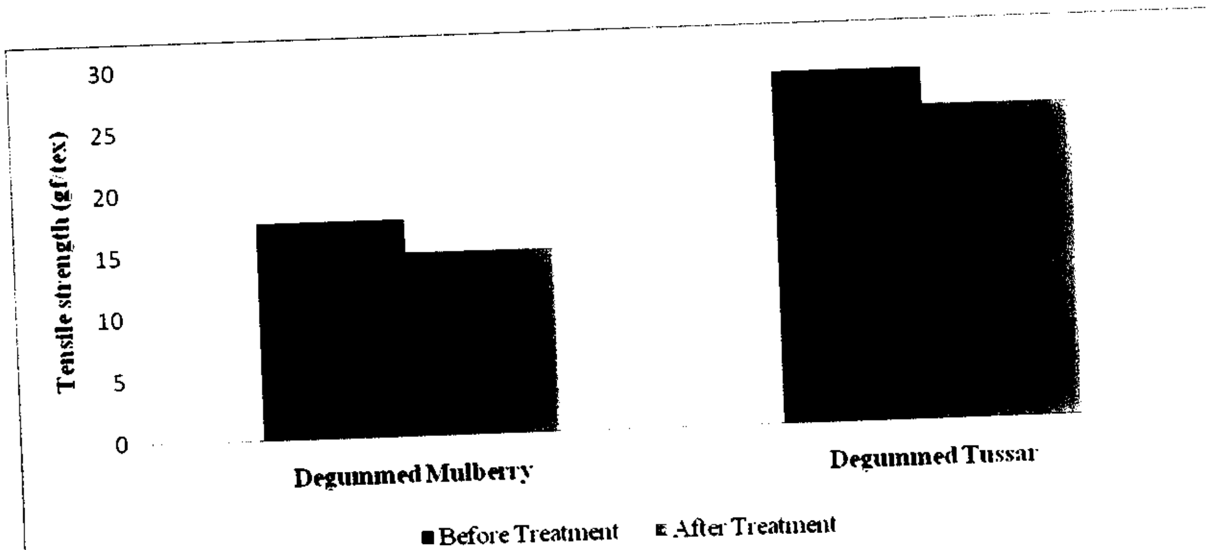


Fig. 4.6 Average Tensile Strength of Raw Silk – Before & After Plasma Treatment

It is noticed that, after plasma treatment with oxygen gas, the average tensile strength

Type of Silk	Average Tensile Strength (gf/tex)		Variation (%)	
	Before Treatment	After Treatment		
Degummed Mulberry	17.52	14.81	-18	↓
Degummed Tasar	28.37	25.37	-12	↓

Table. 4.7 Average Tensile Strength of Degummed Silk – Before & After Plasma Treatment

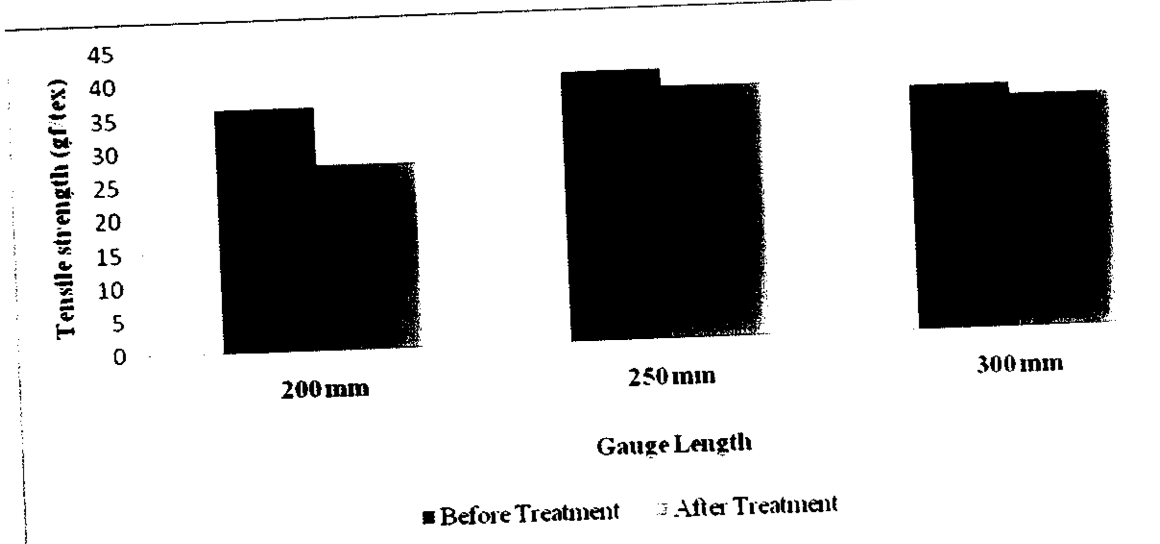


4.2 ZARI COMPONENTS TEST RESULTS

4.2.1 Instron Test Results

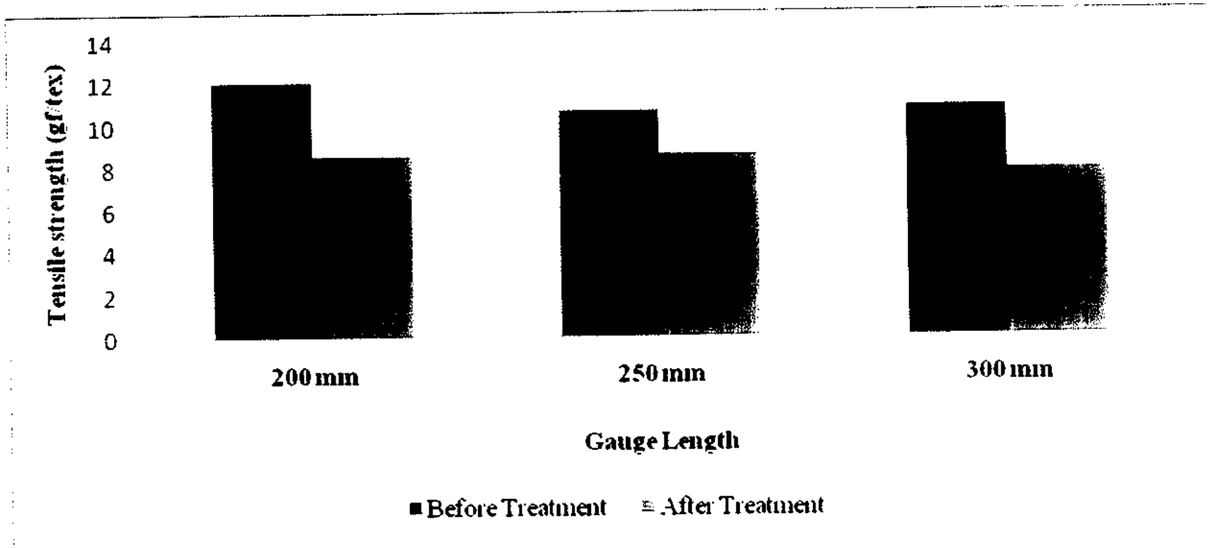
		Tensile Strength (gf/tex)		Variation (%)	
		Before Treatment	After Treatment		
Gauge Length	200 mm	36.10	27.56	-31	↓
	250 mm	40.02	37.47	-7	↓
	300 mm	36.14	34.51	-5	↓
	Average	**37.42**	**33.18**	**-13**	↓

Table. 4.8 Tensile Strength of Red Silk – Before & After Plasma Treatment



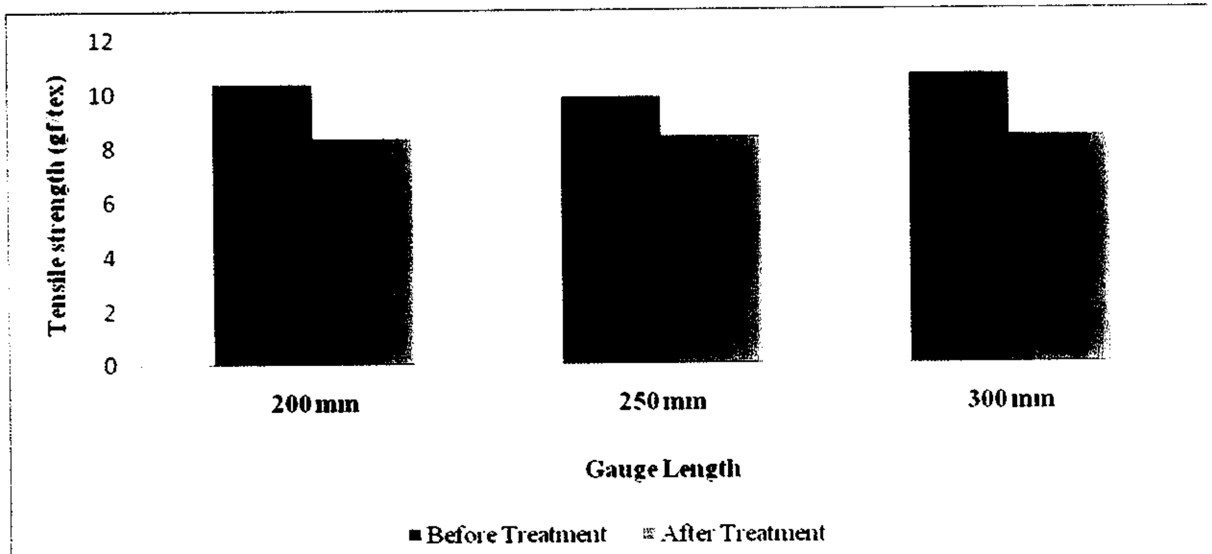
		Tensile Strength (gf/tex)		Variation (%)	
		Before Treatment	After Treatment		
Gauge Length	200 mm	12.05	8.55	-41	↓
	250 mm	10.67	8.66	-23	↓
	300 mm	10.83	7.89	-37	↓
	Average	**11.18**	**8.37**	**-34**	↓

Table. 4.9 Tensile Strength of Silver Wrapped Red Silk – Before & After Plasma Treatment



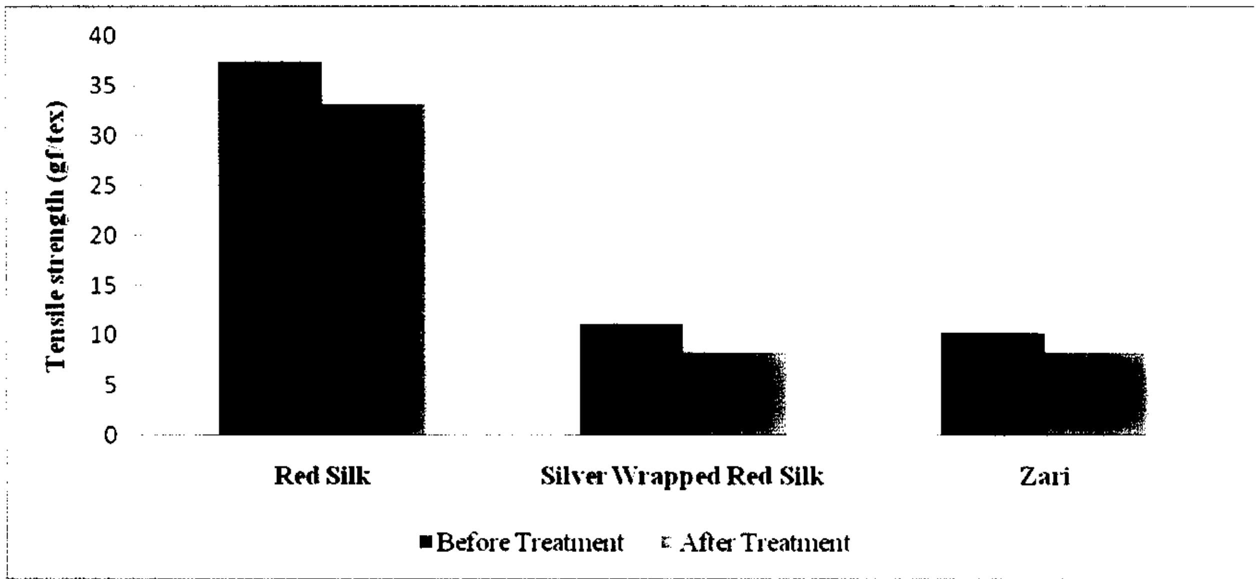
		Tensile Strength (gf/tex)		Variation (%)	
		Before Treatment	**After Treatment**		
Gauge Length	200 mm	10.37	8.37	-24	↓
	250 mm	9.84	8.40	-17	↓
	300 mm	10.67	8.40	-27	↓
	Average	**10.29**	**8.39**	**-23**	↓

Table. 4.10 Tensile Strength of Zari – Before & After Plasma Treatment



	Average Tensile Strength (gf/tex)		**Variation (%)**	
	Before Treatment	**After Treatment**		
Red Silk	37.42	33.18	-13	↓
Silver Wrapped Red Silk	11.18	8.37	-34	↓
Zari	10.29	8.39	-23	↓

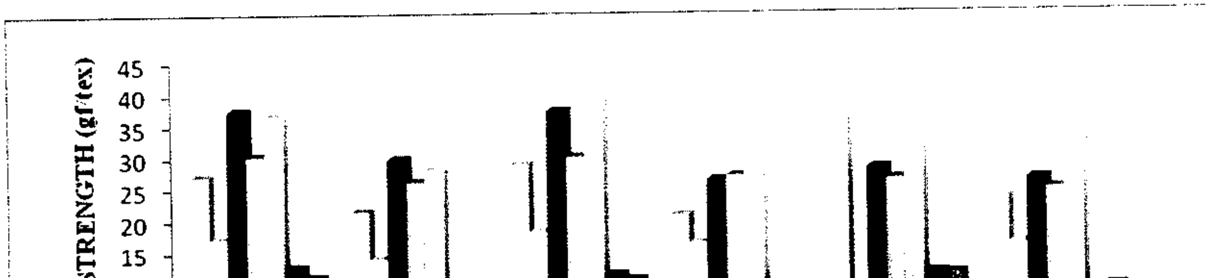
Table. 4.11 Average Tensile Strength of Zari Components – Before & After Plasma Treatment



4.3 SILK YARN AND ZARI COMPONENTS TEST RESULTS SUMMARY

	GAUGE LENGTH 200 mm		GAUGE LENGTH 250 mm		GAUGE LENGTH 300 mm	
	BEFORE PLASMA TREATMENT	AFTER PLASMA TREATMENT	BEFORE PLASMA TREATMENT	AFTER PLASMA TREATMENT	BEFORE PLASMA TREATMENT	AFTER PLASMA TREATMENT
Raw Mulberry	26.57	20.95	28.31	20.16	37.89	22.87
Degummed Mulberry	16.61	13.41	17.59	15.68	18..35	15.35
Raw Tasar	36.84	29.15	36.66	25.70	27.45	25.67
Degummed Tasar	29.78	25.62	29.52	26.39	25.80	24.11
Red Silk	36.10	27.56	40.02	37.47	36.14	34.51
Silver Wrapped Red Silk	12.05	8.55	10.67	8.66	10.83	7.89
Zari	10.37	8.37	9.84	8.40	10.67	8.40

Table. 4.12 Summary of Average Tensile Strength (gf/tex)



4.4 OFFLINE ZARI TESTER – TEST RESULTS

4.4.1 Instrument test Result (Faults per Meter)

Sample No.	MACHINE SPEED (Rpm)					
	3 rpm		6 rpm		9 rpm	
	RED SILK	SILVER	RED SILK	SILVER	RED SILK	SILVER
1	40	8	37	5	33	3
2	42	6	38	7	35	4
3	41	6	37	6	34	3
4	38	5	39	5	37	5
5	40	7	35	4	35	3
6	43	8	37	4	34	4
7	39	6	36	4	36	5
8	42	7	39	7	33	3
9	40	7	38	6	32	5
10	43	8	35	5	33	4
SD	**1.6**	**0.981**	**1.37**	**0.421**	**1.47**	**0.83**
CV %	**3.93**	**14.53**	**3.7**	**7.8**	**4.29**	**2.09**
MAX	**43**	**8**	**39**	**7**	**37**	**5**
MIN	**38**	**5**	**35**	**4**	**32**	**33**
MEAN	**40.75**	**6.75**	**37.1**	**5.33**	**34.25**	**3.99**

Table. 4.13 Instrument Test Result (Faults per Meter)

4.4.2 Instrument test Result –Summary

	Average faults per meter	
	[illegible]	Silver

4.5 STATISTICAL ANALYSIS

4.5.1 Two-way ANOVA: TENSILE STRENGTH (gf/tex) RAW SILK (MULBERRY/TASAR)- BEFORE PLASMATREATMENT

Source	DF	SS	MS	F	P
GAUGE LENGTH	2	1.049	0.5246	0.01	0.992
TYPE OF SILK	1	11.152	11.1521	0.17	0.720
Error	2	130.942	65.4712		
Total	5	143.144			

S = 8.091 R-Sq = 8.52% R-Sq(adj) = 0.00%

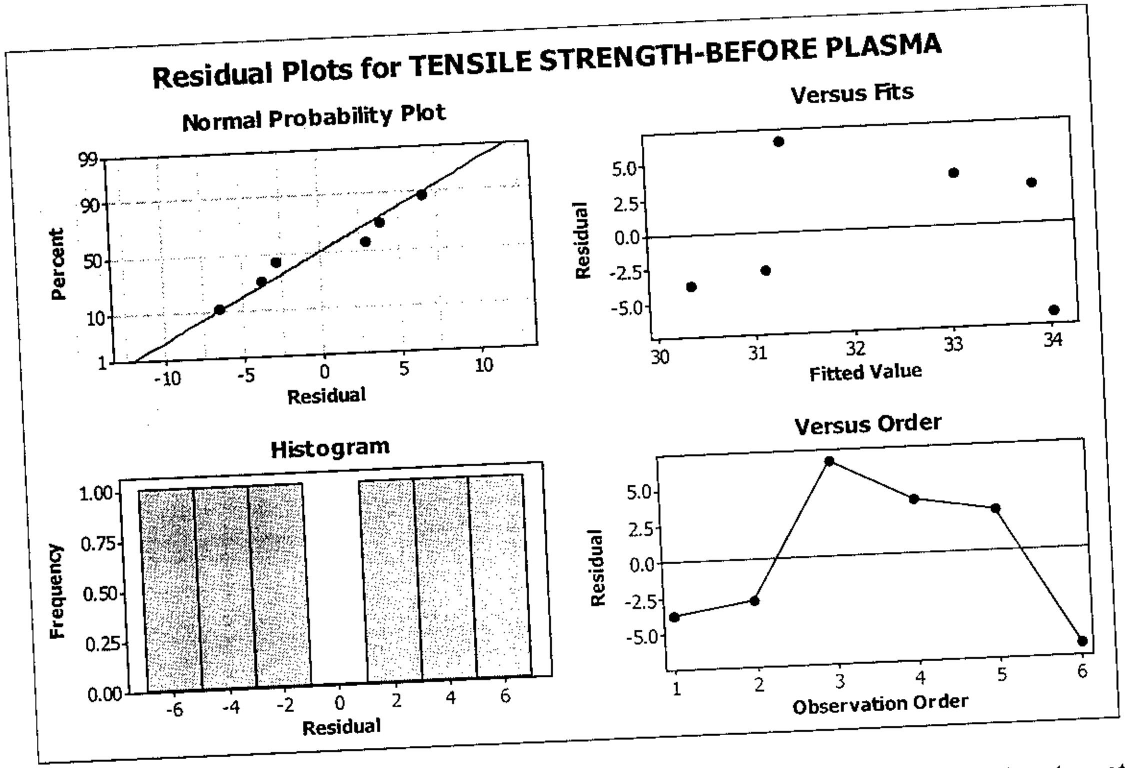


Fig. 4.13 Tensile Strength (gf/tex) Raw Silk (Mulberry/Tasar)- Before Plasma treatment – Residual Plots

INFERENCE

4.5.2 Two-way ANOVA: TENSILE STRENGTH (gf/tex) DEGUMMED SILK (MULBERRY/TASAR)) – BEFORE PLASMA TREATMENT

Source	DF	SS	MS	F	P
GAUGE LENGTH	2	2.287	1.143	**0.25**	0.800
TYPE OF DEGUMMED SILK	1	177.453	177.453	**38.82**	0.025
Error	2	9.143	4.571		
Total	5	188.883			

S = 2.138 R-Sq = 95.16% R-Sq(adj) = 87.90%

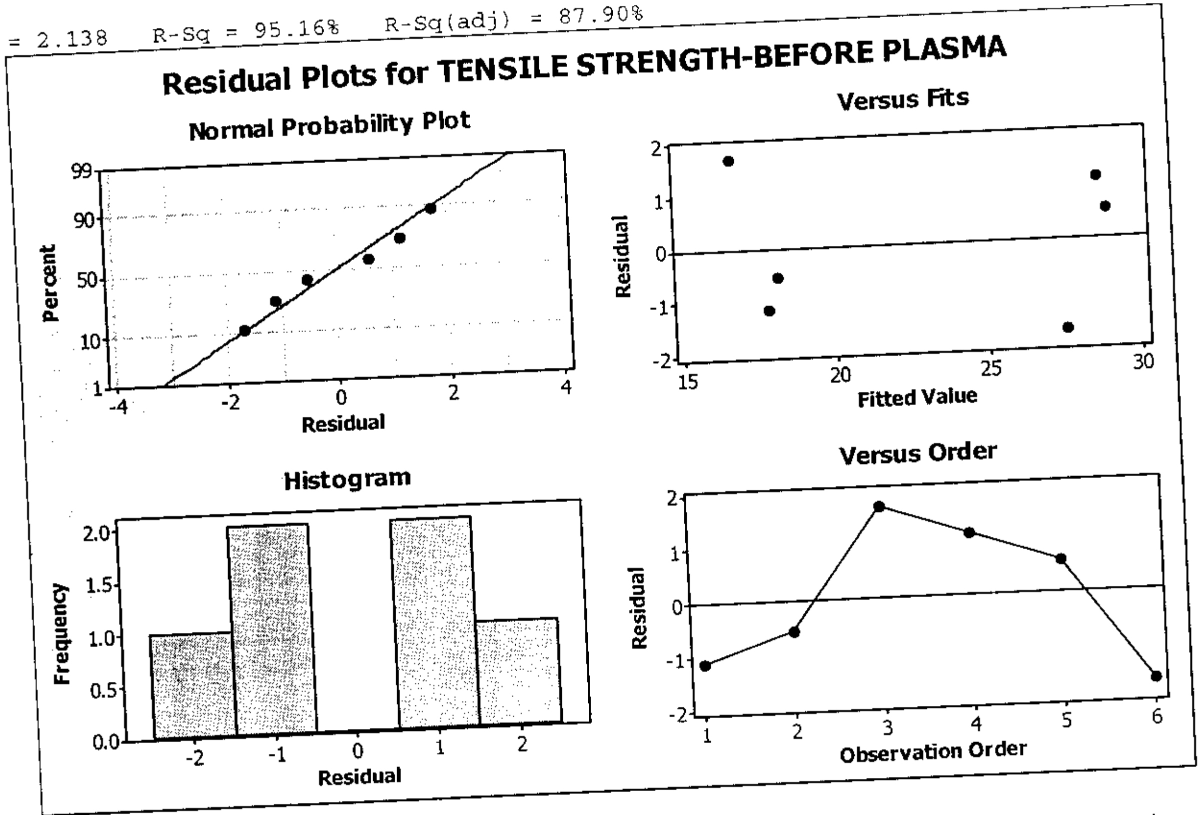


Fig. 4.14 Tensile Strength (gf/tex) Degummed Silk (Mulberry/Tasar)- Before Plasma treatment – Residual Plots

INFERENCE

	Degrees of	Value (95% Confidence Level)	Result

4.5.3 Two-way ANOVA: TENSILE STRENGTH (gf/tex) RAW SILK (MULBERRY/TASAR)- AFTER PLASMA TREATMENT

Source	DF	SS	MS	F	P
GAUGE LENGTH	2	4.5989	2.2995	0.63	0.613
TYPE OF SILK	1	45.5953	45.5953	12.51	0.071
Error	2	7.2905	3.6453		
Total	5	57.4847			

S = 1.909   R-Sq = 87.32%   R-Sq(adj) = 68.29%

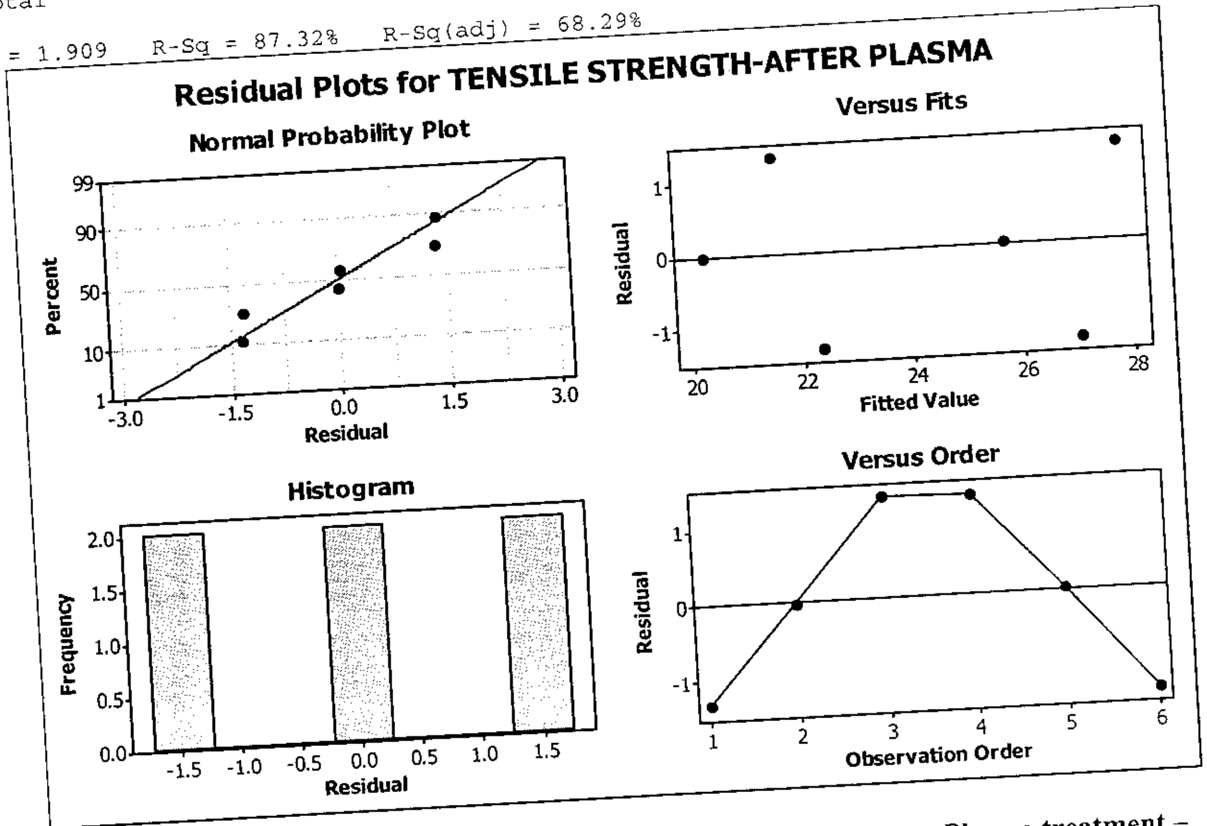


Fig. 4.15 Tensile Strength (gf/tex) Raw Silk (Mulberry/Tasar)- After Plasma treatment – Residual Plots

INFERENCE

	Degrees of Freedom	Value (95% Confidence Level)		Result
		F-Table	Calculated	

4.5.4Two-way ANOVA: TENSILE STRENGTH (gf/tex) DEGUMMED SILK (MULBERRY/TASAR) – AFTER PLASMA TREATMENT

```
Source                 DF       SS        MS       F       P
GAUGE LENGTH            2    2.706     1.353    0.90   0.525
TYPE OF DEGUMMED SILK   1  167.270   167.270  111.79   0.009
Error                   2    2.992     1.496
Total                   5  172.969

S = 1.223   R-Sq = 98.27%   R-Sq(adj) = 95.67%
```

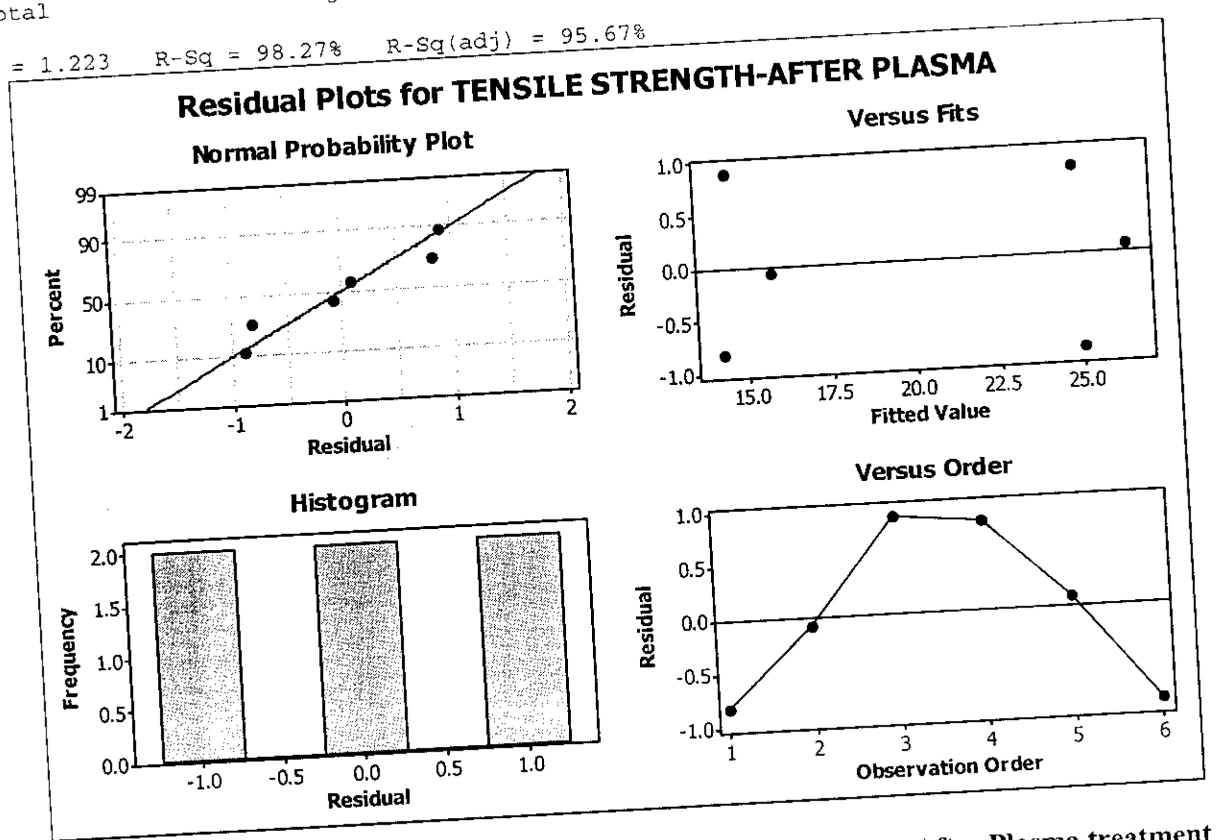


Fig. 4.16 Tensile Strength (gf/tex) Degummed Silk (Mulberry/Tasar)- After Plasma treatment – Residual Plots

INFERENCE

	Degrees of Freedom	Value (95% Confidence Level)		Result
		F Table	Calculated	

4.5.5 Two-way ANOVA: TENSILE STRENGTH (gf/tex) TYPE OF RAW SILK – BEFORE AND AFTER PLASMA TREATMENT

Source	DF	SS	MS	F	P
TYPE OF SILK	1	16.9744	16.9744	8.79	0.207
TYPE OF TREATMENT	1	67.2400	67.2400	34.80	0.107
Error	1	1.9321	1.9321		
Total	3	86.1465			

S = 1.39   R-Sq = 97.76%   R-Sq(adj) = 93.27%

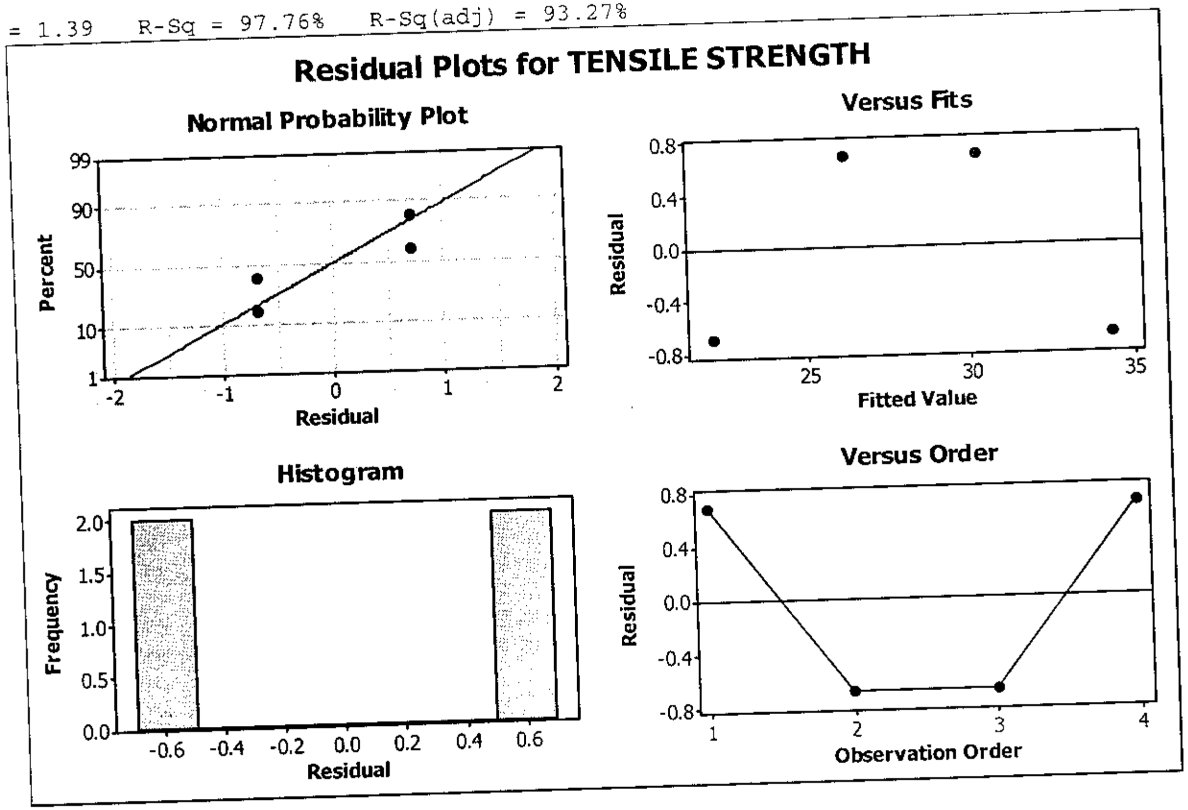


Fig. 4.17 Tensile Strength (gf/tex) Raw Silk (Mulberry/Tasar)- Before and After Plasma treatment – Residual Plots

INFERENCE

	Degrees of Freedom	Value (95% Confidence Level)		Result
		F Table	Calculated	

4.5.6 Two-way ANOVA: TENSILE STRENGTH (gf/tex) DEGUMMED SILK – BEFORE & AFTER PLASMA TREATMENT

Source	DF	SS	MS	F	P
TYPE OF DEGUMMED SILK	1	114.597	114.597	5450.51	0.009
TYPE OF TREATMENT	1	8.151	8.151	387.68	0.032
Error	1	0.021	0.021		
Total	3	122.769			

S = 0.145   R-Sq = 99.98%   R-Sq(adj) = 99.95%

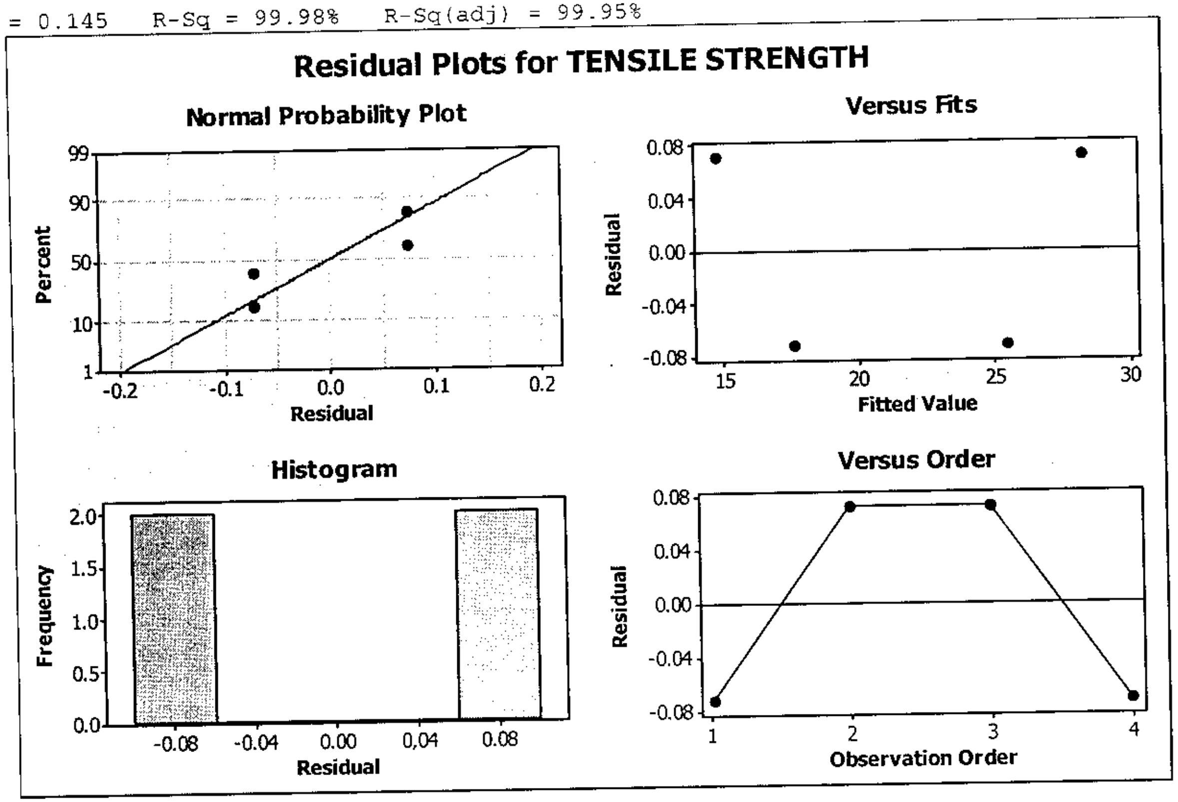


Fig. 4.18 Tensile Strength (gf/tex) Degummed Silk (Mulberry/Tasar)- Before and After Plasma treatment – Residual Plots

INFERENCE

	Degrees of	Value (95% Confidence Level)	Result

4.5.7 Two-way ANOVA: TENSILE STRENGTH (gf/tex) RED SILK -BEFORE & AFTER PLASMA TREATMENT

Source	DF	SS	MS	F	P
GAUGE LENGTH	2	47.8191	23.9096	3.40	0.227
TYPE OF TREATMENT	1	26.9664	26.9664	3.83	0.189
Error	2	14.0791	7.0395		
Total	5	88.8646			

S = 2.653 R-Sq = 84.16% R-Sq(adj) = 60.39%

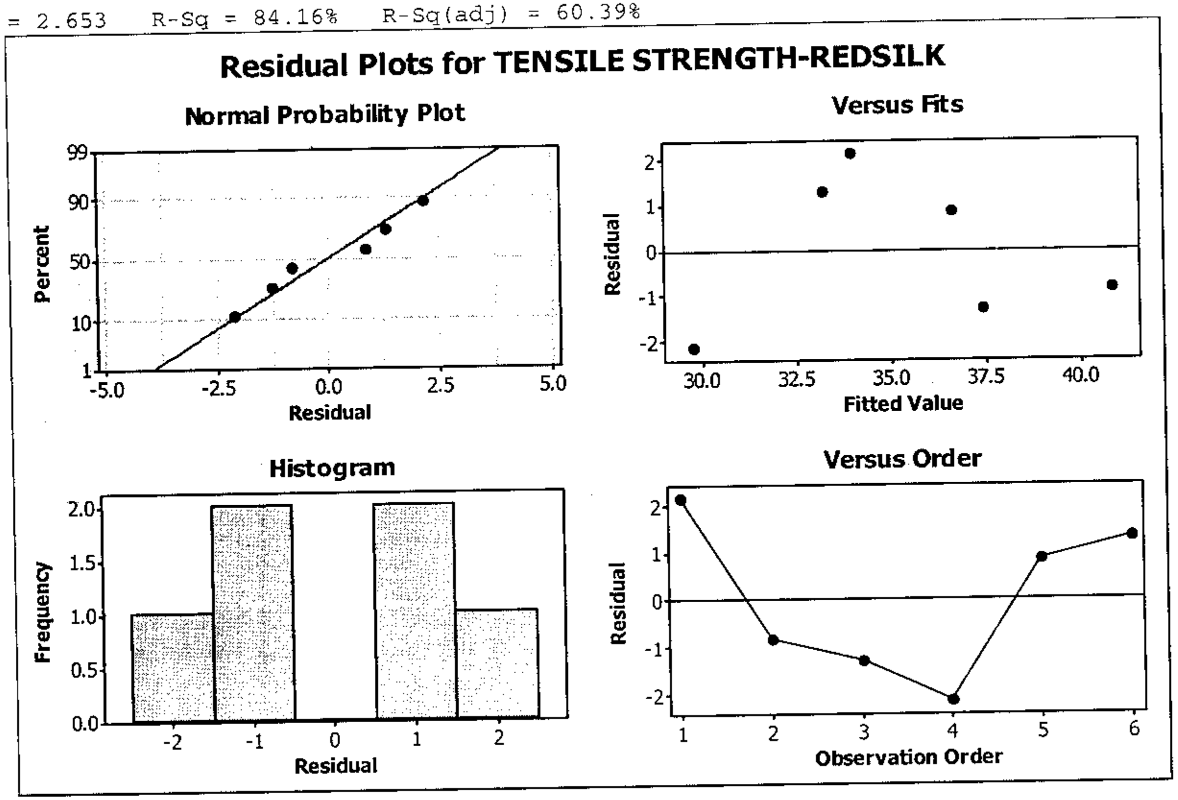


Fig. 4.19 Tensile Strength (gf/tex) Red Silk - Before and After Plasma treatment – Residual Plots

INFERENCE

	Degrees of	Value (95% Confidence Level)	Result

4.5.8 Two-way ANOVA: TENSILE STRENGTH (gf/tex) SILVER WRAPPED RED SILK – BEFORE AND ATER PLASMA TREATMENT

Source	DF	SS	MS	F	P
GAUGE LENGTH	2	0.9199	0.4600	1.62	0.381
TYPE OF TREATMENT SILK	1	11.9004	11.9004	42.02	0.023
Error	2	0.5664	0.2832		
Total	5	13.3868			

S = 0.5322   R-Sq = 95.77%   R-Sq(adj) = 89.42%

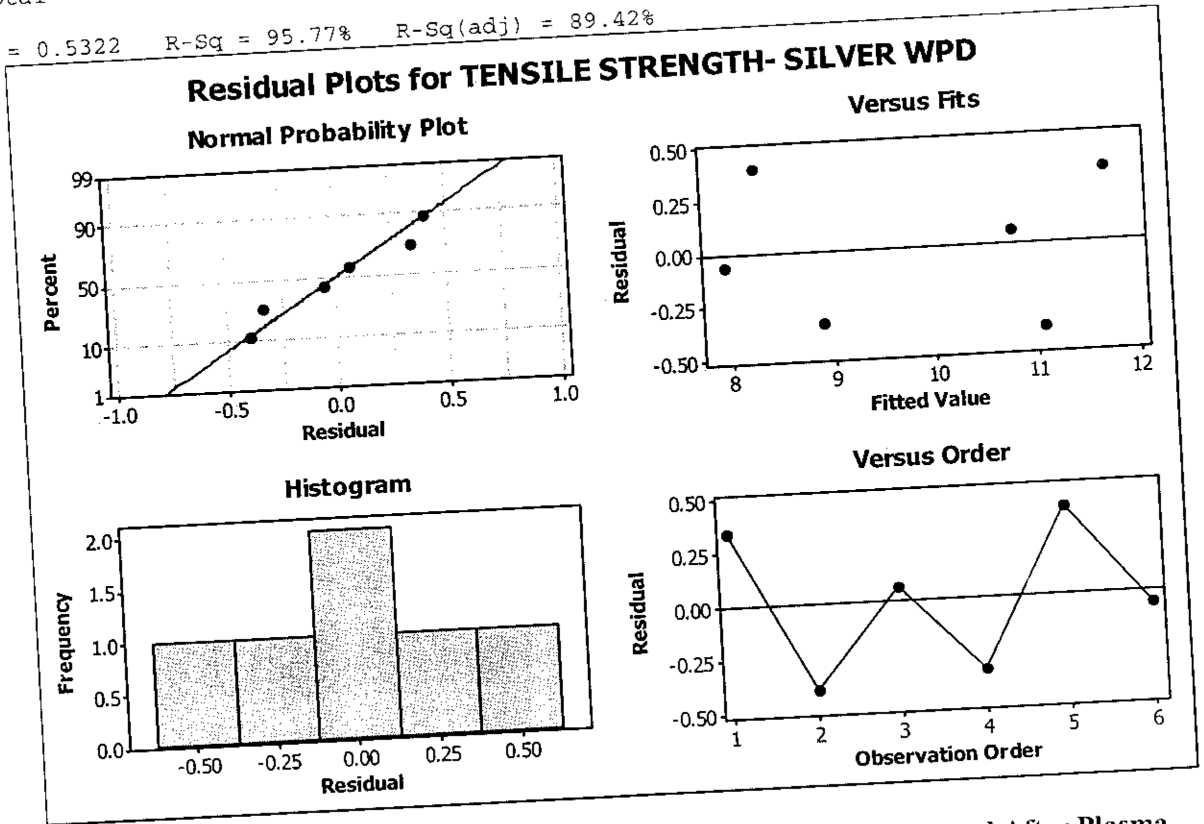


Fig. 4.20 Tensile Strength (gf/tex) Silver Wrapped Red Silk - Before and After Plasma treatment – Residual Plots

INFERENCE

	Degrees of Freedom	Value (95% Confidence Level)		Result
		F Table	Calculated	

4.5.9 Two-way ANOVA: TENSILE STRENGTH (gf/tex) ZARI-BEFORE AND AFTER PLASMA TREATMENT

Source	DF	SS	MS	F	P
GAUGE LENGTH	2	0.17463	0.08732	0.97	0.506
TYPE OF TREATMENT	1	5.43402	5.43402	60.64	0.016
Error	2	0.17923	0.08962		
Total	5	5.78788			

S = 0.2994 R-Sq = 96.90% R-Sq(adj) = 92.26%

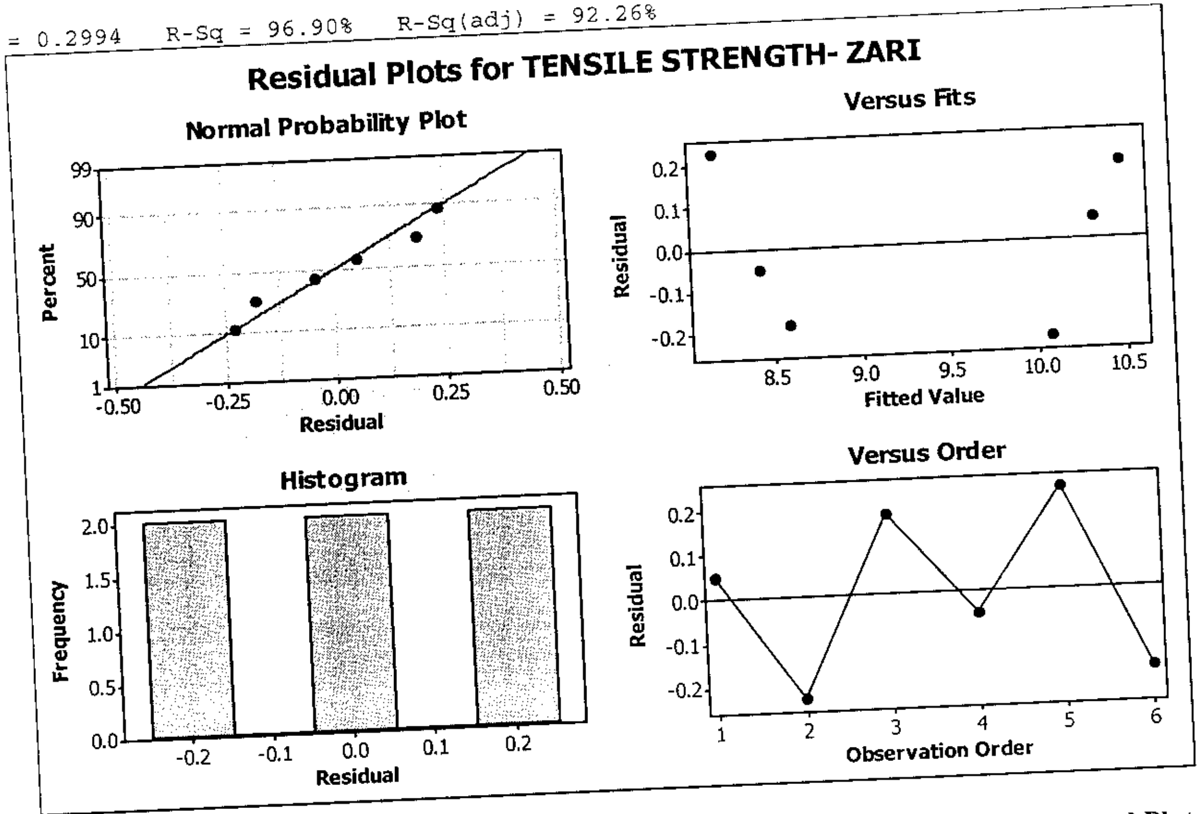


Fig. 4.21 Tensile Strength (gf/tex) Zari - Before and After Plasma treatment – Residual Plots

INFERENCE

	Degrees of Freedom	Value (95% Confidence Level)		Result
		F Table	Calculated	
	2	19.0000	0.97	The difference is

4.5.10 Two-way ANOVA: TENSILE STRENGTH (gf/tex) ZARI COMPONENTS-BEFORE AND AFTER PLASMA TREATMENT

Source	DF	SS	MS	F	P
ZARI COMPONENT	2	883.758	441.879	635.14	0.002
TYPE OF TREATMENT	1	13.350	13.350	19.19	0.048
Error	2	1.391	0.696		
Total	5	898.499			

S = 0.8341 R-Sq = 99.85% R-Sq(adj) = 99.61%

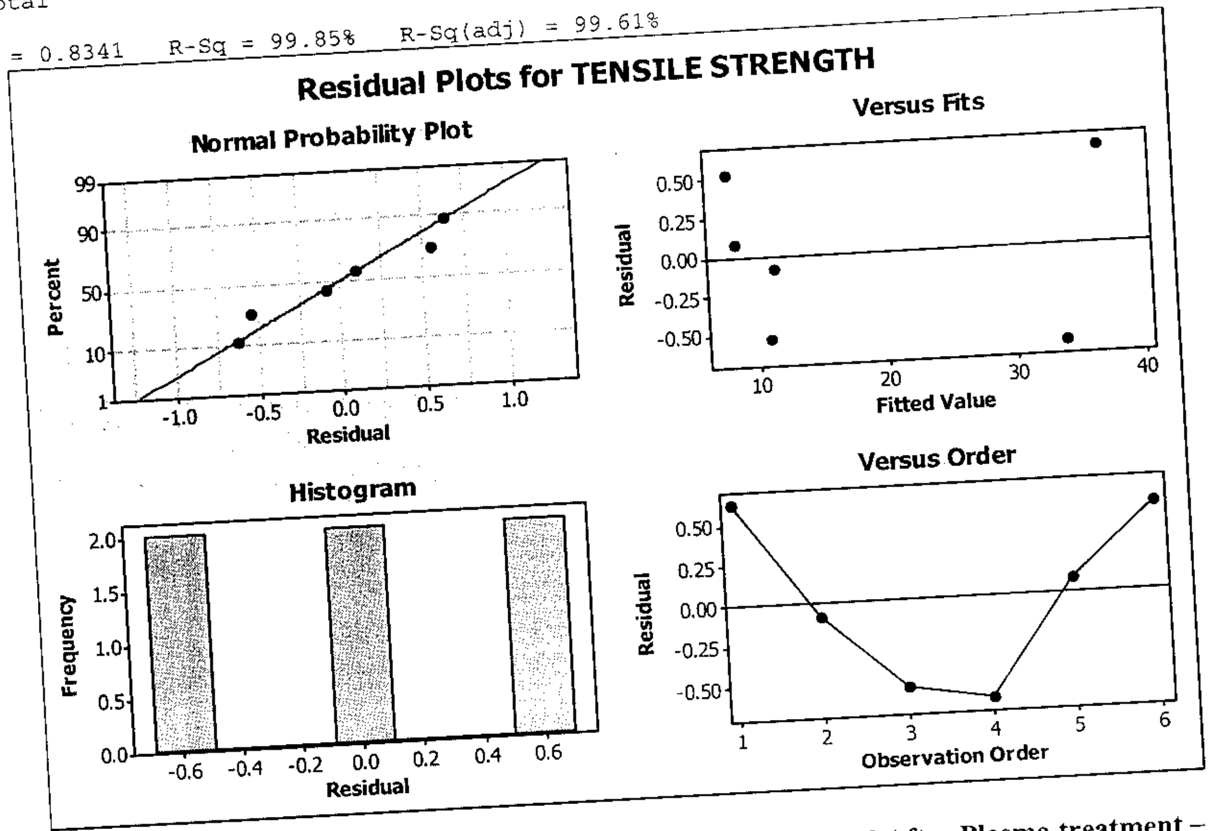


Fig. 4.22 Tensile Strength (gf/tex) Zari Components - Before and After Plasma treatment – Residual Plots

INFERENCE

	Degrees of Freedom	Value (95% Confidence Level)		Result
		F-Table	Calculated	

4.5.11 Two-way ANOVA: FAULTS PER METER – OFFLINE ZARI TESTER

Source	DF	SS	MS	F	P
MACHINE SPEED	2	21.50	10.75	**6.07**	0.141
COMPONENTS	1	1536.96	1536.96	**868.31**	0.001
Error	2	3.54	1.77		
Total	5	1562.00			

S = 1.330 R-Sq = 99.77% R-Sq(adj) = 99.43%

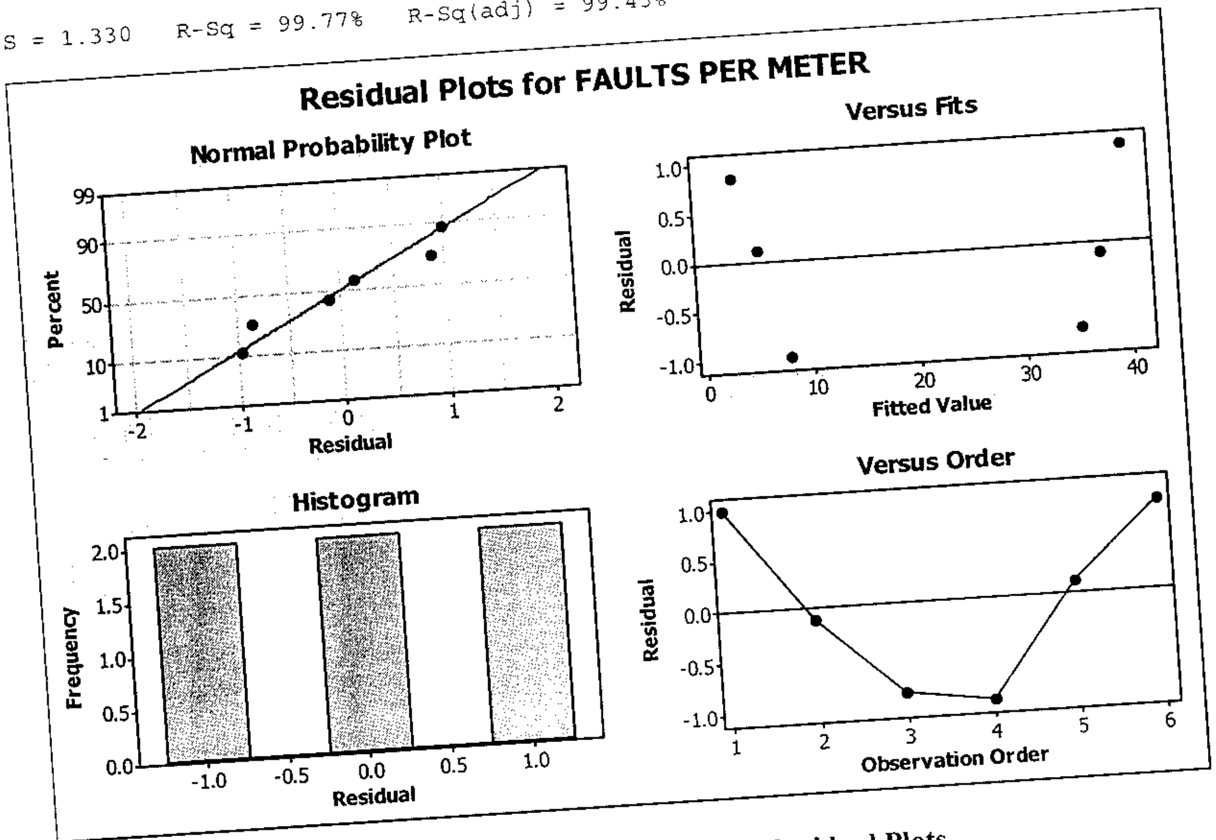


Fig. 4.23 Faults per Meter – Residual Plots

INFERENCE

	Degrees of Freedom	Value (95% Confidence Level)		Result
		F Table	Calculated	

4.6 STATISTICAL ANALYSIS – SUMMARY

4.6.1 Average Tensile Strength (gf/tex) -At Three Different Gauge lengths

Before Plasma Treatment	Raw Silk	The difference is not Significant
	Degummed Silk	The difference is not Significant
	Red Silk	The difference is not Significant
	Silver wrapped Red Silk	The difference is not Significant
	Zari	The difference is not Significant
After Plasma Treatment	Raw Silk	The difference is not Significant
	Degummed Silk	The difference is not Significant
	Red Silk	The difference is not Significant
	Silver wrapped Red Silk	The difference is not Significant
	Zari	The difference is not Significant

Table. 4.26 Average Tensile Strength (gf/tex) at Three gauge lengths

4.6.2 Average Tensile Strength (gf/tex) –Before and After Plasma Treatment

1	Raw Silk	The difference is not Significant
2	Degummed Silk	The difference is Significant
3	Red Silk	The difference is not Significant
4	Silver wrapped Red Silk	The difference is Significant
5	Zari	The difference is Significant

Table. 4.27 Average Tensile Strength (gf/tex) - Before and After Plasma Treatment

CHAPTER 5

CONCLUSION

- The change in the gaugelength (between 200 to 300) does not affect the average tensile strength values of Raw silk yarns(Mulberry/Tasar) and Degummed silk yarns(Mulberry/Tasar) both before plasma treatment and after treatment with oxygen gas.
- The change in the gauge length (between 200 to 300) does not affect the average tensile strength values of Zari yarn and its components (Red silk & Silver wrapped red silk) both before plasma treatment and after treatment with oxygen gas.
- After plasma treatment with oxygen gas, the average tensile strength values of raw silk yarns (Mulberry/Tasar) decreases.
- After plasma treatment with oxygen gas, the average tensile strength values of degummed silk yarns(Mulberry/Tasar) decreases.
- The decrease in average tensile strength (gf/tex) is higher in raw silk yarns (Mulberry/Tasar) than in degummed silk yarns(Mulberry/Tasar).
- The average tensile strength values (gf/tex) of red silk, silver wrapped red silk and Zari decreases after plasma treatment with oxygen gas.
- The decrease in average tensile strength (gf/tex) is higher in silver wrapped red

CHAPTER 6

REFERENCE

1. Amelia Sparavigna, "Plasma treatment: advantages for textiles", www.fibre2fashion.com/articles/technology
2. Babu Rao, "Development of X-ray Fluorescence-based Methodology for Quality control of Zari used in Silk Saris", AUTEX Research Journal, Vol. 4, No3, September 2004 (http://www.autexrj.org/No3-2004/0104.pdf 118).
3. Carty P. (1996) "Fibre Properties", Pentaxion Publishers, ISBN: 9781874430889.
4. Gupta V.P. and Kothari V. K. (1997) "Manufactured Fibre Technology", Chapman & Hall Publishers.
5. Hartwig Höcker, "Plasma treatment of textile fibers" Deutsches Wollforschungs institutander RWTH Aachene.V., Veltmanplatz 8,D-52062 Aachen, Germany.
6. http://allabouttextiles.blogspot.com/2008/01/silk-properties.html
7. http://allabouttextiles.blogspot.com/2008/01/silk-properties.html
8. http://en.wikipedia.org/wiki/Silk
9. http://en.wikipedia.org/wiki/Zari
10. Inbakumar S and Anu kaliani A (2010), "Effect of Plasma Treatment on Surface of Protein Fabrics" Journal of Physics: Conference Series 208 (2010) 012111

13. Morton W.E. and Hearle J.W.S. (1993), "Physical properties of Textile fibres", Textile Institute, UK.

14. New Cloth Market, "Plasma Treatment Technology for Textile Industry".

15. Peter J. Hauser (2005),"Plasma Treatment of Textiles: Changing Fiber Surfaces" North Carolina State University - College of Textiles, http://www2.ncsu.edu/unity/lockers/project/ntcprojects/projects/C99-S09/.

16. Shillin Sangappa, Roy S and Prabhakara H.R (November 2009), "The application of low pressure plasma treatment to silk yarn and fabric. National workshop on eco-friendly plasma applications in textile", Institute for plasma research, Bhat, Gandhinagar,India.

17. Warner S,(1995) "Fiber Science", Prentice Hall, ISBN: 9780024245410.

18. www.britannica.com/silk

19. www.fibersource.com

20. www.fibre2fashion.com.

21. www.plasma.com

22. www.tnzari.net

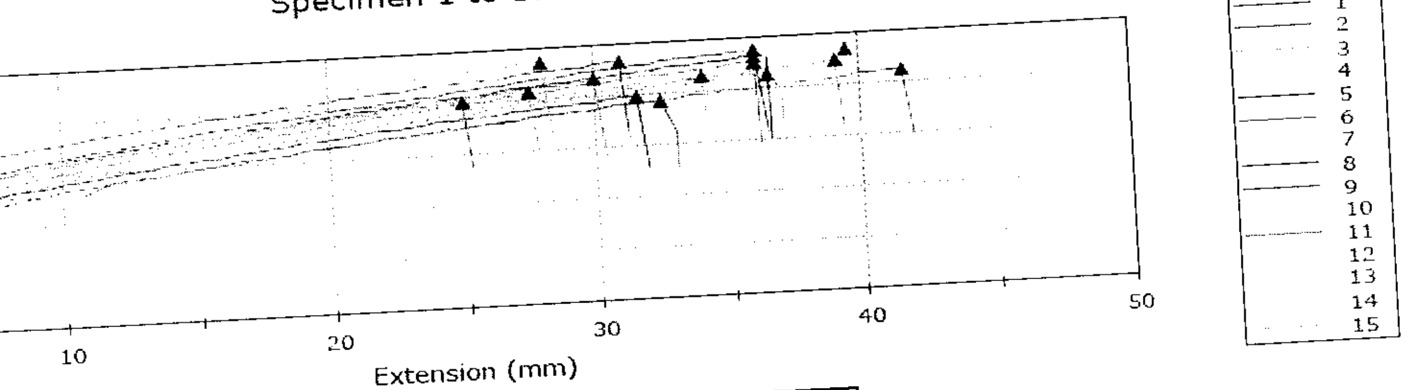
23. www.zarithread.com/zari-threads.html

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

Coimbatore - 641 049

	Untreated Raw Mulberry
	6.35
(Tex)	200.
gth (mm)	300.
n/min)	

Specimen 1 to 15

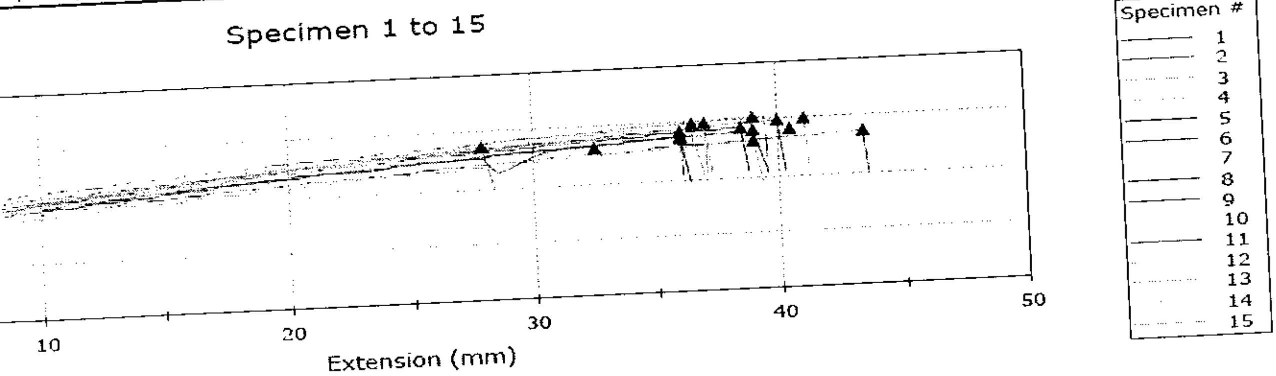


Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
143.67	32.50	22.63
188.72	36.00	29.72
173.37	39.00	27.30
186.42	28.00	29.36
181.82	36.00	28.63
162.08	41.50	25.52
185.20	39.50	29.17
148.61	31.50	23.40
152.04	25.00	23.94
165.19	34.00	26.01
188.72	41.50	29.72
143.67	25.00	22.63
168.71	34.30	26.57
16.81534	5.20790	2.64808
9.96689	15.18338	9.96689

Coimbatore - 641 049

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

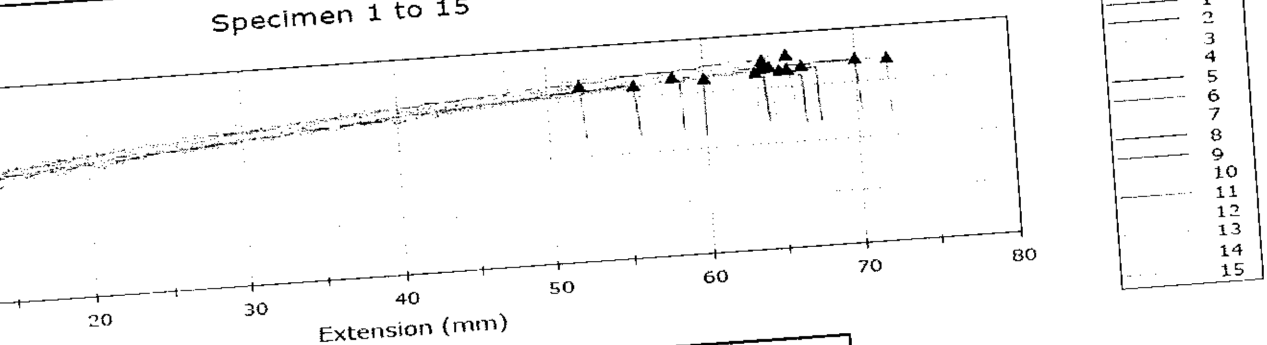
	Untreated Raw Mulberry
el	6.35
t (Tex)	250.
ngth (mm)	300.
m/min)	



Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
172.03	43.50	27.09
196.74	40.00	30.98
161.62	39.00	25.45
175.75	36.00	27.68
173.22	36.00	27.28
204.57	39.00	32.22
182.14	40.50	28.68
186.67	38.50	29.40
182.92	36.00	28.81
162.21	32.50	25.54
204.57	43.50	32.22
161.62	32.50	25.45
179.79	38.10	28.31
13.83600	3.07137	2.17890
7.69577	8.06135	7.69577

RE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Raw Mulberry
	6.35
(Tex)	300.
th (mm)	300.
/min)	



Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
234.30	58.00	36.90
252.55	64.00	39.77
258.92	65.50	40.77
245.34	64.00	38.64
223.20	55.50	35.15
237.75	64.00	37.44
235.93	66.50	37.15
233.87	65.00	36.83
243.58	70.00	38.36
240.29	64.50	37.84
258.92	70.00	40.77
223.20	55.50	35.15
240.57	63.70	37.89
10.15183	4.12445	1.59871
4.21985	6.47481	4.21985

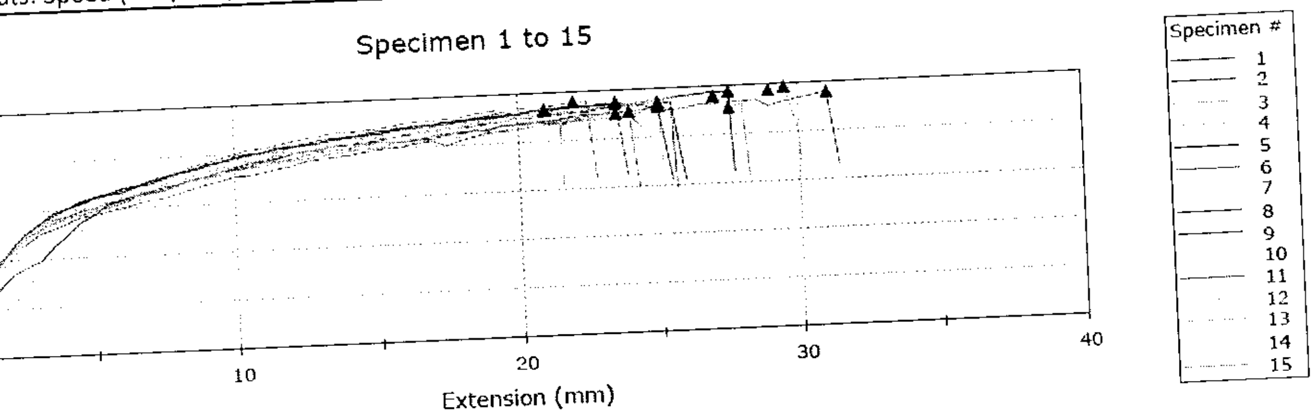
Untreated Raw Mulberry - Instron Result (300 mm)

Coimbatore - 641 049

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Raw Tasar
Specimen label	6.35
uts: Yarn Count (Tex)	200.
uts: Gauge Length (mm)	300.
uts: Speed (mm/min)	

Specimen 1 to 15



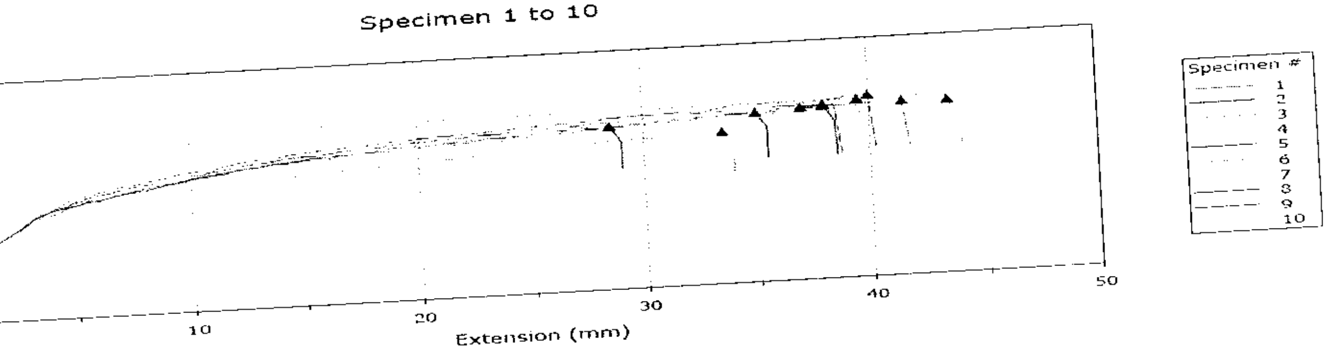
	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	212.39	31.00	33.45
2	231.24	25.00	36.41
3	249.26	21.00	39.25
4	275.57	29.50	43.40
5	230.04	25.00	36.23
6	255.08	22.00	40.17
7	248.63	29.00	39.15
8	206.41	27.50	32.51
9	217.80	23.50	34.30
10	213.15	27.00	33.57
ximum	275.57	31.00	43.40
nimum	206.41	21.00	32.51
Mean	233.96	26.05	36.84
andard eviation	22.52931	3.31202	3.54792
efficient ariation	9.62970	12.71407	9.62970

Untreated Raw Tasar - Instron Result (200 mm)

Coimbatore - 641 049

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Raw Tasar
ecimen label	6.35
: Yarn Count (Tex)	250.
s: Gauge Length (mm)	300.
s: Speed (mm/min)	



	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	255.27	38.00	40.20
2	206.71	35.00	32.55
3	232.92	33.50	36.68
4	213.61	43.50	33.64
5	222.91	28.50	35.10
6	246.41	41.50	38.80
7	219.44	37.00	34.56
8	234.32	38.00	36.90
9	261.67	40.00	41.21
10	234.89	39.50	36.99
num	261.67	43.50	41.21
num	206.71	28.50	32.55
Mean	232.82	37.45	36.66
dard ation	17.81208	4.29761	2.80505
cient ation	7.65071	11.47559	7.65071

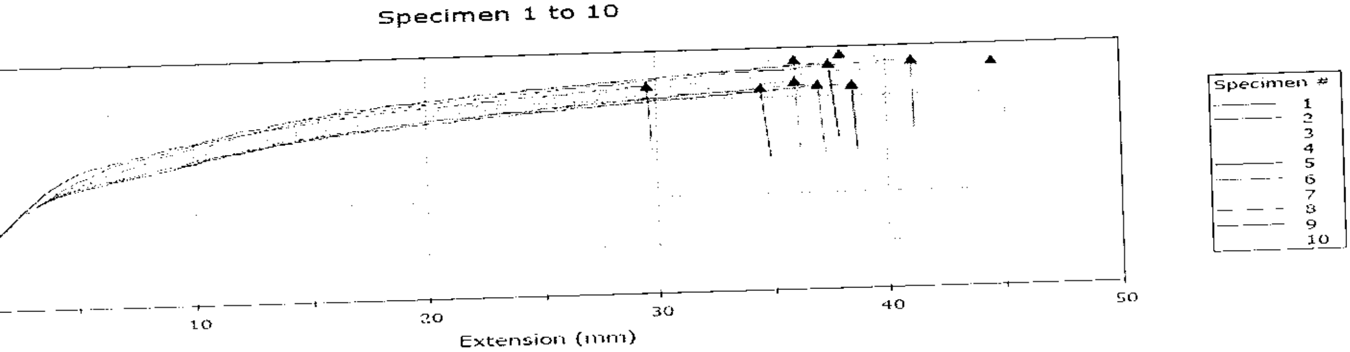
Untreated Raw Tasar - Instron Result (250 mm)

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

Coimbatore - 641 049

Specimen label	Untreated Raw Tasar
...ts: Yarn Count (Tex)	6.35
...ts: Gauge Length (mm)	300.
...ts: Speed (mm/min)	300.

Specimen 1 to 10



	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	164.35	29.50	25.88
2	159.30	34.50	25.09
3	164.95	36.00	25.98
4	182.62	44.50	28.76
5	160.73	38.50	25.31
6	161.89	37.00	25.49
7	187.97	36.00	29.60
8	183.83	37.50	28.95
9	184.76	41.00	29.10
10	192.38	38.00	30.30
...mum	192.38	44.50	30.30
...mum	159.30	29.50	25.09
...Mean	174.28	37.25	27.45
...dard ...ation	13.05026	3.93877	2.05516
...cient ...ation	7.48819	10.57387	7.48819

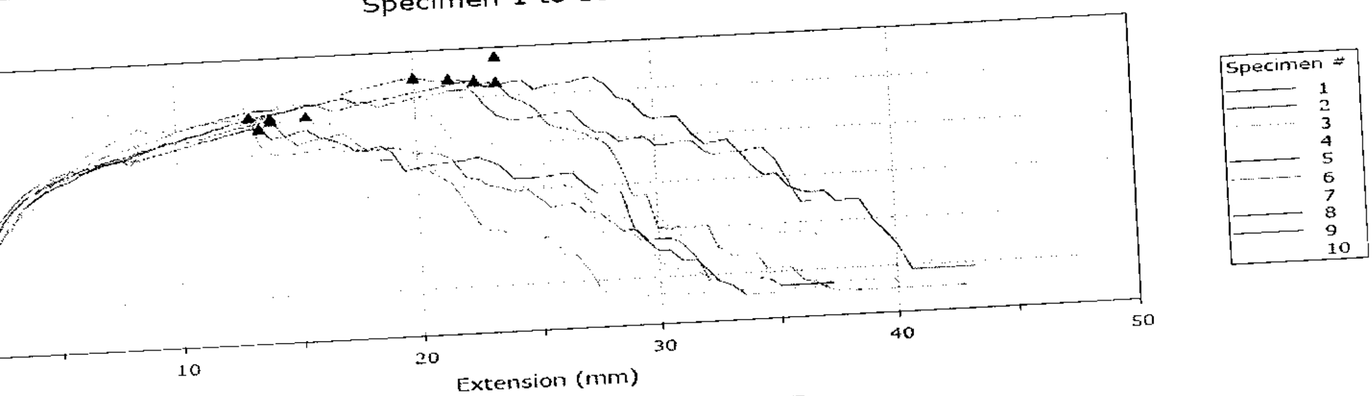
Untreated Raw Tasar - Instron Result (300 mm)

Coimbatore - 641 049

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Degummed Mulberry
ecimen label	4.92
s: Yarn Count (Tex)	200.
s: Gauge Length (mm)	300.
s: Speed (mm/min)	

Specimen 1 to 10



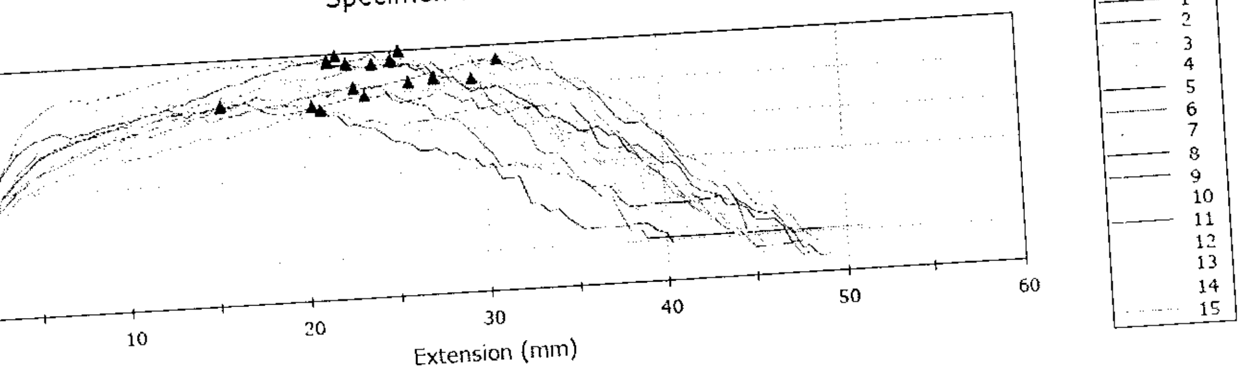
	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	85.59	23.50	17.40
2	89.31	20.00	18.15
3	75.57	14.00	15.36
4	75.07	15.50	15.26
5	70.68	13.50	14.37
6	75.95	13.00	15.44
7	96.51	23.50	19.62
8	86.56	22.50	17.59
9	74.01	14.00	15.04
10	87.87	21.50	17.86
um	96.51	23.50	19.62
um	70.68	13.00	14.37
ean	81.71	18.10	16.61
lard tion	8.49340	4.47710	1.72630
ient tion	10.39431	24.73537	10.39431

Untreated Degummed Mulberry - Instron Result (200 mm)

FAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Degummed Mulberry
ecimen label	4.92
s: Yarn Count (Tex)	250.
s: Gauge Length (mm)	300.
s: Speed (mm/min)	

Specimen 1 to 15



	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	79.42	23.50	16.14
2	83.57	23.00	16.99
3	94.69	22.50	19.25
4	99.98	25.50	20.32
5	96.93	21.50	19.70
6	73.45	21.00	14.93
7	84.46	26.00	17.17
8	77.95	15.50	15.84
9	99.43	22.00	20.21
10	75.42	20.50	15.33
um	99.98	26.00	20.32
um	73.45	15.50	14.93
ean	86.53	22.10	17.59
lard tion	10.29451	2.93258	2.09238
ient tion	11.89704	13.26957	11.89704

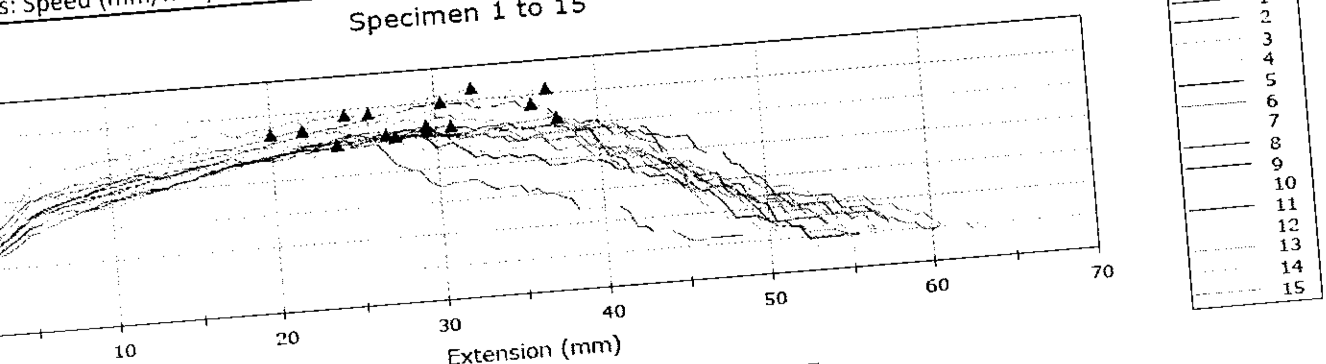
Untreated Degummed Mulberry - Instron Result (250 mm)

Coimbatore - 641 049

FAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Degummed Mulberry
ecimen label	4.92
s: Yarn Count (Tex)	300.
s: Gauge Length (mm)	300.
s: Speed (mm/min)	

Specimen 1 to 15



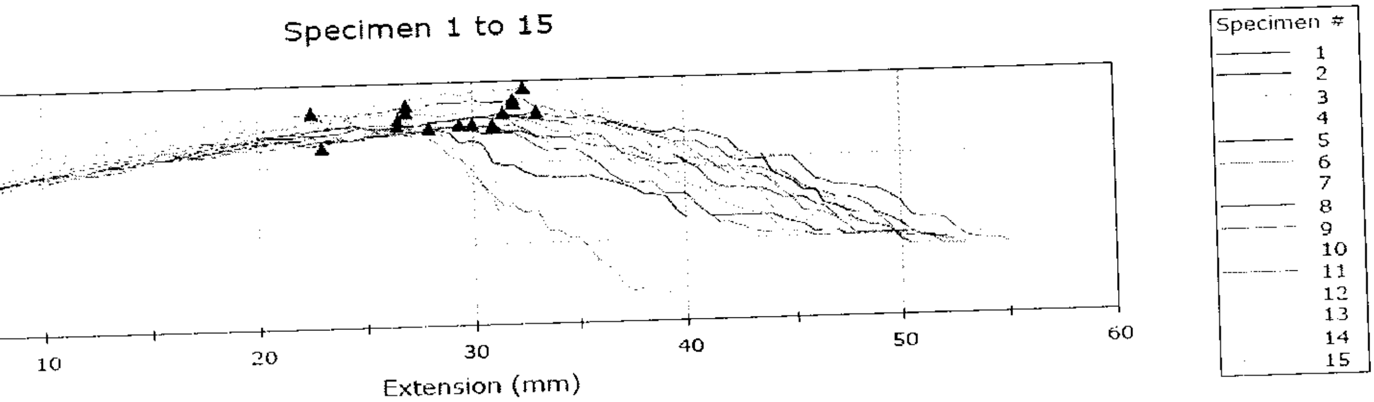
	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	99.99	30.50	20.32
2	85.84	29.50	17.45
3	106.46	32.50	21.64
4	85.41	37.50	17.36
5	85.65	31.00	17.41
6	82.60	27.00	16.79
7	93.66	36.00	19.04
8	81.74	27.50	16.61
9	84.12	29.50	17.10
10	97.13	26.00	19.74
mum	106.46	37.50	21.64
mum	81.74	26.00	16.61
Mean	90.26	30.70	18.35
ndard iation	8.49278	3.75056	1.72618
ficient riation	9.40924	12.21679	9.40924

Untreated Degummed Mulberry - Instron Result (300 mm)

CORE in Textile Technology & Machinery, Kumaraguru College of Technology

Coimbatore - 641 049

el	Untreated Degummed Tasar
nt (Tex)	4.41
ngth (mm)	200.
m/min)	300.



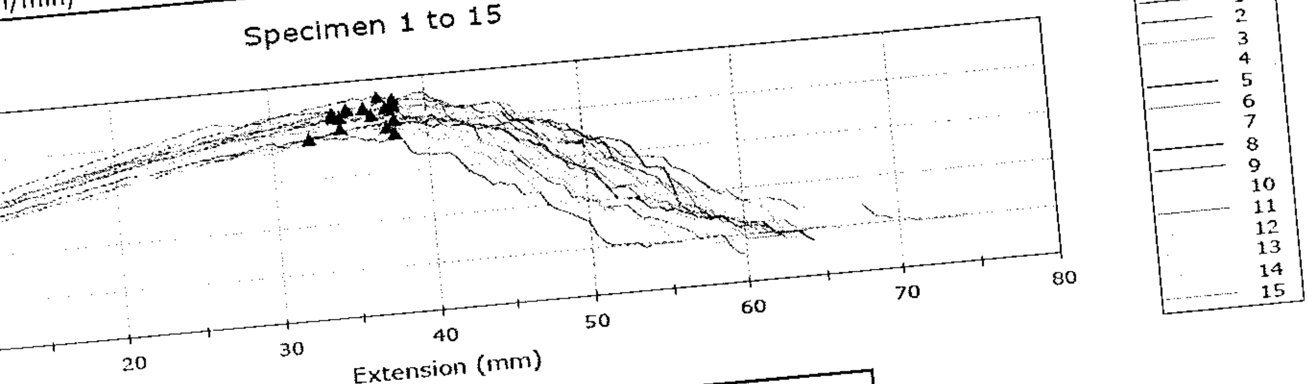
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
131.34	30.00	29.78
125.25	33.00	28.40
127.16	32.00	28.83
136.15	32.50	30.87
129.49	31.50	29.36
131.45	32.00	29.81
134.93	27.00	30.60
135.15	28.00	30.65
130.47	26.50	29.58
131.76	29.50	29.88
136.15	33.00	30.87
125.25	26.50	28.40
131.31	30.20	29.78
3.48720	2.37112	0.79075
2.65563	7.85140	2.65563

Untreated Degummed Tasar - Instron Result (200 mm)

Coimbatore - 641 049

RE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Degummed Tasar
	4.41
	250.
(Tex)	300.
gth (mm)	
n/min)	

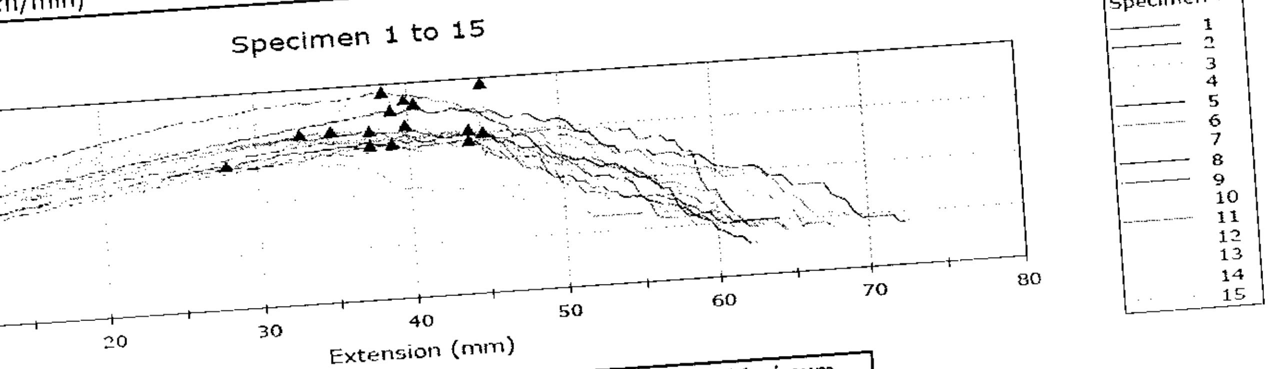


Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
132.71	38.00	30.09
128.42	32.50	29.12
107.82	36.50	24.45
132.44	37.50	30.03
121.23	38.00	27.49
134.15	36.00	30.42
131.47	34.50	29.81
134.17	34.50	30.42
141.36	37.00	32.05
138.02	34.00	31.30
141.36	38.00	32.05
107.82	32.50	24.45
130.18	35.85	29.52
9.51241	1.88635	2.15701
7.30725	5.26180	7.30725

Coimbatore - 641 049

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Degummed Tasar
l	4.41
t (Tex)	300.
ngth (mm)	300.
m/min)	



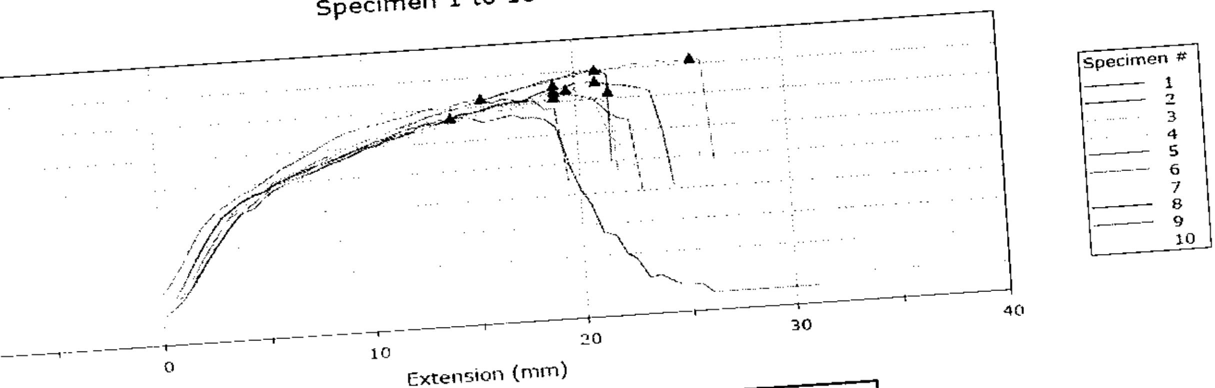
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
102.73	44.00	23.29
143.72	38.50	32.59
84.21	28.00	19.10
111.47	40.00	25.28
125.23	39.00	28.40
94.69	39.00	21.47
146.00	45.00	33.11
100.43	45.00	22.77
94.14	44.00	21.35
135.14	40.00	30.64
146.00	45.00	33.11
84.21	28.00	19.10
113.78	40.25	25.80
22.24132	5.05113	5.04338
19.54834	12.54939	19.54834

Untreated Degummed Tasar - Instron Result (300 mm)

Coimbatore - 641 049

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

pecimen label	Un treated Redsilk
ts: Yarn Count (Tex)	3.58
ts: Gauge Length (mm)	200.
ts: Speed (mm/min)	300.



	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	127.03	19.00	35.48
2	139.77	21.00	39.04
3	123.65	19.00	34.54
4	127.84	19.50	35.71
5	132.68	21.00	37.06
6	143.21	25.50	40.00
7	131.33	19.00	36.68
8	115.30	14.00	32.21
9	126.02	15.50	35.20
10	125.67	21.50	35.10
mum	143.21	25.50	40.00
mum	115.30	14.00	32.21
Mean	129.25	19.50	36.10
ndard iation	8.01229	3.18852	2.23807
ficient iation	6.19907	16.35139	6.19907

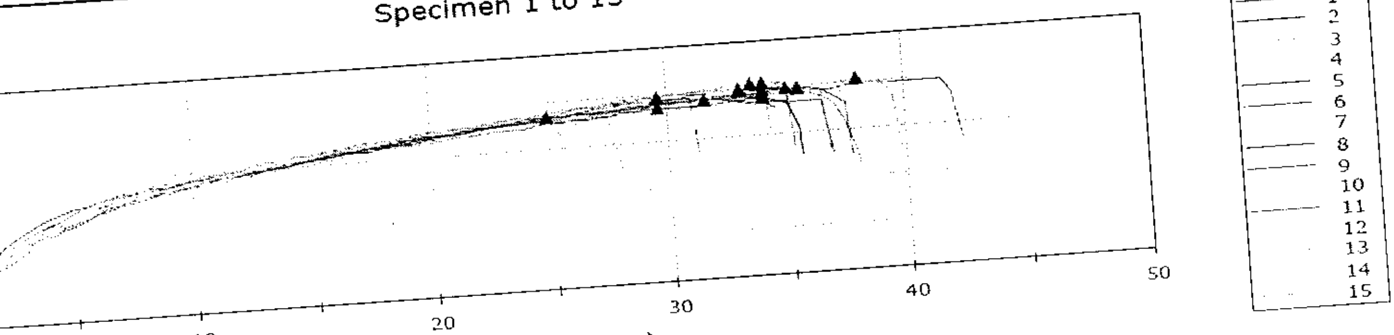
Untreated Redsilk - Instron Result (200 mm)

Coimbatore - 641 049

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Un treated Redsilk
ecimen label	3.58
s: Yarn Count (Tex)	250.
s: Gauge Length (mm)	300.
s: Speed (mm/min)	

Specimen 1 to 15



	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	146.40	29.50	40.89
2	141.10	31.50	39.41
3	145.94	34.00	40.77
4	134.60	25.00	37.60
5	141.62	31.50	39.56
6	148.86	35.00	41.58
7	135.35	29.50	37.81
8	140.34	34.00	39.20
9	147.77	35.50	41.28
10	150.74	33.00	42.11
Maximum	150.74	35.50	42.11
Minimum	134.60	25.00	37.60
Mean	143.27	31.85	40.02
Standard Deviation	5.55914	3.19766	1.55283
Coefficient of Variation	3.88013	10.03973	3.88013

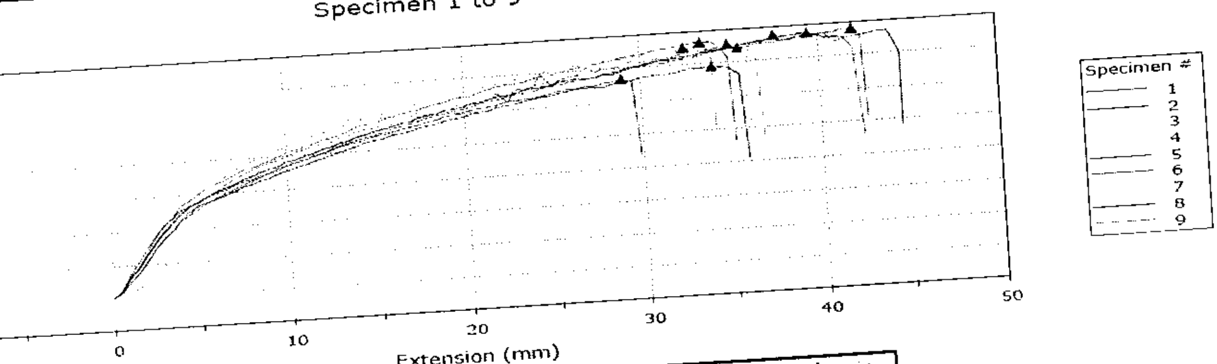
Untreated Redsilk - Instron Result (250 mm)

Coimbatore - 641 049

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

pecimen label	Un treated Redsilk
ts: Yarn Count (Tex)	3.58
ts: Gauge Length (mm)	300.
ts: Speed (mm/min)	300.

Specimen 1 to 9



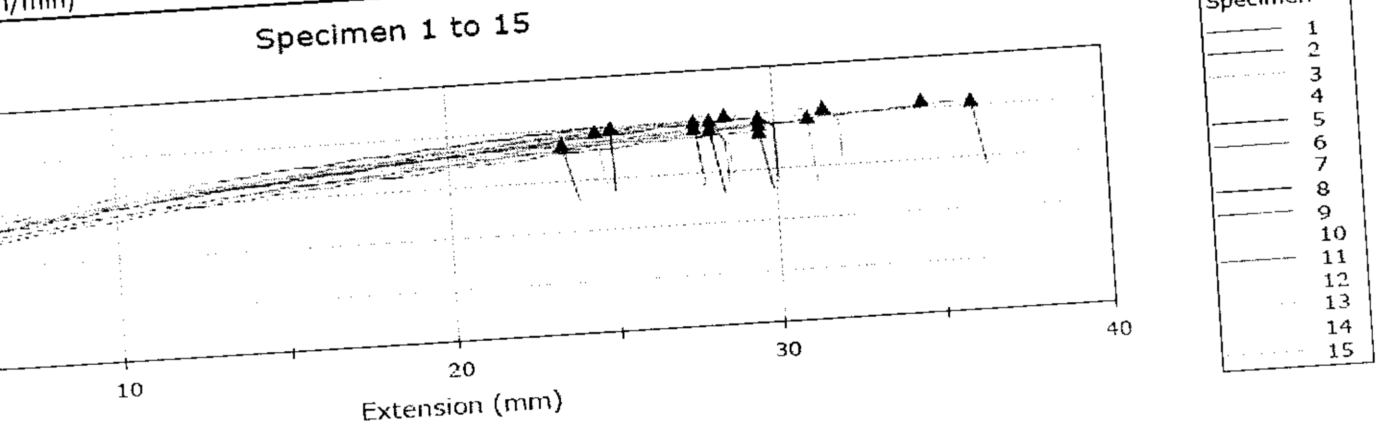
	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	133.32	33.50	37.24
2	113.65	29.00	31.75
3	130.46	32.50	36.44
4	129.62	35.50	36.21
5	118.23	34.00	33.03
6	135.16	37.50	37.75
7	131.21	35.00	36.65
8	135.52	39.50	37.85
9	136.48	42.00	38.12
10	130.22	32.00	36.37
Maximum	136.48	42.00	38.12
Minimum	113.65	29.00	31.75
Mean	129.39	35.05	36.14
Standard Deviation	7.55774	3.80387	2.11110
Coefficient of Variation	5.84119	10.85270	5.84119

Untreated Redsilk - Instron Result (300 mm)

RE in Textile Technology & Machinery, Kumaraguru College of Technology

Coimbatore - 641 049

	Untreated silver wrapped redsilk
	12.18
(Tex)	200.
gth (mm)	300.
n/min)	

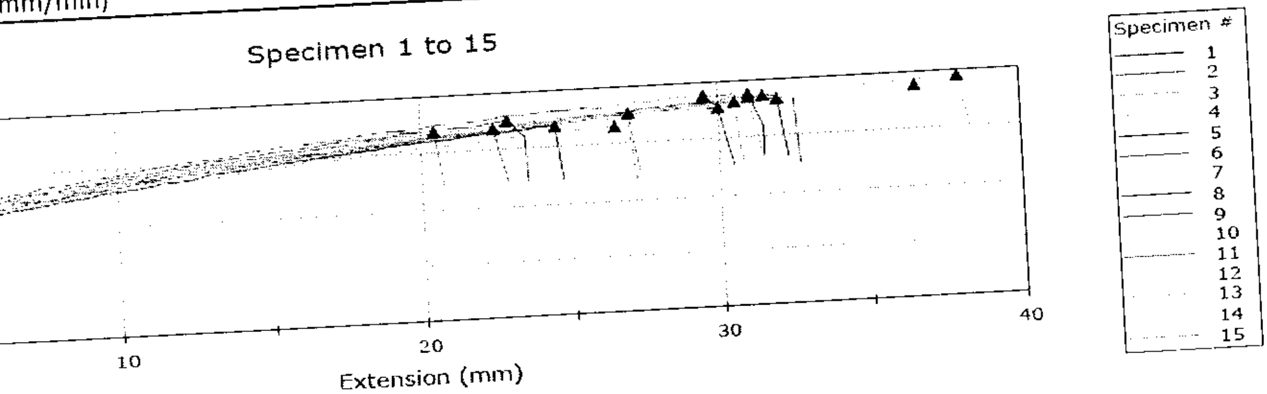


Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
138.22	29.50	11.35
143.19	28.00	11.76
144.02	27.50	11.82
148.16	31.00	12.16
150.92	29.50	12.39
151.59	28.00	12.45
158.40	34.50	13.00
150.50	25.00	12.36
136.53	23.50	11.21
146.44	24.50	12.02
158.40	34.50	13.00
136.53	23.50	11.21
146.80	28.10	12.05
6.58278	3.28971	0.54046
4.48428	11.70717	4.48428

Coimbatore - 641 049

CORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated silver wrapped redsilk
bel	12.18
unt (Tex)	250.
ength (mm)	300.
mm/min)	

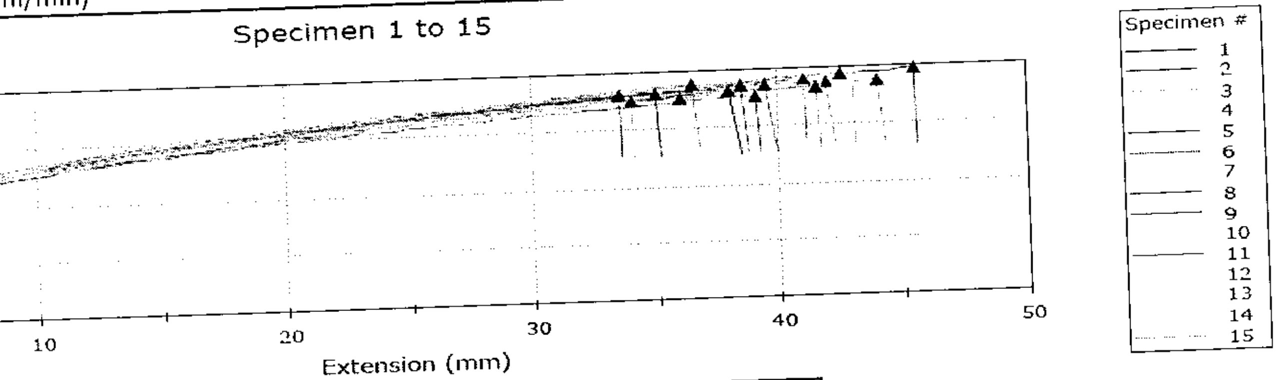


Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
133.80	32.00	10.99
128.01	30.00	10.51
115.33	26.50	9.47
132.01	30.50	10.84
135.53	31.50	11.13
118.14	22.50	9.70
139.29	36.50	11.44
118.92	24.50	9.76
139.56	31.00	11.46
138.92	29.50	11.41
139.56	36.50	11.46
115.33	22.50	9.47
129.95	29.45	10.67
9.36243	4.02389	0.76867
7.20459	13.66345	7.20459

Coimbatore - 641 049

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated silver wrapped redsilk
el	12.18
nt (Tex)	300.
ngth (mm)	300.
m/min)	



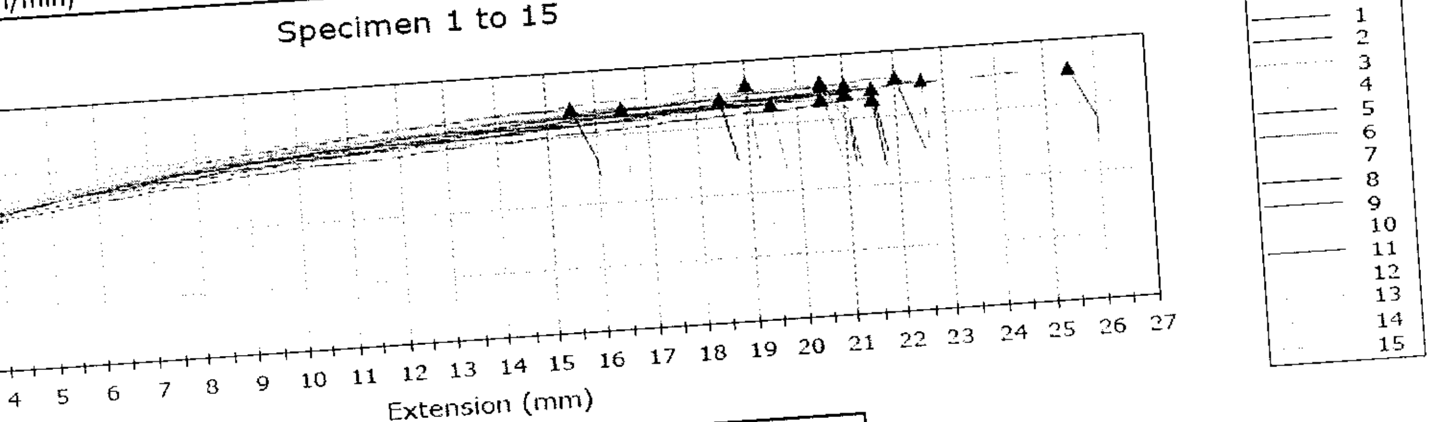
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
135.75	38.50	11.15
130.01	33.50	10.67
137.31	44.00	11.27
133.51	41.50	10.96
131.21	35.00	10.77
140.70	41.00	11.55
126.38	36.00	10.38
132.26	38.00	10.86
127.01	39.00	10.43
124.83	34.00	10.25
140.70	44.00	11.55
124.83	33.50	10.25
131.90	38.05	10.83
5.08448	3.45969	0.41745
3.85489	9.09248	3.85489

Untreated Silver Wrapped Redsilk - Instron Result (300 mm)

Coimbatore - 641 049

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Zari
(Tex)	11.69
gth (mm)	200.
n/min)	300.



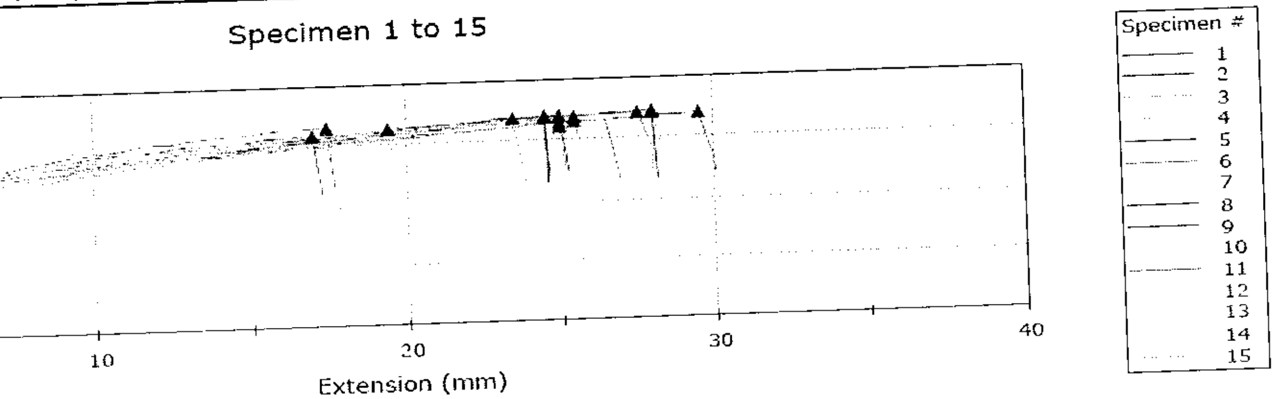
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
128.39	25.50	10.98
114.25	21.50	9.77
126.03	22.50	10.78
115.38	19.50	9.87
120.12	21.00	10.28
117.38	20.50	10.04
126.34	21.00	10.81
122.00	18.50	10.44
122.72	15.50	10.50
119.59	16.50	10.23
128.39	25.50	10.98
114.25	15.50	9.77
121.22	20.20	10.37
4.77164	2.89828	0.40818
3.93635	14.34790	3.93635

Coimbatore - 641 049

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Zari
el	11.69
t (Tex)	250.
gth (mm)	300.
m/min)	

Specimen 1 to 15

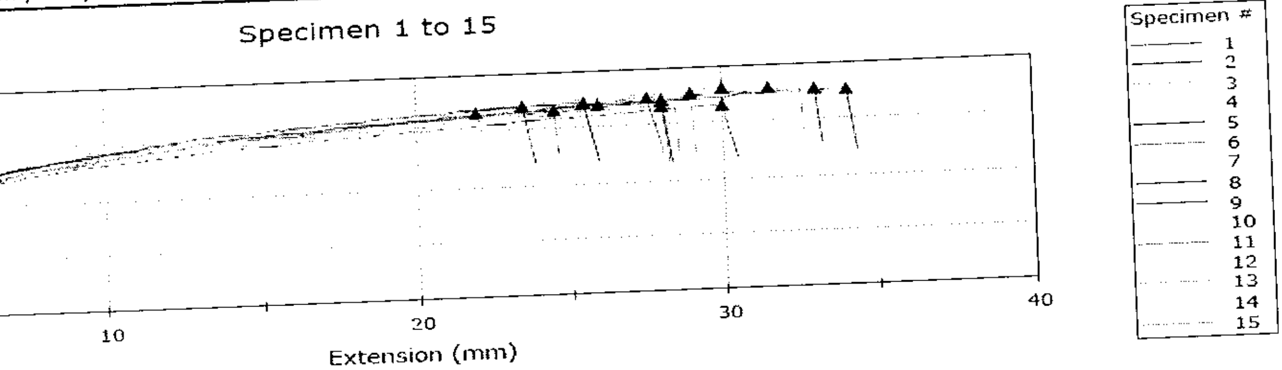


Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
115.82	17.50	9.91
109.12	17.00	9.33
118.64	23.50	10.15
113.83	25.00	9.74
117.64	24.50	10.06
115.82	17.50	9.91
109.12	17.00	9.33
118.64	23.50	10.15
113.83	25.00	9.74
117.64	24.50	10.06
118.64	25.00	10.15
109.12	17.00	9.33
115.01	21.50	9.84
3.55385	3.69685	0.30401
3.09004	17.19463	3.09004

Coimbatore - 641 049

CORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Untreated Zari
el	11.69
nt (Tex)	300.
ngth (mm)	300.
m/min)	



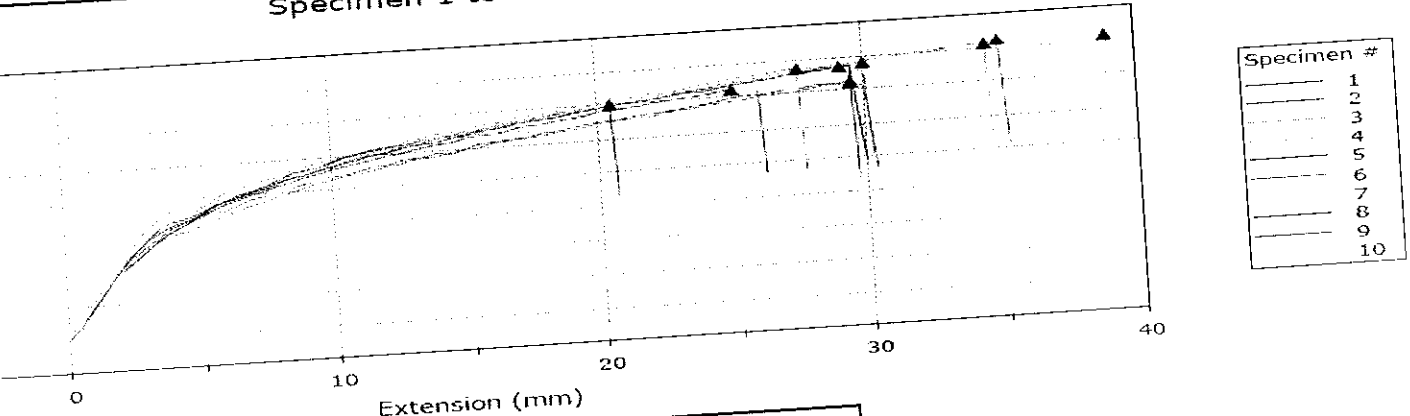
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
128.54	33.00	11.00
126.74	34.00	10.84
128.83	31.50	11.02
128.03	29.00	10.95
122.73	25.50	10.50
123.58	27.50	10.57
120.32	26.00	10.29
121.83	28.00	10.42
115.54	30.00	9.88
130.77	30.00	11.19
130.77	34.00	11.19
115.54	25.50	9.88
124.69	29.45	10.67
4.71828	2.82302	0.40362
3.78398	9.58581	3.78398

Coimbatore - 641 049

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Plasma treated Raw Mulberry
	6.35
(Tex)	200.
gth (mm)	300.
n/min)	

Specimen 1 to 10



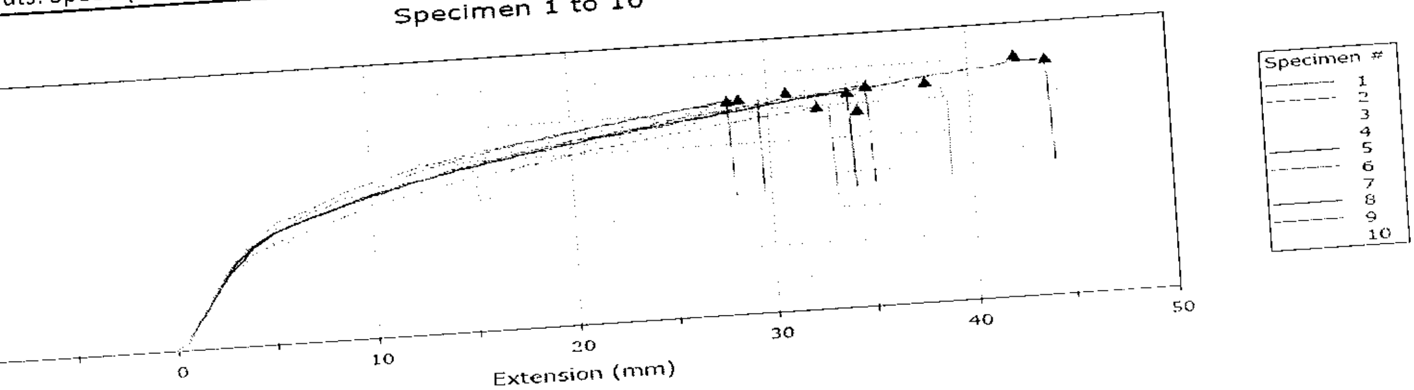
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
125.39	29.50	19.75
124.81	25.00	19.66
134.24	27.50	21.14
135.63	30.00	21.36
120.30	20.50	18.94
124.82	29.50	19.66
143.86	39.00	22.66
134.20	29.00	21.13
144.22	35.00	22.71
142.76	34.50	22.48
144.22	39.00	22.71
120.30	20.50	18.94
133.02	29.95	20.95
8.83280	5.26229	1.39099
6.64006	17.57024	6.64006

Coimbatore - 641 049

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

Specimen label	Plasma treated Raw Mulberry
uts: Yarn Count (Tex)	6.35
uts: Gauge Length (mm)	250.
uts: Speed (mm/min)	300.

Specimen 1 to 10



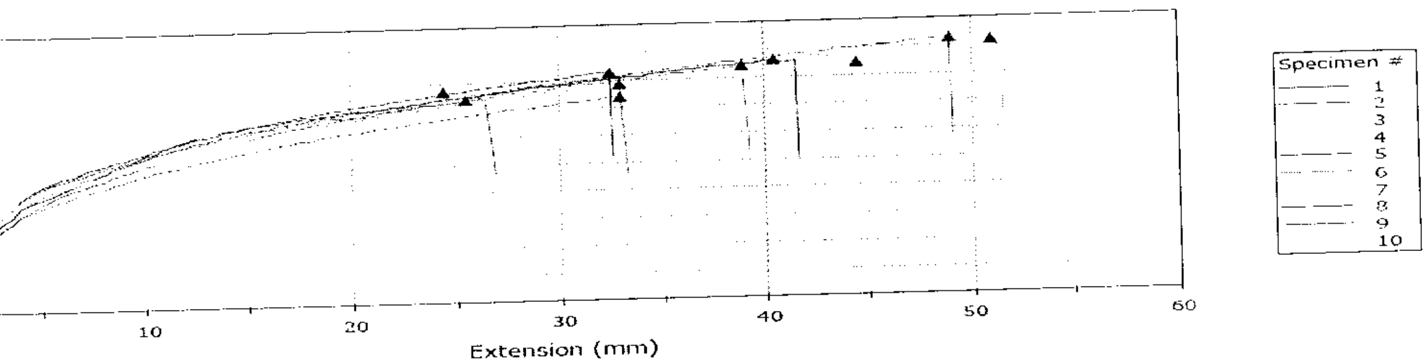
	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	126.21	28.50	19.88
2	129.52	35.00	20.40
3	129.18	38.00	20.34
4	141.69	42.50	22.31
5	126.60	34.00	19.94
6	118.66	32.50	18.69
7	115.62	34.50	18.21
8	138.54	44.00	21.82
9	125.79	28.00	19.81
10	128.51	31.00	20.24
Maximum	141.69	44.00	22.31
Minimum	115.62	28.00	18.21
Mean	128.03	34.80	20.16
Standard Deviation	7.83871	5.38104	1.23444
Coefficient of Variation	6.12246	15.46275	6.12246

Plasma Treated Raw Mulberry - Instron Result (250 mm)

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology Coimbatore - 641 049

Specimen label	Plasma treated Raw Mulberry
uts: Yarn Count (Tex)	6.35
uts: Gauge Length (mm)	300.
uts: Speed (mm/min)	300.

Specimen 1 to 10



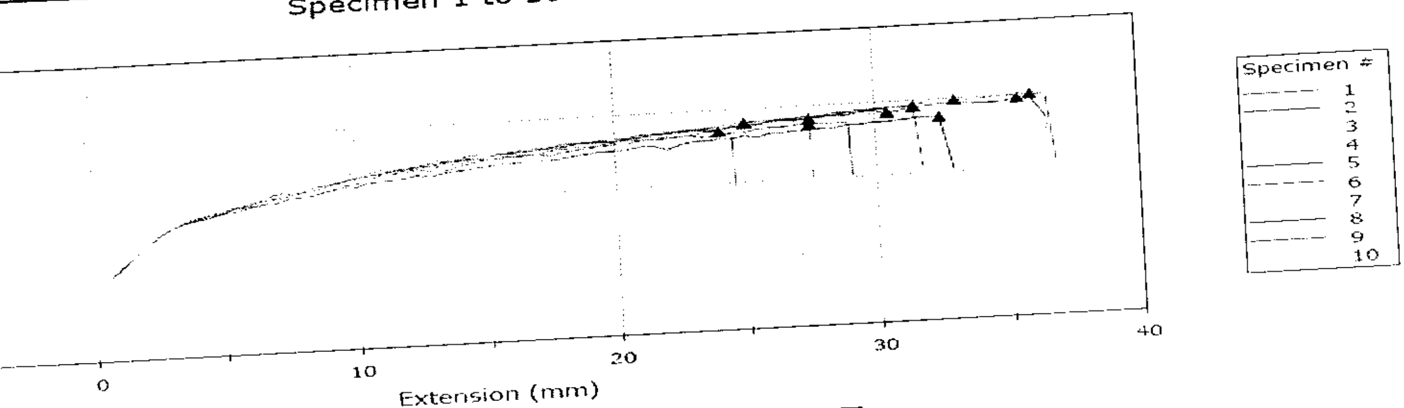
	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	127.84	33.00	20.13
2	127.71	25.50	20.11
3	137.10	33.00	21.59
4	164.16	51.00	25.85
5	151.96	40.50	23.93
6	148.22	39.00	23.34
7	149.56	44.50	23.55
8	145.99	32.50	22.99
9	165.88	49.00	26.12
10	134.04	24.50	21.11
aximum	165.88	51.00	26.12
inimum	127.71	24.50	20.11
Mean	145.25	37.25	22.87
Standard Deviation	13.57694	9.14467	2.13810
oefficient Variation	9.34755	24.54945	9.34755

Plasma Treated Raw Mulberry - Instron Result (300 mm)

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Plasma Treated Raw Tasar
l	6.35
t (Tex)	200.
gth (mm)	300.
n/min)	

Specimen 1 to 10

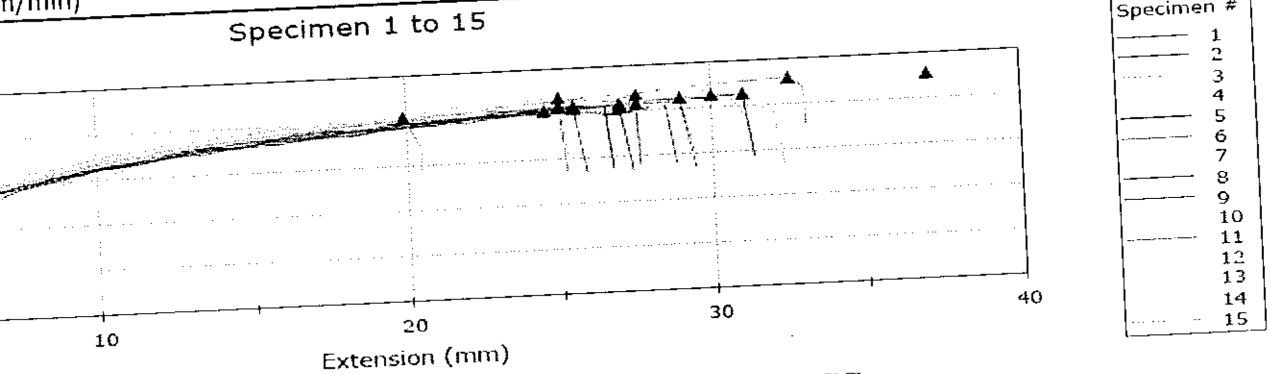


Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
174.31	27.50	27.45
200.89	36.00	31.64
181.01	27.50	28.51
185.96	30.50	29.29
195.42	35.50	30.77
170.75	24.00	26.89
196.36	33.00	30.92
176.49	32.50	27.79
190.15	31.50	29.94
179.87	25.00	28.33
200.89	36.00	31.64
170.75	24.00	26.89
185.12	30.30	29.15
10.27084	4.17133	1.61746
5.54818	13.76677	5.54818

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

Coimbatore - 641 049

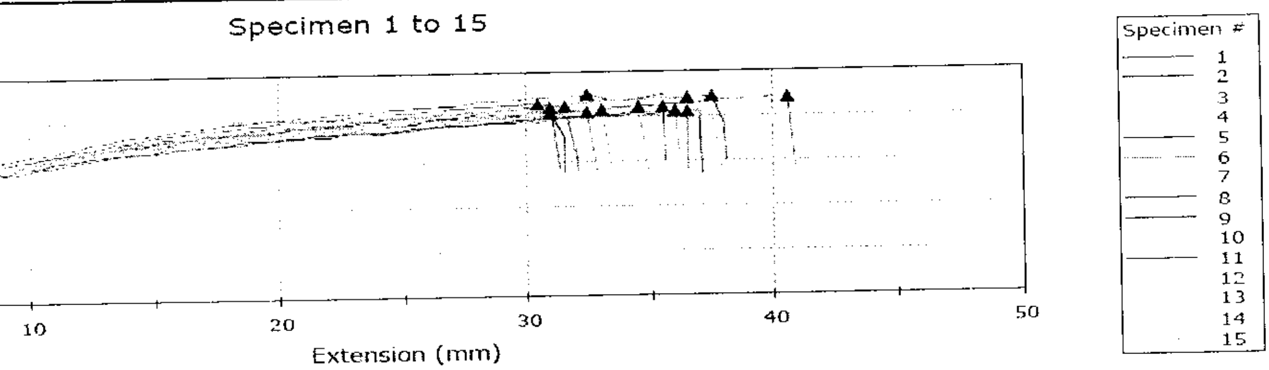
	Plasma Treated Raw Tasar
l	6.35
t (Tex)	250.
gth (mm)	300.
m/min)	



Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
153.56	24.50	24.18
158.61	27.00	24.98
179.81	32.50	28.32
161.81	29.00	25.48
163.27	31.00	25.71
159.08	27.50	25.05
178.23	37.00	28.07
158.21	25.50	24.91
155.31	25.50	24.46
164.26	30.00	25.87
179.81	37.00	28.32
153.56	24.50	24.18
163.22	28.95	25.70
8.96274	3.83297	1.41145
5.49137	13.23997	5.49137

Plasma Treated Raw Tasar - Instron Result (250 mm)

el	Plasma Treated Raw Tasar
nt (Tex)	6.35
ngth (mm)	300.
m/min)	300.



Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
173.96	32.50	27.40
171.85	37.50	27.06
158.53	33.00	24.97
161.04	34.50	25.36
155.89	31.00	24.55
170.58	40.50	26.86
156.28	36.00	24.61
155.36	36.50	24.47
155.59	36.00	24.50
170.94	36.50	26.92
173.96	40.50	27.40
155.36	31.00	24.47
163.00	35.40	25.67
7.82982	2.74672	1.23304
4.80351	7.75908	4.80351

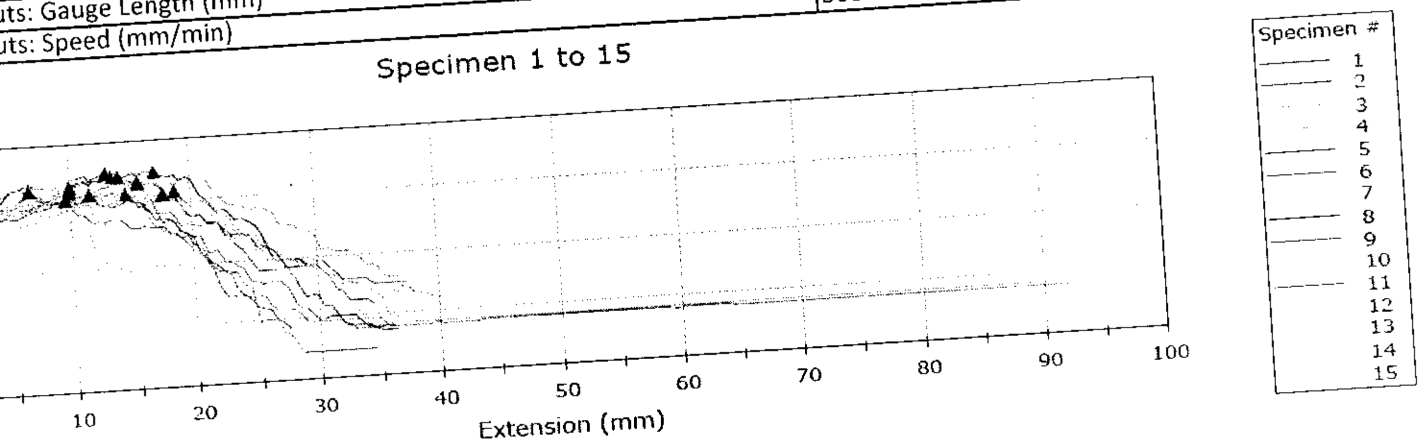
Plasma Treated Raw Tasar - Instron Result (300 mm)

Coimbatore - 641 049

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

Specimen label	Plasma treated Degummed Mul
ts: Yarn Count (Tex)	4.92
ts: Gauge Length (mm)	200.
ts: Speed (mm/min)	300.

Specimen 1 to 15



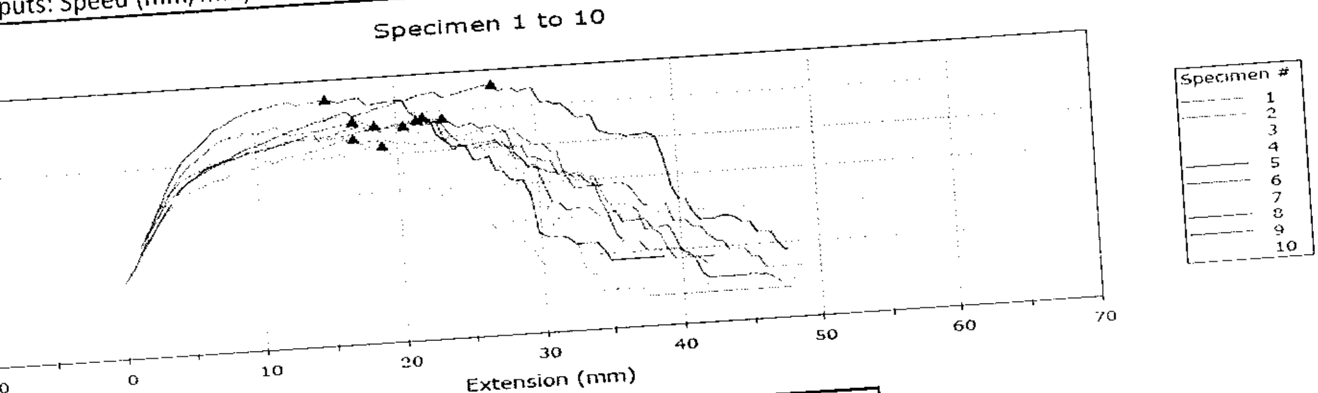
	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	72.50	13.50	14.74
2	64.22	6.50	13.05
3	55.95	17.50	11.37
4	60.61	3.50	12.32
5	74.94	13.00	15.23
6	58.27	11.50	11.84
7	72.51	14.00	14.74
8	74.19	17.00	15.08
9	61.55	10.00	12.51
10	64.84	15.50	13.18
ximum	74.94	17.50	15.23
nimum	55.95	3.50	11.37
Mean	65.96	12.20	13.41
andard eviation	7.03749	4.48578	1.43038
efficient ariation	10.66965	36.76869	10.66965

Plasma Treated Degummed Mulberry - Instron Result (200 mm)

Coimbatore - 641 049

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Plasma treated Degummed Mulberry
Specimen label	4.92
puts: Yarn Count (Tex)	250.
puts: Gauge Length (mm)	300.
puts: Speed (mm/min)	



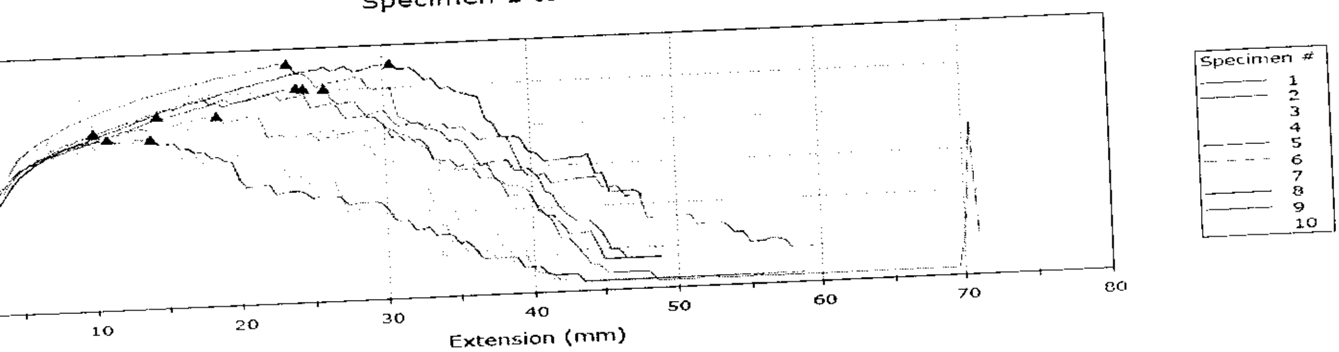
	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	76.86	21.50	15.62
2	76.88	23.50	15.63
3	74.00	20.50	15.04
4	63.76	19.00	12.96
5	92.42	27.00	18.78
6	68.31	17.00	13.88
7	77.12	22.00	15.67
8	90.10	15.00	18.31
9	77.40	17.00	15.73
10	74.64	18.50	15.17
Maximum	92.42	27.00	18.78
Minimum	63.76	15.00	12.96
Mean	77.15	20.10	15.68
Deviation	8.65869	3.55746	1.75990
Coefficient f Variation	11.22333	17.69883	11.22333

Plasma Treated Degummed Mulberry - Instron Result (250 mm)

TIFAC CORE in Textile Technology & Machinery, Kumaraguru College of Technology Coimbatore - 641 049

Specimen label	Plasma treated Degummed Mulberry
uts: Yarn Count (Tex)	4.92
uts: Gauge Length (mm)	300.
uts: Speed (mm/min)	300.

Specimen 1 to 10



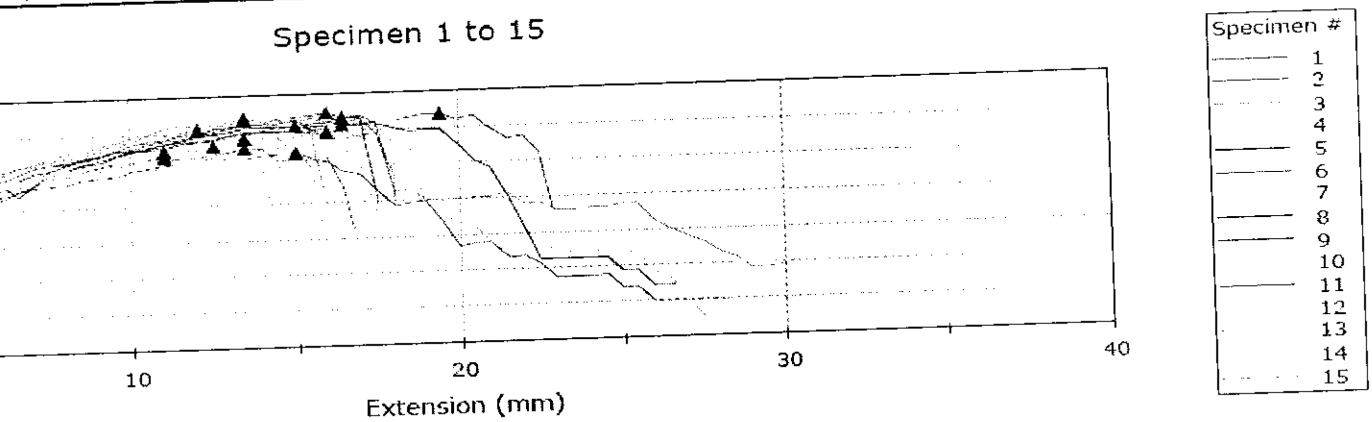
	Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
1	81.90	24.00	16.65
2	80.24	26.00	16.31
3	60.43	14.00	12.28
4	70.81	14.50	14.39
5	61.21	11.00	12.44
6	70.40	18.50	14.31
7	81.22	24.50	16.51
8	91.59	30.50	18.62
9	93.34	23.50	18.97
10	64.06	10.00	13.02
ximum	93.34	30.50	18.97
nimum	60.43	10.00	12.28
Mean	75.52	19.65	15.35
andard viation	11.94192	7.01605	2.42722
fficient riation	15.81292	35.70510	15.81292

Plasma Treated Degummed Mulberry - Instron Result (300 mm)

CORE in Textile Technology & Machinery, Kumaraguru College of Technology

Coimbatore - 641 049

	Plasma treated Redsilk
el	3.58
nt (Tex)	200.
ngth (mm)	300.
m/min)	



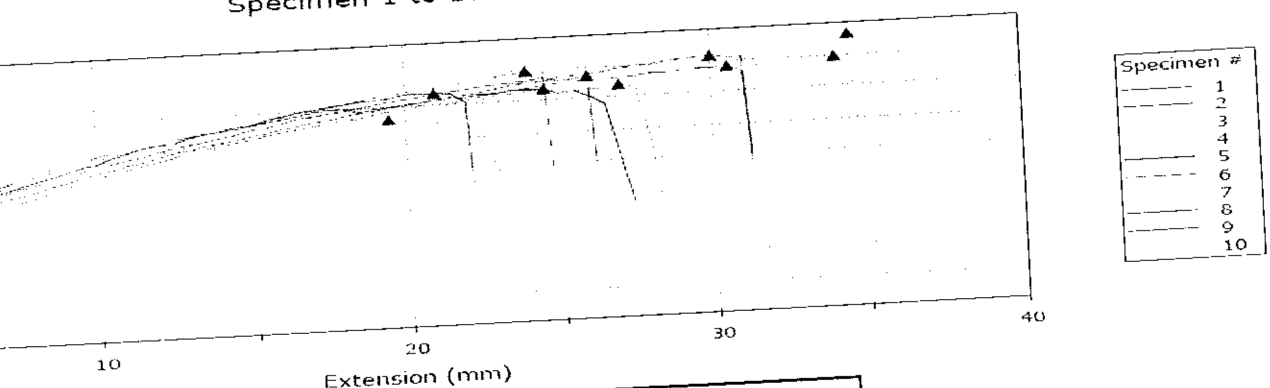
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
88.01	15.00	24.58
90.80	13.50	25.36
101.67	12.00	28.40
98.56	16.00	27.53
103.09	16.50	28.80
102.72	15.00	28.69
89.71	11.00	25.06
106.13	16.50	29.65
109.39	16.00	30.56
96.44	13.50	26.94
109.39	16.50	30.56
88.01	11.00	24.58
98.65	14.50	27.56
7.27511	1.92931	2.03215
7.37452	13.30556	7.37452

Coimbatore - 641 049

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Plasma treated Redsilk
l	3.58
t (Tex)	250.
gth (mm)	300.
n/min)	

Specimen 1 to 10



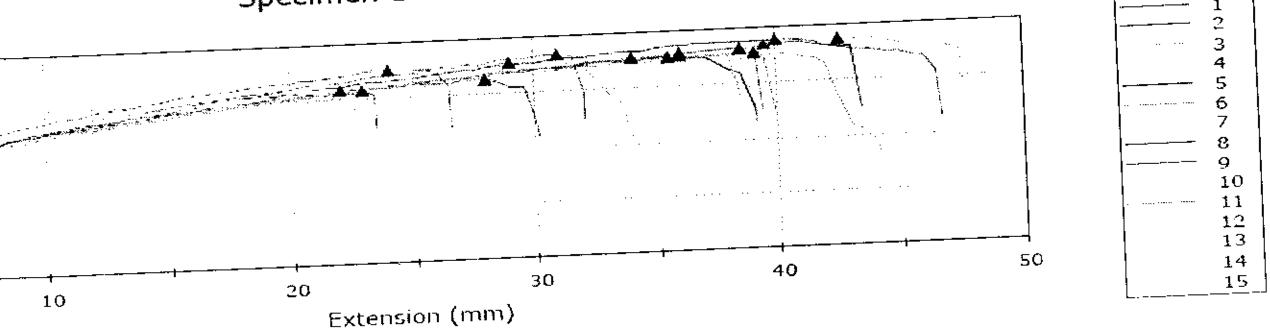
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
136.43	30.50	38.11
134.31	26.00	37.52
127.75	27.00	35.68
112.35	19.50	31.38
127.51	24.50	35.62
138.95	24.00	38.81
152.92	34.50	42.72
128.44	21.00	35.88
143.57	30.00	40.10
139.21	34.00	38.89
152.92	34.50	42.72
112.35	19.50	31.38
134.14	27.10	37.47
10.99399	5.10882	3.07095
8.19566	18.85172	8.19566

Coimbatore - 641 049

ORE in Textile Technology & Machinery, Kumaraguru College of Technology

	Plasma treated Redsilk
el	3.58
t (Tex)	300.
gth (mm)	300.
m/min)	

Specimen 1 to 15



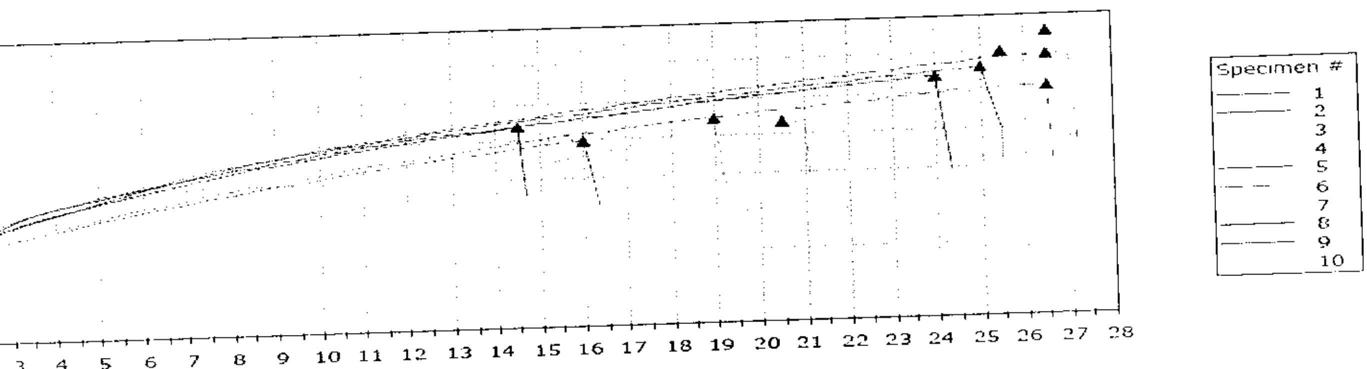
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
125.47	24.00	35.05
113.42	28.00	31.68
127.47	29.00	35.61
127.63	39.00	35.65
138.56	40.00	38.70
133.31	31.00	37.24
127.85	34.00	35.71
126.21	35.50	35.25
107.38	23.00	29.99
108.24	22.00	30.23
138.56	40.00	38.70
107.38	22.00	29.99
123.55	30.55	34.51
10.43660	6.49123	2.91525
8.44700	21.24790	8.44700

Plasma Treated Redsilk - Instron Result (300 mm)

C CORE in Textile Technology & Machinery, Kumaraguru College of Technology Coimbatore - 641 049

	Plasma treated silver wrapped redsilk
bel	12.18
unt (Tex)	200.
ength (mm)	300.
mm/min)	

Specimen 1 to 10

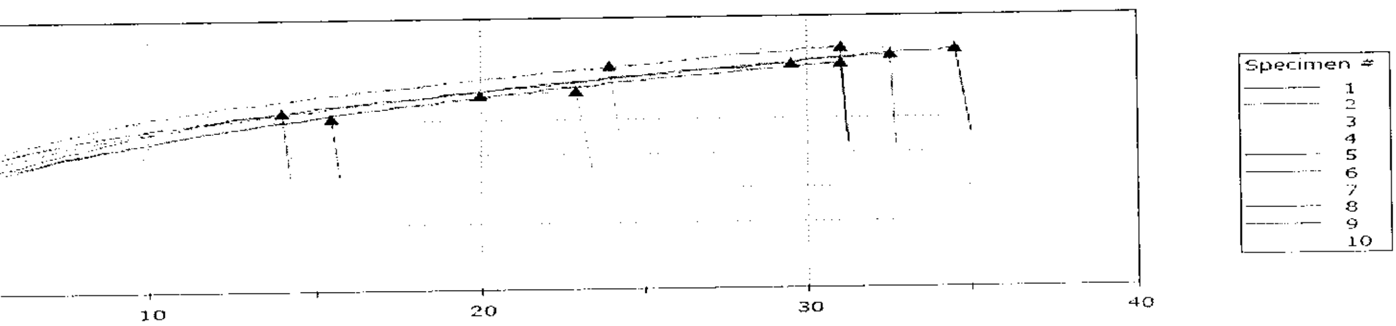


Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
119.68	26.50	9.83
112.87	25.00	9.27
87.44	20.50	7.18
89.73	19.00	7.37
108.88	24.00	8.94
102.85	26.50	8.44
120.84	25.50	9.92
87.70	14.50	7.20
79.69	16.00	6.54
131.76	26.50	10.82
131.76	26.50	10.82
79.69	14.50	6.54
104.14	22.40	8.55
17.44262	4.56922	1.43207
16.74856	20.39831	16.74856

C CORE in Textile Technology & Machinery, Kumaraguru College of Technology Coimbatore - 641 049

abel	Plasma treated silver wrapped redsilk
unt (Tex)	12.18
Length (mm)	250.
mm/min)	300.

Specimen 1 to 10

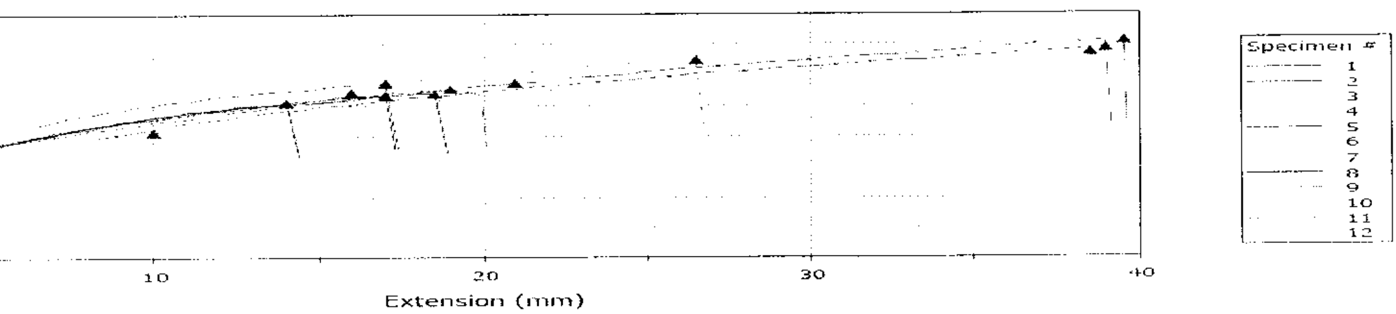


Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
82.19	15.50	6.75
85.43	14.00	7.01
97.31	23.00	7.99
111.36	24.00	9.14
112.53	31.00	9.24
116.85	32.50	9.59
112.24	29.00	9.22
119.80	34.50	9.84
121.91	31.00	10.01
94.60	20.00	7.77
121.91	34.50	10.01
82.19	14.00	6.75
105.42	25.45	8.66
14.39049	7.25507	1.18148
13.65036	28.50717	13.65036

C CORE in Textile Technology & Machinery, Kumaraguru College of Technology Coimbatore - 641 049

abel	Plasma treated silver wrapped redsilk
unt (Tex)	12.18
Length (mm)	300.
mm/min)	300.

Specimen 1 to 12



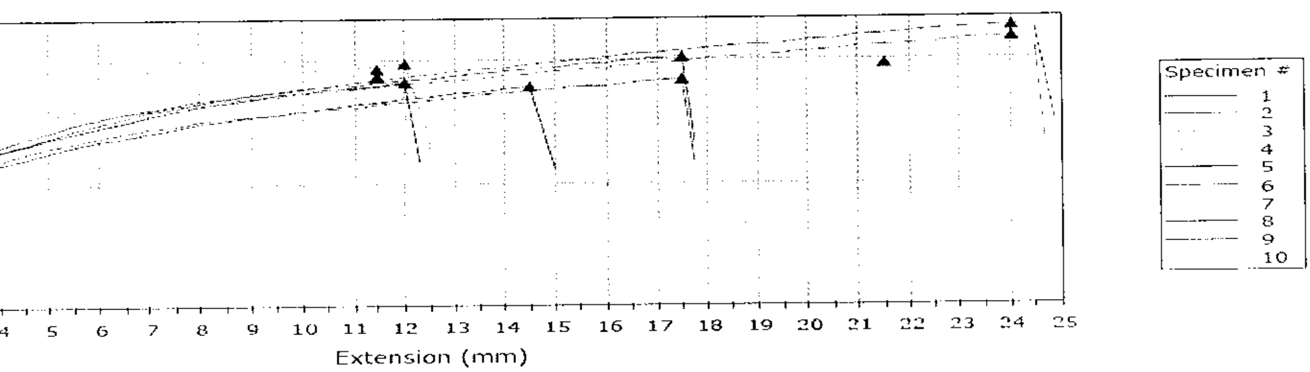
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
94.92	17.00	7.79
87.71	18.50	7.20
110.22	26.50	9.05
95.02	21.00	7.80
87.15	17.00	7.16
91.10	19.00	7.48
88.38	16.00	7.26
81.93	14.00	6.73
117.09	39.00	9.61
62.61	10.00	5.14
122.77	39.50	10.08
62.61	10.00	5.14
96.12	23.00	7.89
17.18929	10.40979	1.41127
17.88362	45.25994	17.88362

Plasma Treated silver wrapped redsilk - Instron Result (300 mm)

C CORE in Textile Technology & Machinery, Kumaraguru College of Technology Coimbatore - 641 049

bel	Plasma treated Zari
unt (Tex)	11.69
ength (mm)	200.
mm/min)	300.

Specimen 1 to 10



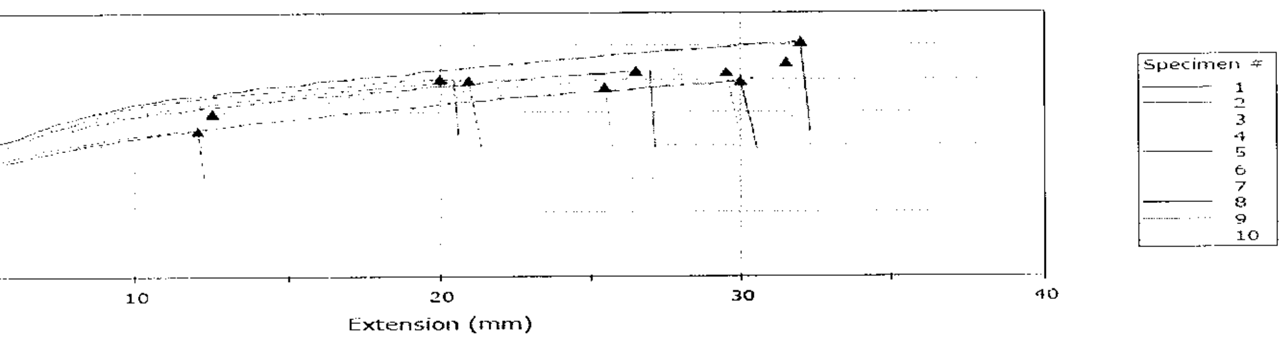
Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
116.24	24.00	9.94
101.46	17.50	8.68
98.79	12.00	8.45
91.92	11.50	7.86
86.96	14.50	7.44
110.33	24.00	9.44
97.73	21.50	8.36
88.95	12.00	7.61
90.81	17.50	7.77
95.84	11.50	8.20
116.24	24.00	9.94
86.96	11.50	7.44
97.90	16.60	8.37
9.39511	5.09793	0.80369
9.59635	30.71042	9.59635

Plasma Treated Zari - Instron Result (200 mm)

C CORE in Textile Technology & Machinery, Kumaraguru College of Technology Coimbatore - 641 049

bel	Plasma treated Zari
unt (Tex)	11.69
ength (mm)	250.
mm/min)	300.

Specimen 1 to 10

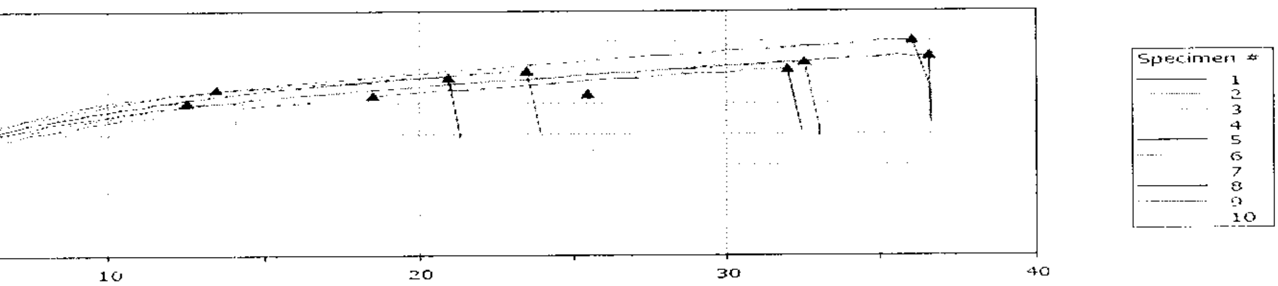


Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
99.93	20.00	8.55
104.66	26.50	8.95
104.31	29.50	8.92
94.80	25.50	8.11
98.85	30.00	8.46
99.32	21.00	8.50
79.24	12.50	6.78
122.18	32.00	10.45
69.00	12.00	5.90
110.11	31.50	9.42
122.18	32.00	10.45
69.00	12.00	5.90
98.24	24.05	8.40
14.99736	7.42537	1.28292
15.26604	30.87472	15.26604

CORE in Textile Technology & Machinery, Kumaraguru College of Technology Coimbatore - 641 049

bel	Plasma treated Zari
unt (Tex)	11.69
ength (mm)	300.
nm/min)	300.

Specimen 1 to 10



Maximum Load (gf)	Extension at Maximum Load (mm)	Tenacity at Maximum Load (gf/tex)
120.76	36.00	10.33
102.46	32.00	8.76
89.44	13.50	7.65
81.30	12.50	6.95
110.96	36.50	9.49
106.88	32.50	9.14
84.61	18.50	7.24
97.47	21.00	8.34
101.28	23.50	8.66
86.69	25.50	7.42
120.76	36.50	10.33
81.30	12.50	6.95
98.19	25.15	8.40
12.71392	8.86645	1.08759
12.94894	35.25426	12.94894

Plasma Treated Zari - Instron Result (300 mm)