QUALITY CONTROL MEASURES IN PREPARATORY WET PROCESSING

BY

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Introduction

I INTRODUCTION

The term quality control is commonly used to meet the assessment of the quality of a finished product, which is necessary to ensure that goods supplied match the buyer's satisfaction's. This involves testing a representative sample and deciding, on the basis of that sample, whether the whole is acceptable or not.

Quality control effect is a part of efficient management but to maintain the constant interest in this activity, it is essential that quality control effort is strengthened or complimented with the Research and Development effort in so far as introducing new products or processes as well as introducing new norms for the existing process after testing their efficiency in the research laboratory or pilot plant.

Quality in the textile trader might perhaps be defined as the degree of confirmity to a specification, the specification itself having been drawn with the object of providing an article which has suitability for an end-use.

Quality in subjective aspects conveys style, design, colour, fabric and material aesthetics, standards of make, finish, comfort where as-confirming to requirement, component specifications, performance, safety and fit, are the objective aspects of quality. All those are very

important parameters for quality product manufacturing in Textile Industry - Shah (1984).

The importance of quality control in textile industry or for that matter in many other industry cannot be minimised. In chemical reaction a standard product is to be obtained with maximum yield possible, there should be analytical control at each stage of the reaction inorder to ensure that the reaction is processing along with the right lines. So also should be the case in the processing of cloth from the grey to be the finished state. Unfortunately, however, there is not as much quality control done in the textile industry as one would desire to have, more things are achieved by the rule of the thumb.

Neither textile testing nor quality control alone can serve fully the textile technician, the mill, or the industry, but together they form a very strong team with dynamic possibilities, testing provides the background data, and quality control applies the result.

In textile finishing the quality of the pre-treatment is essential for the quality of the final product. Process/quality control starts right from the inspection of the grey fabric through various wet processing sequences such as Bleaching, Dyeing, Printing and finishing.

Quality control is aimed to provide assurance that the specified quality standards of final product manufactured and has its root in process control. Process controls are devised maintain quality standards at each constituent process and aim to reduce variations and damages in the final product.

Process control refers In-process Quality Control and is aimed to maintain consistently uniform quality of the material in process at various stages of its manufacture or processing. However today as we face the challenges for ISO-9000 we will surely realise that the need of the coming decades is "Quality for the massess". Hence the investigator has selected the topic to assess the impact of quality control measures in preparatory wet processing.

The objectives of the study are :

- to find out the difference in the qualities of the finished material with standard parameters and materials with those of slight variations.
- to compare the effect of dyeing on the finished (scoured and mercerised) materials of varied parameters and
- to ascertain that the quality control measures have great impact of the finished products.

Review of Literature

II REVIEW OF LITERATURE

The literature of the study was reviewed under the following headings.

A. Wet processing treatment

B. Preparatory treatments

   1. Levelness in pretreatment

   2. Errors in pretreatment

   3. Types of pretreatment

C. Dyes used for cotton fabrics

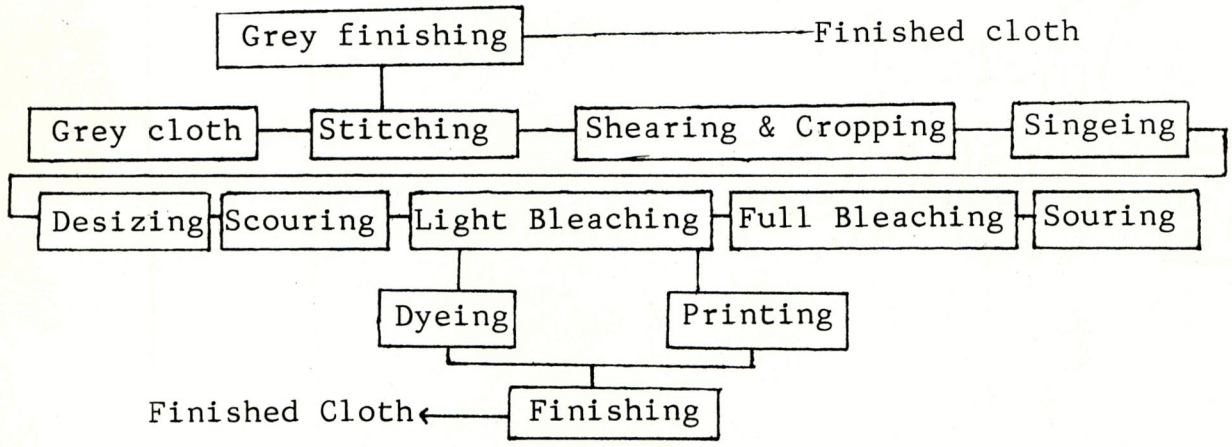
D. Dyeing methods used for cotton fabrics

E. Quality Control

F. Quality control in textile wet processing

A. Wet processing treatment

Modi and Garde (1975) illustrate the sequence of wet processing treatment as



Tantillo (1980) defines preparations of textile fabric encompasses the processes of desizing, scouring, bleaching and mercerisation.

Patwardhan (1981) defines chemical preparation as a procedure mainly concern with the removal of contaminants or impurities interfering in subsequent processing of dyeing, printing and finishing.

Dixit (1981) feels that textiles wet processing is in many aspects similar to Chemical Engineering in as much as a textile wetprocessing sequence is characterised by a number of unit operations following each other in series, to ultimately yield the bleached fabric.

According to Dixit (1982) whatever sequence is adopted for pretreatments, it is important that each treatment stage is carried out satisfactorily in as much as the success of the next treatment depends to a large extent on the satisfactory completion of the previous process.

Betrabet et al (1985) explain the wet processing is a comprehensive term covering those processes which convert grey goods, i.e., cloth coming off the loom, into finished cloth, ready for marketing. Further they add that a textile wet processing sequence is characterised by a number of unit operations or stages of processing such as desizing, scouring, bleaching, washing etc.

Juby (1985) recommends that one-step fabric preparation has several advantages, reduction in investment, better tensile strength, ease of operation, even application of chemicals, reduced energy requirements, reduced use of water and reduced waste stream.

B. Preparatory treatments

1. Levelness in pretreatment

The object of pretreatment is to convert loom stage cotton to a cellulosic fibre fabric with uniform dyeing behaviour says Gebret (1978). Further he lists out that levelness in pretreatment as ;

- Uniform extraction of whiteness
- Level degree of whiteness
- Level degree of swelling
- Level residual humidity

2. Errors in pretreatment

Gebret (1978) refers that errors in pretreatment of cotton piece-goods caused by

- unknown origin of the fabric to be treated
- errorneous concept of procedure
- faulty operations of machines
- faulty feeding of chemicals
- haphazard work

3. Types of Pretreatment

Dixit (1982) classifies pretreatments as Dry pretreatment and wet pretreatments. Dry treatment includes mending, Stain removing, shearing, singeing and wet treatments include desizing, scouring, bleaching, souring and mercerising.

a. Dry Pretreatments

Modi and Garde (1975) agree that the shearing machine is used to remove big loose ends, shuttle ends and some protruding hairs.

Mending and stain removing are generally overloaded. They are usually given a cursoy treatment or no treatment at all most stains should be removed by local spotting with an efficient stain remover says Dixit (1982). He also agrees that shearing is carried out to remove loose threads.

Betrabet et al (1985) opine that the yarn/fabric is to remove the short fibres from the cloth when it is received from the loom.

b. Wet Pretreatments

i. Desizing

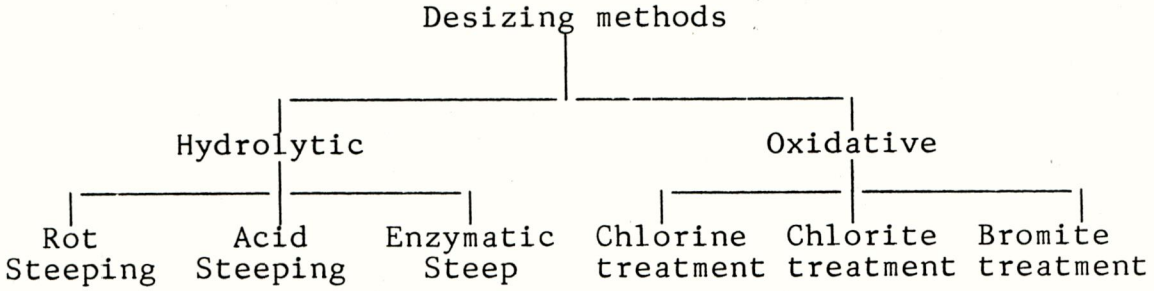
Vaidya and Trivedi (1975) say that the process of removing size from the cloth is termed as desizing.

Desai (1981) states that the purpose of desizing is to remove starch and other fillings used in sizing for imparting strength to the fibres during weaving.

Dixit (1982) strongly stresses that a preliminary check of the size content on the fabric to be desized will help in maintaining uniform desizing conditions and avoid the incidence of differential desizing due to varying size content.

Dixit (1982) explains that the purpose of desizing is to remove the sizing material deposited on the yarn prior to the weaving operation which having served their purpose, are no longer required. Mittal and Trivedi (1983) declare that the native of desizing process depends upon the nature of the sizing materials to be removed.

Betrabel et al (1985) classify the desizing methods as :



Vaidya and Trivedi (1975) declare that the enzymes convert starch in to soluble products which are removed by washing with water. Bacterial enzymes, malt enzymes and pancreatic enzymes are employed for desizing.

Desizing with alkaline hydrogen peroxide is an advantageous process for starches, modified starches, carboxymethyl cellulose and polyvinyl alcohol (Textile dyer and printer). The same fact was stated by Dickinson and Thompson (1980).

Mehra (1981) recommends that desizing can be done by using acids, alkalines, enzymes, hypoclorite and sodium bromite. The same fact was stated by Vaidya and Trivedi(1975).

Dickinson et al (1983) state that peroxygen chemicals have the potential to improve the removal of sizes in all conventional preparation processes desizing, scouring and bleaching. This allows the finisher to eliminate one or more process stages, thereby producing significant energy savings with minimal capital outlay.

Mittal and Trivedi (1983) view that the usual method of desizing is to pad the material with 0.5 - 1 percent enzyme plus an equal amount of salt and 0.1 percent of a suitable wetting agent call conditions based on total bath at 60 to 70 ^{o}C. Addition of 50 ml/1 of hydrocarbon solvent and 4 g/1 of a suitable emulsifier to the desizing bath will assist in the removal of waxes used in sizing. The material is stored for 4-8 hours. This is then followed by hot and cold washes. Further they list out that the enzymatic desizing is carried out by the following methods.

* Pad - batch on rolls, dwelling for 8-12 hours and wash
* Pad - Steam for minute or two and wash; enzymes stable to high temperatures should be used.
* Run six ends on Jig and then wash.
* Desizing in a kier prior to boil off.

Bille (1987) reports that shortened pretreatment could be achieved by dispensing with enzymatic desizing.

As stated by Dixit (1982) all grey fabrics are water repellent, not only due to the natural waxes present in the cellulose but also due to the softeners added to the size mist. This aspect makes uniform wetting of the fabric by the desizing liquor difficult. The use of suitable wetting agents preferably of the nonionic type is essential, certain selected anionic wetting agents can also be used equally satisfactorily and there are either of the type of

soap or the sodium or ammonium salts of sulphated or sulphonated unsaturated fatty acids or alcohols. Even after using a wetting agent, the pickup of the desizing liquor by the fabric will rarely exceed 50 - 60%.

A modern development in desizing area is a continuous enzyme desize achieved by padding in enzyme and steaming for very short times, for example 15 to 30 seconds at 105 ^{o}C (Colourage 1979).

Dixit (1981) lists out enzyme activity is most manifest at the following conditions : (for most enzymatic preparation).

pH	:	5.5 - 7.5
Temperature	:	45 ^{o}C - 65 ^{o}C
Concentration	:	2 - 10 grams per litre
Time	:	2 - 12 Hours

Saraiya (1981) contributes that the process control includes measurement of concentration of enzymes, wetpickup, pH and temperature.

According to Dixit (1982) the conditions of desizing will ultimately decide the efficiency of the process in terms of starch liquefaction and removal.

ii. Scouring

Vaidya and Trivedi (1975) state that after desizing, cotton materials are subjected to a process known as scouring. The impurities are removed by scouring in which the material is treatment with alkali.

Modi and Garde (1975) pointout that this operation is meant to remove the natural and added impurities such as waxes, nitrogenous matter. Seed husks, leaves and softeners. The same was stated by Vadiya and Trivedi (1983).

Mehra (1981) feels that after desizing cotton materials is subjected to a process known as scouring caustic soda is mainly used to remove fats and waxes.

According to Dixit (1982) the purpose of scouring textile materials is to remove the natural and other impurities associated with the cotton fibre, further he specifies that the chemical most commonly used for the scouring of cotton textiles, is caustic soda in combination with other supporting alkaline substances like soda ash, sodium silicate and trisodium phosphate.

Betrabert et al (1985) opine that the chief aim of scouring textile materials is to remove the natural and added impurities, thus rendering the materials cleaner and more absorbent.

Modi and Garde (1975) classify kiers as vertical and horizontal. In horizontal kiers, the cloth is scoured in open width. There are two types of scouring operations. Pressure boil and open boil, pressure boil is given to completely white fabrics where as open boil is meant for fabrics having dyed yarns.

Carbman (1985) explains that the method of first boiling off the goods is kiers, which are large steel vessels that hold about 5 tons of cloth. The goods are boiled for 12 hours under pressure in a 3 per cent solution of caustic soda plus soap and sodium silicate. Then they are washed with cold water, pulled out of the kier washed again, "Soured" by passing them through a weak solution of sulphuric acid to neutralise the alkali.

Dixit (1982) describes that the J-Box machine is in essence of J shaped rectangular - crosssectional vessel with both the ends open. It is classical (example) of how the relationship between time, temperature and concentration of the chemical has been used to short durations of reaction timings. Thus, while in a kier, dilute concentrations, longer times and higher temperature are required in the case of the J-Box system, one comes across higher concentrations, lower time of reaction and lower temperatures than in the case of the kier system.

As stated by Dixit (1981) normally as practiced in the industry, a complete kier cycle requires 18-24 hours of completion as seen in the following :-

Loading the material	: 2 - 3 hours
Reaching the required pressure	: 3 - 4 hours
Kiering at pressure	: 8 - 10 hours
Washing in the kier	: 3 - 4 hours
Unloading the materials	: 2 - 3 hours
Total :	18 - 24 hours

Saraiya (1981) Lists out the process control measures adopted are ;

Concentration of caustic, Steam pressure, Wet-pickup - padding, Nip - Pressure - padding and Temperature.

Residual alkalinity at the time of drain should not be less than 10% of the starting bath to maintain impurities in the suspended form.

Doshi and Shan (1984) recommend that the optimisation of steam pressure and time of boiling are very important process controls in scouring. Caustic alkalinity at the time of drain should not be less than 10% of the starting concentration in order to maintain the impurities in the suspended form. For this purpose, a periodic check of

alkalinity in the kiering solution is desirable during the course of scouring operation.

iii. Souring

Modi and Goude (1975) explain that souring is carried out on an ordinary washing machine. The concentration is added to the trough of the washing machine. The concentration of the acid can be estimated by titrating with standard caustic soda. Acid should not be allowed to dry on the fabric, other wise the fabric will be degraded. After souring the fabric is thoroughly washed with water.

The fabric after bleaching contains metallic salts such as calcium carbonate, magnesium carbonate etc., and mineral matters. The salts, if deposited on the fabric, will not only give a harsh feel but will also affect the uniformity of the shade during dyeing. In order to make these salts soluble in water, the fabric is treated with either dilute hydrochloric acid or sulphuric acid. Hydrochloric acid is used for fabrics meant for dyeing where as sulphuric acid, being cheap, is used for fabrics meant for white finish. Hydrochloric acid is better than shulphuric acid. The concentration used is about 0.5 to 1.0% on the weight of the fabric.

According to Dixit (1982) the process of souring is very important in any wet processing preparatory

treatments. It is generally carried out using dilute solutions of mineral acids, like sulphuric acid and hydrochloric acid.

Doshi and Shah (1984) state this operation is considered to be very useful from many considerations especially for goods meant for dyeing. Similarly, in souring were to precede peroxide bleaching it helps in reducing the problems of metallic contamination, which would otherwise cause localised tendering in peroxide bleaching due to catalytic degradation at such places.

Saraiya (1981) lists out that the desired process control measures during souring are chiefly concentration of the acid in the souring bath, temperature of the souring bath.

Doshi and Shah (1984) contributes the process control measures, as concentration of acid, temperature of souring bath and residual acidity/alkalinity (if neutralised) after washing-off prior to drying.

iv. Bleaching

Parikh (1976) refers that bleaching is a important process sequence for textiles, and comprises of several operations such as desizing, scouring and removal of colouring impurities from the fabrics. Further he adds a

good bleach is always essential for the successful production of properly dyed, printed and finished fabrics.

Mehra (1981) opines that the object of bleaching is to remove the natural colouring matter from textile material. The same fact is stated by Vaidya and Trivedi (1975).

Dixit (1982) states that bleaching operation aims at the removal by destruction of the residual colouring impurities present in the fabric. Normally most of the colouring impurities present in the fabric have been removed by efficient scouring, however for an acceptable white, it is necessary to remove the fraces of colouring matter.

Textile bleaching refers to the entire sequence of purification processes used for making grey goods white and absorbent, reducing the impurities to a minimum say Betrabet et al (1985).

Modi and Garde (1975) state that the types of oxidising agents used are sodium chlorite. The same is stated by Vaidya and Trivedi (1975).

Parikh (1976) lists out four processes developed by Bombay Textile Research Association Single-Stage bleaching in pressure kier for cotton textiles.

Single-stage bleaching of polyester/cotton blend in batchwise operation in jig.

Single-stage bleaching of polyester/cotton blends on the pad-roll system.

Rapid bleach for continuous bleaching of cotton textiles.

Patil and Paharia (1981) declare that the following methods are in general are.

Chlorine bleaching (Sodium Hypochlorite), Chlorite bleaching and Peroxide bleaching.

According to Dixit (1982) the widely used bleaches are sodium hypochlorite and hydrogen peroxide.

Dixit (1982) explains that the bleaching solutions of hydrogen peroxide, however, necessitate the addition of alkali for the controlled decomposition of hydrogen peroxide, the most preferred alkali is sodium silicate (water glass) with a ratio of Na_2O : SIO_2 as 1 : 1 the bleaching action states at about $50^{o}C$ and is more or less complete at about $85^{o}C$. At about $100^{o}C$ only about 10% of the original hydrogen peroxide remains.

According to Patil and Paharia (1981) peroxide bleach is a tolerable priced bleach.

Saraiya (1981) refers that bleaching is carried out either by hypochlorite or hydrogen peroxide, the process control for both are as concentration of available chlorine, g/l, Alkalinity of the bath, pH of the bath, Time of reaction and Residual Cl_2 in the spendlye.

Further he says that the ration of Na_2O to SIO_2 is a very important process control measure and should be maintained 1 : 1 by adjusting alkalinity by addition of soda ash. Sodium metasilicate is better than sodium silicate because ratio of Na_2O : SIO_2 in this product is always 1:1.

Ratio of Na_2O : SIO_2,
Alkalinity, Time of Bleaching, Residual peroxide at the time of drain, Pickup % in J-Box Saturator or pad steam bath, Reaction time in steamer and Percent peroxide in the fabric.

The same fact is stated by Dixit (1981). The actual mechanism by which bleaching occurs is not fully understood but it is generally agreed that the first stage is an ionisation to form perhydroxyl ions (HOO^-)

$$H_2O_2 - HOO^- + H^+$$

The formation of the active perhydroxyl ions is favoured by alkaline conditions and so most hydrogen peroxide bleaching is carried out under these conditions (Colourage 1981).

v. Mercerising

Majory (1980) defines mercerising as a chemical process applied to cellulose fibres, especially cotton, and to blends including cotton. Mercerisation is a finish that contributes lustre to cotton fibres and increases the case with which cotton accepts color and adds strength.

Sitver (1980) summarizes, mercerizing today is carried on for the following purposes improved stabilization, improved tensile strength, luster and Smoothness of fabric.

Tantillo (1985) lists out that the fabric or yarn with alkali which causes, a decrease in the area of the cloth. Increase in tensile strength, Increase in absorption of water stabilized fabric width and Increased dye reaction at lower temperature.

Mehra (1981) States that mercerisation of cotton materials is carried out to improve its, strength, lustre and dye absorption. The same is stated by Vaidya and Trivedi (1978).

Mehra (1981) opines that the process of mercerisation, cotton goods are treated with 52 - 54 ^{o} Tw sodium hydroxide, stretched and washed. A good wetting agent which will be able to with stand the mercerising strength of caustic soda is employed.

Dixit (1982) views that the chief aims of mercerising as, Industrial mercerising is carried out mainly with the view of obtaining for the cotton material, Increased tensile strength, Increased lustre and increased capacity of dye absorption.

Mercerising by definition is understood to refer to the treatment of cotton with strong, cold caustic soda solution of 28-30 ^{o} Be/48.5 - 52.5 ^{o} Tw under tension (colour chronicle 1982).

Procedure for observing the kinetics of the swelling process during the mercerisation of cotton in hydroxide are described. The effect of mercerisation on dye uptake and fabric lustre is studied during mercerisation says Bechter et al (1985).

Conditions of mercerisation :

Process control measures recommended for mercerising are stated by Saraiya (1981) caustic lye concentration in Mercerising bath caustic concentration of wash liquors, Wet pick - up %, Time of contact, Temperature of the caustic lye, Speed of the mercerising machine, width measurements of the fabric before and after mercerising and Residual alkali concentration on the fabric.

C. Dyes used for cotton fabrics :

Birrell (1959) defines dyes as a class of substances known as colloidal electrolytes, their conductivity depending upon the mobility of the ions present.

Kosti (1975) defines dyes as " a substance which is applied to the fibre either by dispersion or by dissolution". A dye may or may not soluble in water.

Modi and Crade (1975) state the dyes used for cotton fabrics are azoic, sulphur, vat, Reactive, solublised vat dyes, direct dyes, phthalocyanine dyes and pigment dyes.

Mehra (1981) lists out that the dyes used for cotton fabrics are reactive, vat, direct, azoic and sulphur dyes. The same is stated by Vaidya and Trivedi (1975).

D. Dyeing Methods used for cotton fabrics.

Gohl and Vilensky (1985) defines dyeing is the process of colouring textile materials by immersing them in an aqueous solution of dye called dye liquor.

Kosti (1975) views that the latest development in the dyeing of cellulosic fibre is the use of reactive dyes. These dyes, unlike any other class, react and combine chemically with cellulose and there by give good fasteners properties. They also give very bright shade such as orange, pink, magenta, turquoise, etc., which were not possible with other dyes. Because of their case of application, bright

tones and comparatively low cost, reactive dyes are become very popular.

Kulkarni et al (1986) refers that dyeing is permanently colouring fabric by transfering dye molecules into fibre. The key factors which effect the exhaustion rate are as follows (UPI, 1981) Inherent substantivity of the dye stuff. Liquor ratio, Dye bath temperature, Salt concentration, Inherent leveling properties of the dye stuff, Inherent chemical reactivity of the dye stuff and pH of the dye bath.

Saraiya (1981) lists out the process control measures of dyeing as concentration of chemicals such as concentration of caustic soda and hydrosulphite in vat dyeing. Temperature measurements, Material to liquor ratio, Total time of dyeing and number of turns during each sequence, pH of the dye liquor, How rate measurements, Time of reversal of cycle in package dyeing speed of machine, Nip pressure - pad Jig, Wet pick-up, Temperature of Intermediate dyeing, Concentration of chemicals in the developing bath-pad steam and Time of steaming.

E. Quality control

Quality control denotes the use of charted results, obtained from routine samples taken during the manufacture of a product, to secure the control of the

process, in order to maintain a desired quality in the product-British standard institution (1947).

Quality control is the continuous testing and inspection of textile mill operations to make certain that all yarns and fabrics measure up to quality standards previously set - Encyclopedia of Textiles (1972).

Juran (1974) defines quality control as the regulatory process through which we measure actual quality performance, compare it with standards, and act on the difference.

According to Ishida (1977) quality control is one of the production controls used in Industry.

Shrock (1979) states that modern quality control is the combination of all the devices and techniques that are used to found in many definitions, used to control product quality at the most economical costs which yield adequate customer satisfaction.

According to Dudeja (1981), the term quality means that the product is good for the intended usage. A quality textile product is the result of a well planned quality control programme which assures the cost and quality of a yarn or fabric.

Quality control in textile industry is as old as the industry itself. Right from selection of raw cotton, to final quality inspection of finished goods, the textile material undergoes various controls - Gupte (1984).

According to Gopalakrishnan (1986) quality control is the regulatory process to measure quality against stipulated standards.

F. Quality control in textile wet processing.

In textile finishing, the quality of the pretreatment is essential for the quality of the final product says Gebret (1978).

Narsian (1978) states that the quality control functions as Testing at predetermined stages and supplying test results quickly to the department clearly defined standards of quality sufficient inspection for quality standards. This involves inspection of random samples at important stages of production and preferable involving the producer and consumer section for this inspection.

Pandit (1991) edits the benefits arising from quality as;

- Increased ability to quickly respond to market - demand
- Improved on time delivery performance
- Reduced stock level requirements

- Planning and production becomes scheduling vs capacity
- A straight forward cost saving benefit of around 20% being the prize.

Mahesh and Sharma (1981) state that quality control is aimed to provide assurance about the specified quality standards of final product manufactured and has its root in process control.

Doshi and Shah (1984) illustrate the quality control measures for bleached, mercerised and dyed materials as follows :

Quality control measures for Bleached and Mercerised materials.

Desized	Scoured	Bleached	Soured	Mercerised
* Size removal	* Scouring loss		* Ash content	* Barium - activity number
* Fluidity	* Fats & wax content	* Whiteness and its retention	* Fluidity	* Lustre (%)
	* Absorbancy	* Fluidity	* Fabric strength	* Width shrinkage
	* Fluidity	* Fabric strength		* Residual alkalinity
				* Fabric strength

Quality control measures for dyed materials

Uniformity of dyeing	Levelness and Penetration of dyeing	Fastness to various agencies
		* Washing
		* Light
		* Dry and Wet rubbing
		* Perspiration
		* Bleaching :
		a. Hypochlorite
		b. Peroxide

Experimental Procedure

III EXPERIMENTAL PROCEDURE

The experimental procedure constitutes the following aspects :

A. Selection of the material

B. Selection of the Preparatory Process Sequence

C. Nomenclature of the samples

D. Conduction of experiment

E. Evaluation of the processed samples

1. Laboratory tests
    a. Desizing efficiency
    b. Absorbancy
    c. Whiteness
    d. Barium activity number
    e. Fabric strength
        i. Tear strength
        ii. Bursting strength
    f. Colour fastness tests
        i. Colour fastness to washing
        ii. Colour fastness to sunlight

A. Selection of the material

Bille (1987) states that cotton fibres contains natural and added impurities such as sizes and spinning assistants and to remove these impurities it has to under go

all the chemical pretreatments. Hence to assess the impact of quality control measures in preparatory wet processing, cotton material was selected for the study. The selected cotton materials were of 20's count (12 metres) and 40's count (12 metres).

B. Selection of the preparatory process sequence

The normal sequence of the preparatory process is

Desizing

|

Scouring

|

Souring

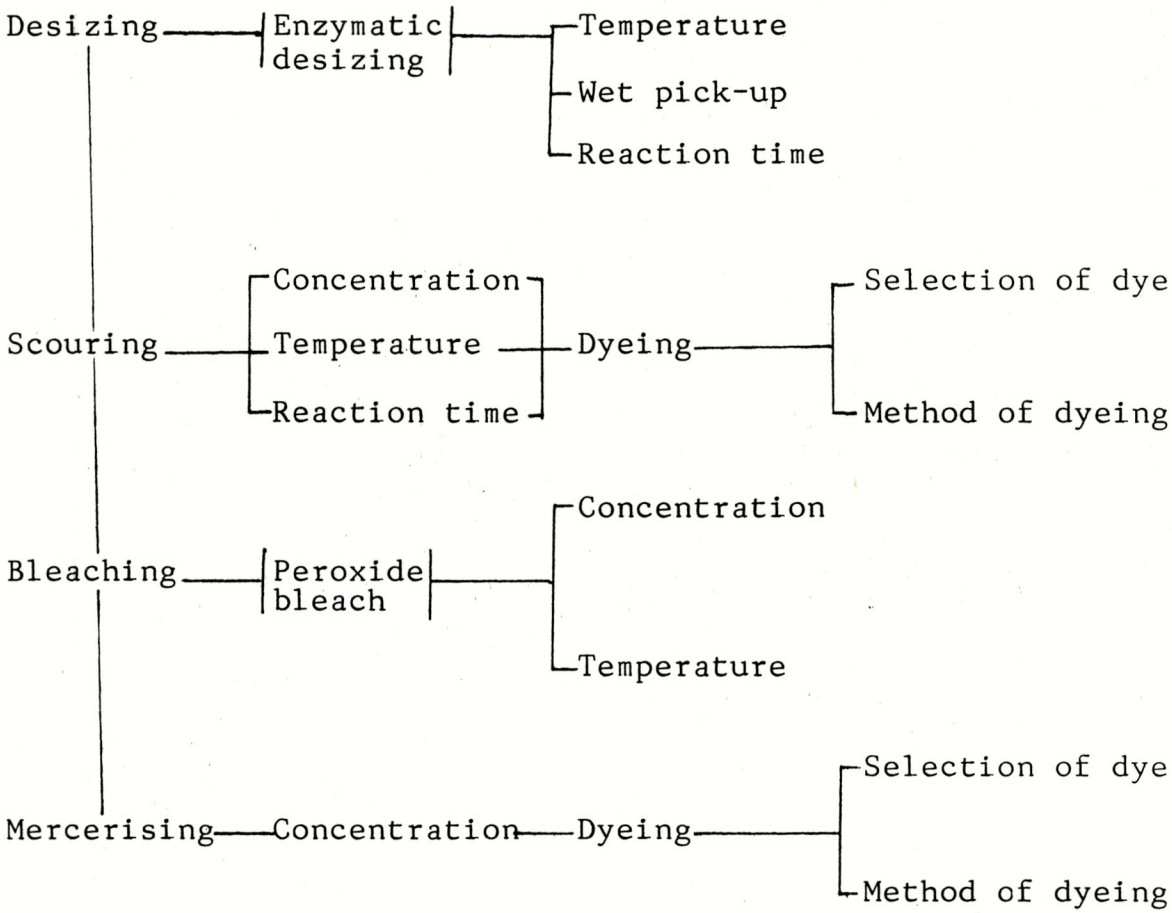
|

Bleaching

|

Mercerising

It is not possible to do souring at laboratory level, hence the following preparatory process sequence with varying parameters were selected for the study.



C. Nomenclature of the samples

The following letters indicate the count, preparatory treatments and variations.

X	- 40's count	te	- temperature
Y	- 20's count	w	- wet pickup
D	- Desizing	t	- Reaction time
S	- Scouring	c	- Concentration
B	- Bleaching	1	- below variations
M	- Mercerising	2	- above variations

The following tables indicate the name of the samples and the variations followed in the wet processing treatments.

Desizing :

Name of the samples	Temperature in centigrade	Wetpickup in percentage	Reaction time in hours
Normal XD, YD	60°	100	8
$XDte_1$, $YDte_1$	Room Temperature	100	8
$XDte_2$, $YDte_2$	100°	100	8
XDW_1 , YDW_1	60°	50	8
XDW_2 , YDW_2	60°	150	8
XDt_1 , YDt_1	60°	100	2
XDt_2 , YDt_2	60°	100	16

Scouring :

Name of the samples	Concentration in percentage	Temperature in Centigrade	Time in minutes
Normal			
XS, YS	4	Boiling	60
XSC_1 , YSC_1	1	Boiling	60
XSC_2 , YSC_2	8	Boiling	60
$XSte_1$, $YSte_1$	4	50°	60
XSt_1 , YST_1	4	Boiling	30
XSt_2 , YSt_2	4	Boiling	120

Bleaching :

Name of the Samples	Concentration in grams per litre	Temperature in centigrade
Normal		
XB, YB	20	Boiling
XBC_1 , YBC_1	10	Boiling
XBC_2 , YBC_2	30	Boiling
$XBte_1$, $YBte_1$	20	50°

Mercerising :

Name of the samples	Concentration in Tw
Normal	
XM, YM	50°
XMC_1, YMC_1	30°
XMC_2, YMC_2	80°

D. Conduction of Experiment

1. Desizing

Enzymatic desizing process was selected for the study. Seven samples (25 cm x 1.25 m) from each of the selected cotton materials (x and y) were cut and seven sets of samples were prepared by stitching one x and one y together and weighed separately. Among the seven sets one set was desized by following the normal conditions and the remaining sets were desized by varying the parameters.

The desizing of the samples under normal condition is as follows. According to the weight of the sample the desizing solution was prepared - Appendix II and poured in to the padding mangle. The temperature was maintained at 60 ^{o}C and the samples were padded (1 dip and 1 nip) in the padding mangle and packed in polythene sheets until 8 hours

completed. The samples were taken out and given thorough hot and cold washing and allowed for natural drying.

The same procedure was followed for desizing the remaining six sets of samples; two sets by varying the temperature (Room temperature and 100 ^{o}C), third and fourth sets by varying the wet pickup (50% and 150%) and the fifth and sixth sets by varying the reaction time (2 hours and 16 hours).

The remaining 20 metres of (X - 10 metres and Y - 10 metres) materials was bulk desized - Appendix II under normal condition, to be used for the further processing.

2. Scouring

From the above desized materials (X and Y) twelve samples of 12 inches width and 1.5 metres length in both warp and weft directions were cut and stitched separately. The stitched samples were weighed independently and the scouring solution was prepared according to the weight of the material - Appendix III (A).

The scouring of the samples under normal conditions is as follows. The weighed sample (XS) was loaded in the hand jigger plate - I and wetted with cold water. The scouring solution (4%) was poured in the trough and the sample was run in the jigger for 60 minutes, under boiling

temperature after which a thorough hot and cold washing was given. Then the sample was neutralised with acetic acid, washed thoroughly and allowed for natural drying. The same procedure was followed for sample YS.

The remaining ten samples were scoured by varying the parameters; Four samples by varying the concentration (two samples in 1% and two samples in 8%) two samples by varying the temperature (50 C) and four samples by varying the reaction time (two samples in 30 minutes and two samples in 120 minutes), using the above scouring procedure.

a. Dyeing

One portion of the scoured warp and weft samples were dyed following the given prodcedure.

i. Selection of dye

According to Kosti (1975) that the latest development in the dyeing of cellulosic fibre is the use of reactive dyes. So reactive dye was selected for the study. Remzol brilliant red 5B was selected for both the samples of x and y.

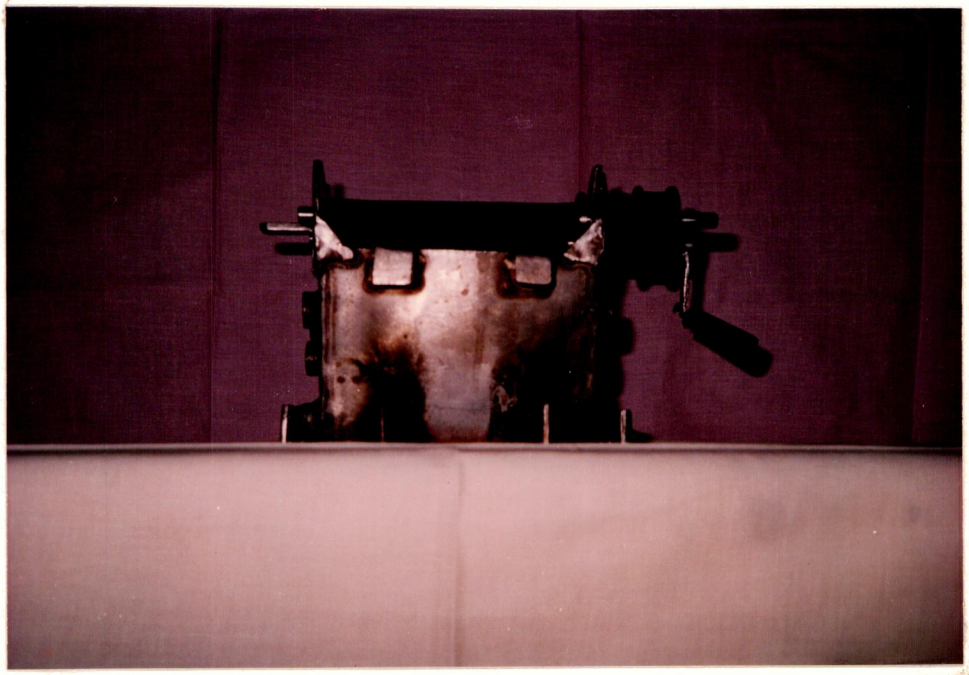


PLATE I

HAND JIGGER MACHINE

ii. Method of dyeing

The portion of warp and weft samples were taken (X and Y) stitched together and weighed independently (X and Y). Depending on the weight the dye solution was prepared - Appendix III (B).

Silicate padding was selected for the study. The prepared dye solution was poured in the padding mangle and the scoured samples of X were padded (2 dip and 2 nip), taken out and packed airtight in polythene sheets until 17 hours was completed. The samples were washed and neutralised with acetic acid, soaping was given and thorough washing was followed. The samples were allowed for natural drying and ironed. The same procedure was followed for the samples of Y.

The remaining materials (X = 6 metres and Y = 6 metres) was bulk scoured under normal conditions - Appendix III (A) for further processes.

3. Bleaching

In the industries hydrogen peroxide bleach was used for bleaching all the cellulosic fabrics. So hydrogen peroxide bleach was selected for the study.

From the above scoured materials (X and Y) 8 samples of 12 inches width and 1.5 metre length in both warp

and weft direction were cut and stitched separately. The stitched samples were weighed independently and the bleaching solution was prepared according to the weight of the material - Appendix IV.

The bleaching of the samples under normal conditions is as follows. The weighed sample (XB) was loaded in the hand jigger plate - I. The bleaching solution (20 gpl) was poured in the trough and the sample was run in the Jigger for 60 minutes under boiling temperature, after which a thorough hot and cold washing was given till the sample was neutralised. The same procedure was followed for sample YB.

The remaining six samples were bleached by varying the parameters. Four samples by varying the concentration (two samples in 10 gpl and two samples in 30 gpl), two samples by varying the temperature (50 C), using the above bleaching procedure.

The remaining materials (X = 3 metres and Y = 3 metres) was bulk bleached under normal conditions - Appendix IV for further process.

4. Mercerising

From the above bleached materials (X and Y) six samples (25 cm x 1 metre) were cut and three sets were

prepared by stitching one x and one y together. Among the three sets one set was mercerised by following the normal conditions and the remaining two sets by varying the parameter.

The mercerising of the samples under normal conditions is as follows. The 50° tw caustic scda solution was prepared - Appendix V (A) and allowed to cool until it reaches the room temperature. The caustic soda solution was poured in the padding mangle and the sample was padded (1 dip and 1 nip) taken out and thoroughly washed with hot and cold water. The sample was neutralised with acetic acid and thoroughly washed and allowed for natural drying.

The same procedure was followed for the remaining two sets by varying the concentration (30° Tw and 80° Tw).

a. Dyeing

One portion of the mercerised samples were dyed following the given procedure.

i. Selection of dye

Remzol brilliant red 5B was selected for the study.

ii. Method of dyeing

The X and Y samples were stitched together and weighed independently. Depending on the weight the dye solution was prepared - Appendix V (B).

Silicate padding was selected for the study. The prepared dye solution was poured in to the padding mangle and the mercerised samples of X were padded (2 dip and 2 nip), taken out and packed airtight in polythene sheets until 17 hours was completed. The samples were washed and neutralised with acetic acid, soaping was given and thorough washing was followed. The samples were allowed for natural drying and ironed. The same procedure was followed for the samples of Y.

E. Evaluation of the processed samples

The processed samples were evaluated by the following tests.

a. Desizing efficiency

For calculating the desizing efficiency the total size of the original samples (X and Y) and the residual size of the desized samples were found out by using the following procedure.

With the help of the template two samples from each of the originals and two samples from each of the desized samples were cut, kept in the oven at 100 °C for 10,minutes, cooled in the desicator and weighed.

Desizing solution was prepared - Appendix VI (A) and the samples were kept in the solution independently for 4 hours at 60 °C, after which thorough hot and cold washing was given. The samples were allowed for natural drying. Again the samples were kept in the oven at 100 °C for 10 minutes, cooled in the desicator and weighed, from which the total size of the originals, residual size of the desized samples and the desizing efficiency were calculated - Appendix IV (A), (B) by using the following formulae.

$$\text{Total size} = \frac{\text{Initial weight - Final weight}}{\text{Final weight}} \times 100$$

$$\text{Residual size} = \frac{\text{Initial weight - Final weight}}{\text{Final weight}} \times 100$$

$$\text{Desizing Efficiency} = \frac{\text{Total size - Residual size}}{\text{Total size}} \times 100$$

b. Absorbancy

Shrinking test was used to find cut the absorbancy power of the scoured, bleached and mercerised samples.

According to Booth (1970) Sinking test is a simple test which helps to measure the wettability of the fabric, by placing a piece of fabric on water surface and the time in which it sinks was measured.

Ten samples were cut in to 2 cm x 2 cm from each of the scoured, bleached and mercerised samples. A 1000 ml beaker was taken and filled with distilled water, few drops of wetting agent was added to the distilled water. A sample piece was dropped on the surface of the water from a standard height. Simultaneously, a stop-watch was started when the sample struck the surface of the water and the stop-watch was stopped when the last corner sank to the bottom of the beaker. The sinking time of the sample was noted and recorded.

C. Whiteness :

The bleached samples were fed in the computer and the results were noted for whiteness Index, yellow Index and Harrision whiteness.

D. Barium activity number :

According to Doshi and Shah (1984) Mercerised cotton absorbs alkali to a greater extent that unmercerised cotton and this differential absorbtion is taken advantage of quality control for quantitative assessment of degree of mercerising. the quality control in mercerising involves the determination of degree of mercerising, i.e., Barium activity Number.

The barium activity number for the mercerised samples was calculated by the following procedure.

The mercerised sample was cut into small pieces from which 2.18 gm were taken and the same way 2.12 g from the desized, scoured, bleached samples (Un mercerised) were taken and put in the conical flask separately. 30 cc of 0.25 N barium hydroxide solution was poured inside each conical flask closed tightly, allowed for 4 hours with in between shaking every one hour.

10 cc of barium hydroxide was taken and titrated against 0.1 N HCl using naptheline as the indicator. The value was noted and kept as blank value. The values for the unmercerised and mercerised samples the above procedure was followed. The values are noted and the barium activity number was calculated - Appendix (VII) by using the following formula.

$$\text{Barium activity number} = \frac{a - b}{a - c} \times 100$$

where

a = Quantity in ml of hydrochloric acid required for the blank.

b = Quantity in ml of hydrochloric acid required for the test samples.

c = Quantity in Ml of hydrochloric acid required for the unmercerised sample.

e. Fabric Strength

i. Tear strength

Grover and Hamby (1969) state that the tearing strength is a measure of the resistance to tearing of either the warp or filling series of yarns.

The tear strength of the samples were determined by elmendrof tear strength tester - Plate II. The tester has three capacities such as 0-1600 g, 0-3200 g and 0-6400 g so that a wide range of fabrics can be tested on it. The scale shall be capable of reading directly the tear strength to an accuracy of 100 g.

The specimens were cut from all the desized, scoured, bleached and mercerised samples and the original both in warp and weft direction using the template. Each specimen was placed securely in the clamps. A slit of 20 mm was made in the specimen starting from the bottom edge by a knife attached to the equipment. The sector release was pressed causing the sector to fall thus moving the perdulum clamp away from the fixed clamp so as to tear the specimen. The force required to tear the specimen was read from the scale. The scale reading was multiplied by an appropriate factor (6400 g) which will be the tear strength of the sample.

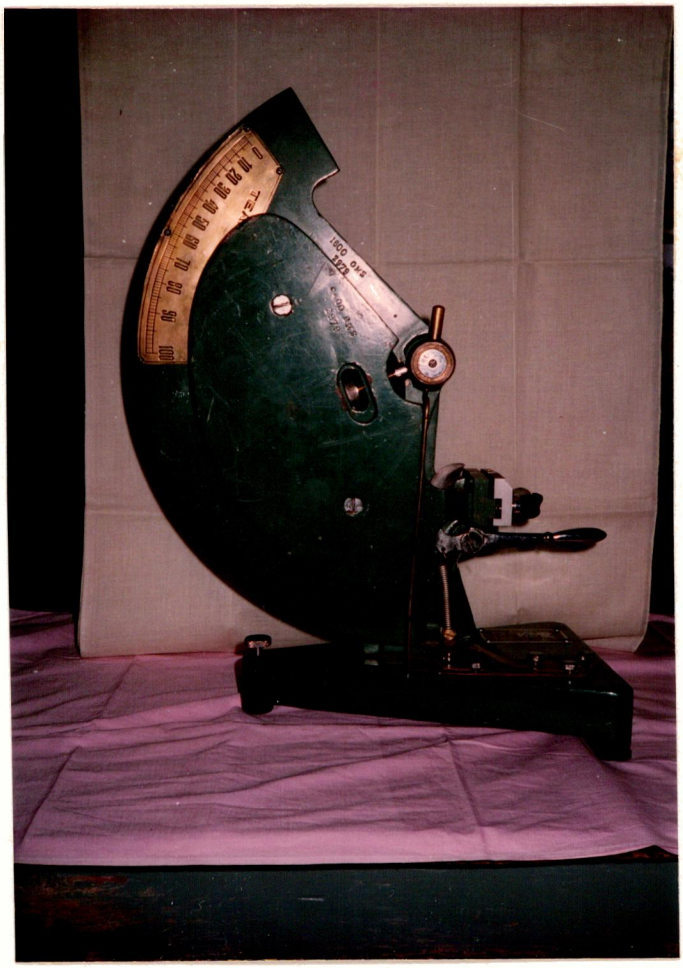


PLATE II

ELMENDROF TEAR STRENGTH TESTER.

ii. Bursting strength

According to Skinkle (1972) bursting strength is the force applied, to break a fabric when applied at right angles to the fabric and uniformly distributed over a given area.

According to Grover and Hamby (1969) the bursting strength test measure the composite strength of both the warp and filling yarns simultaneously and indicate the extent to which a fabric can withstand a bursting type of force with the pressure being applied perpendicular to the surface of the fabric with reference to BSI test methods the bursting strength is defined as the maximum fluid pressure applied to a circular specimen in distending it to rupture.

For determining the bursting strength Eureka's bursting strength tester was used - Plate III and five specimens of dimensions 4" x 4" were cut from each of the desized, scoured, bleached and mercerised samples and also original. The specimen was securely clamped over a thin rubber diaphram and hydrostatic pressure was applied to the underside of the diaphram until the specimen bursted. The bursting pressure was noted in the pressure gauge of the instruments (kg/cm^2).

PLATE - III

BURSTING STRENGTH TESTER

f. Colour fastness tests

According to Doshi and Shah (1984) Fastness, that is the resistance of dyeing and prints to external influences is of decisive importance for the practical use of any dye stuff. Fastness property tests are consequently very extensive and widely standardised.

i. Colour fastness to washing

4" x 4" dimension of the test specimen was placed between two pieces of undyed fabrics of the same dimension. The undyed material should be of plain weave, medium weight and free from sizing.

The specimens were agitated in a 0.5% soap solution at 60°C continuously for a period of 30 minutes, the specimen was then rinsed in cold water, squeezed and air dried in the shade at room temperature. The numerical rating for both the change in colour of the dyed test sample and the staining of the undyed fabrics was rated by using grey scale.

ii. Colour fastness to sunlight

The test specimen of 8" x 1 1/2" was cut from each of the dyed samples and covered with a black chart by dividing it into eight equal parts. The first division was exposed to sunlight from 9 a.m. to 4 p.m. on first day. And

on second day the first and second division was exposed similarly the divisions were increased on each day and the samples were exposed for seven days. The eight division was not exposed and kept as original for comparison. Then the colour fastness of each sample to sunlight was evaluated by using a grey scale.

Statistical Analysis

The results are statistically analysed by using nested design and ANOVA (RBD in two way classification). Gacula and Jagbir Singh (1984) state that there are designs where levels of factor B are nested within those of factor A, and levels of factor C are nested with in those of factor B, following that the nested design was formed and calculated, ANOVA table was formed and tested for its significance at 1% and 5% levels - Appendix VIII.

Results and Discussion

IV RESULTS AND DISCUSSION

The results of the study are discussed under the following aspects.

A. Desizing efficiency of desized samples
B. Absorbancy of the scoured, bleached and mercerised samples
C. Harrision whiteness of the bleached samples
D. Barium activity number of the mercerised samples
E. Tear strength
F. Bursting strength
G. Colour fastness to washing and sunlight.

A. DESIZING EFFICIENCY OF THE DESIZED SAMPLES

The desizing efficiency of the desized samples are presented in the following Table I.

TABLE I

DESIZING EFFICIENCY OF THE DESIZED SAMPLES

S.No.	Name of the samples	Total size in grams	Residual size in grams	Desizing efficiency in percentage
1.	XD, YD	11.9845 , 12.22	1.61065 , 2.568	86.81 , 78.57
2.	$XDte_1$, $YDte_1$	11.9845 , 12.22	2.1105 , 4.18	82.72 , 65.12
3.	$XDte_2$, $YDte_2$	11.9845 , 12.22	2.54 , 3.815	79.21 , 68.16
4.	XDW_1 , YDW_1	11,9845 , 12.22	2.376 , 4.8145	80.55 , 59.82
5.	XDW_2 , YDW_2	11,9845 , 12.22	2.235 , 3.027	81.71 , 74.74
6.	XDt_1 , YDt_1	11,9845 , 12.22	4.158 , 4.141	65.97 , 63.16
7.	XDt_2 , YDt_2	11,9845 , 12.22	3.7425 , 4.16	69.37 , 65.28

DESCRIPTIVE GRADATION FOR DESIZING EFFICIENCY

DESIZING EFFICIENCY (%)	DESCRIPTIVE GRADE
> 90	Excellent
85 - 90	Very good
80 - 85	Good
70 - 80	Moderate
< 70	Poor

From the above table it is evident that the samples desized under normal conditions have greater desizing efficiency (86.81% and 78.57%) when compared to the other samples which were desized by varying the temperature, wetpickup and reaction time. The table also indicates that the samples desized with a lower temperature; lower wetpickup and higher wetpickup show gocd results regarding the desizing efficiency as they were graded as good. But when compared with the samples show a lesser percentage of desizing efficiency. Hence, for desizing normal conditions may be followed for better efficiency. Figure I clearly represents the above fact. From the above results it could be stated that the quality of the material gets affected when the conditions in the process control are changed.

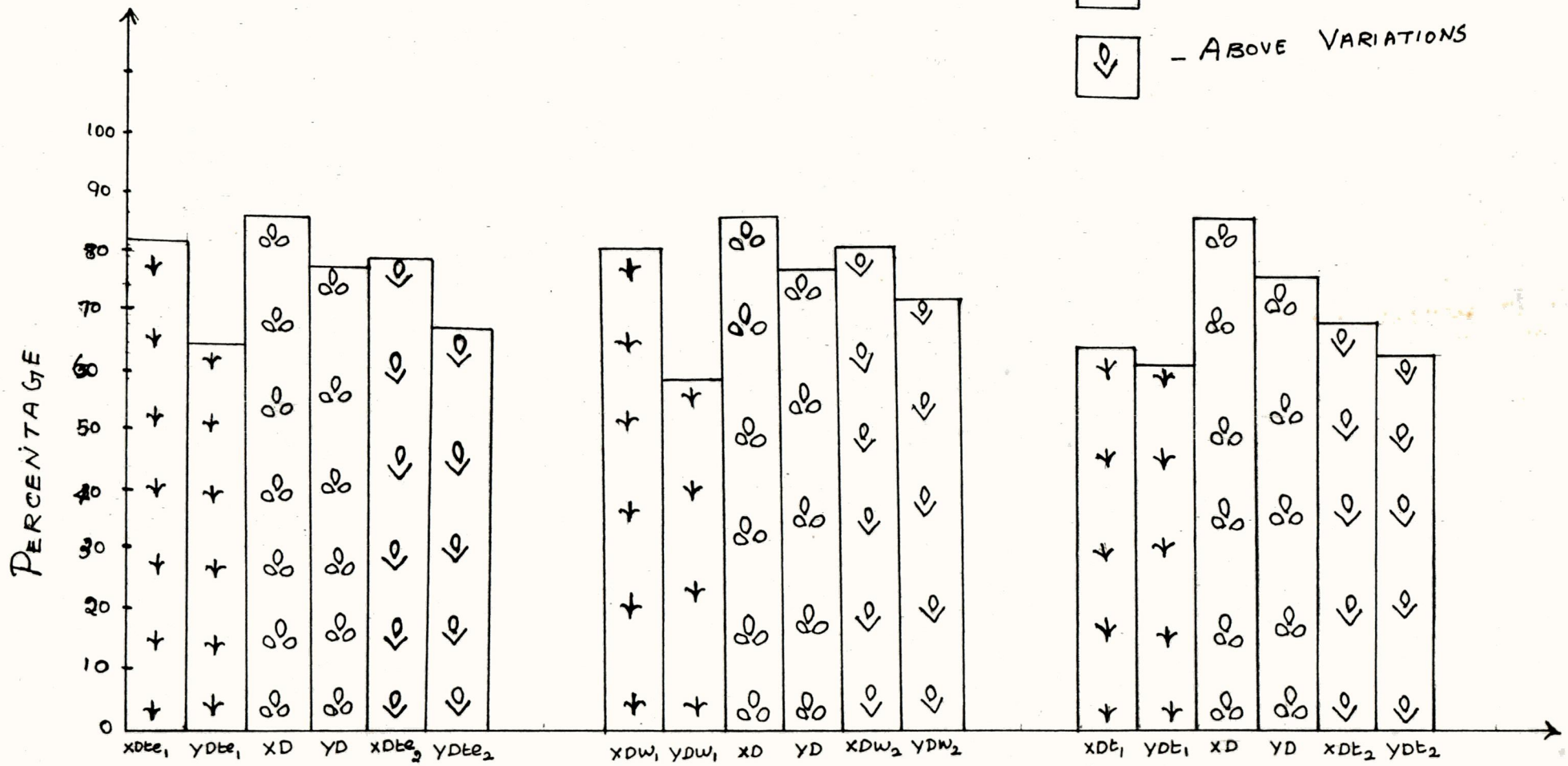


FIGURE I

DESIZING EFFICIENCY OF THE DESIZED SAMPLES

B. ABSORBANCY OF THE SCOURED, BLEACHED AND MERCERISED SAMPLES

The absorbancy power of the scoured, bleached and mercerised samples are given in Table II.

TABLE II

ABSORBANCY OF THE SCOURED, BLEACHED AND MERCERISED SAMPLES

S.No.	Name of the samples	Absorbancy time in seconds
1.	XS , YS	2.9 , 2.8
2.	XSC_1 , YSC_1	11 , 9.5
3.	XSC_2 , YSC_2	2.4 , 2.5
4.	$XSte_1$, $YSte_1$	6.3 , 9.4
5.	XSt_1 , YSt_1	4.4 , 4.1
6.	XSt_2 , YSt_2	2.7 , 2.6
7.	XB , YB	1.2 , 2
8.	XEC_1 , YBC_1	1.6 , 2.35
9.	XBC_2 , YBC_2	0.9 , 1.75
10.	$XBte_1$, $YBte_1$	3.45 , 3.05
11.	XM , YM	0.725 , 0.6
12.	XMC_1 , YMC_1	1.025 , 0.7525
13.	XMC_2 , YMC_2	0.45 , 0.425

Recommended norms for scoured, bleached and mercerised materials Absorbancy > 3 seconds.

The above table indicates the following results.

1. The samples scoured with normal conditions, higher concentrations, higher time show good results in absorbancy. But the higher concentration and higher timing may cause an additional expense when compared to the normal conditions. The above fact is depicted in Figure II A. Hence it could be stated that for scouring normal condition may be followed.
2. The change in temperature affects the absorbancy of the bleached samples whereas the change in concentrations do not have any effect on the absorbancy of the bleached samples. Hence it could be stated that the temperature should not be changed for bleaching. Figure II B clearly illustrates the above fact.
3. Regarding mercerisation the change in concentration do not have any effect on the absorbancy. The above fact is clearly shown in Figure II C.

From the above discussions it could be stated that the normal conditions provide for better result regarding absorbancy in scouring, bleaching and mercerising processes.

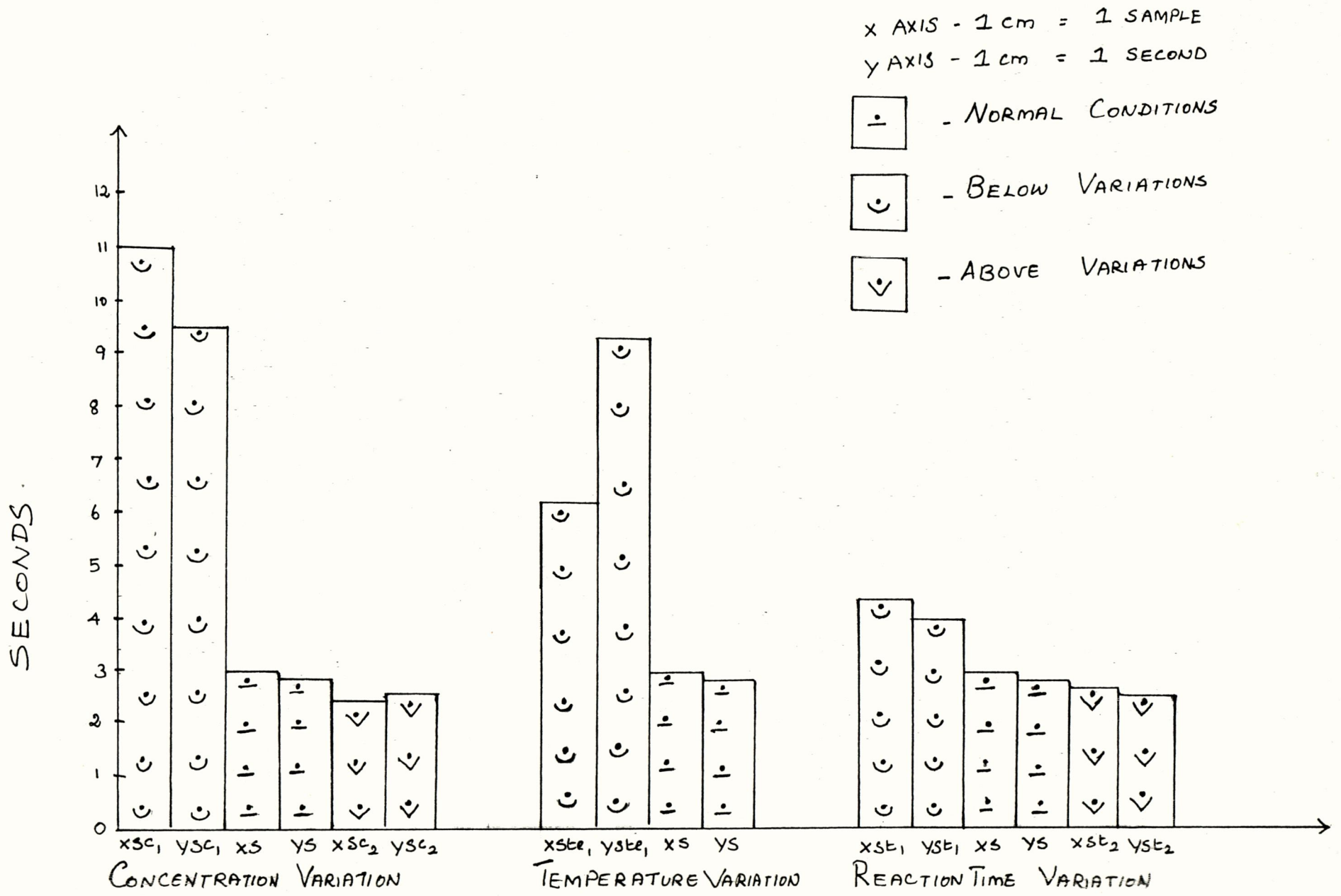


FIGURE II A

ABSORBANCY OF THE SCOURED SAMPLES

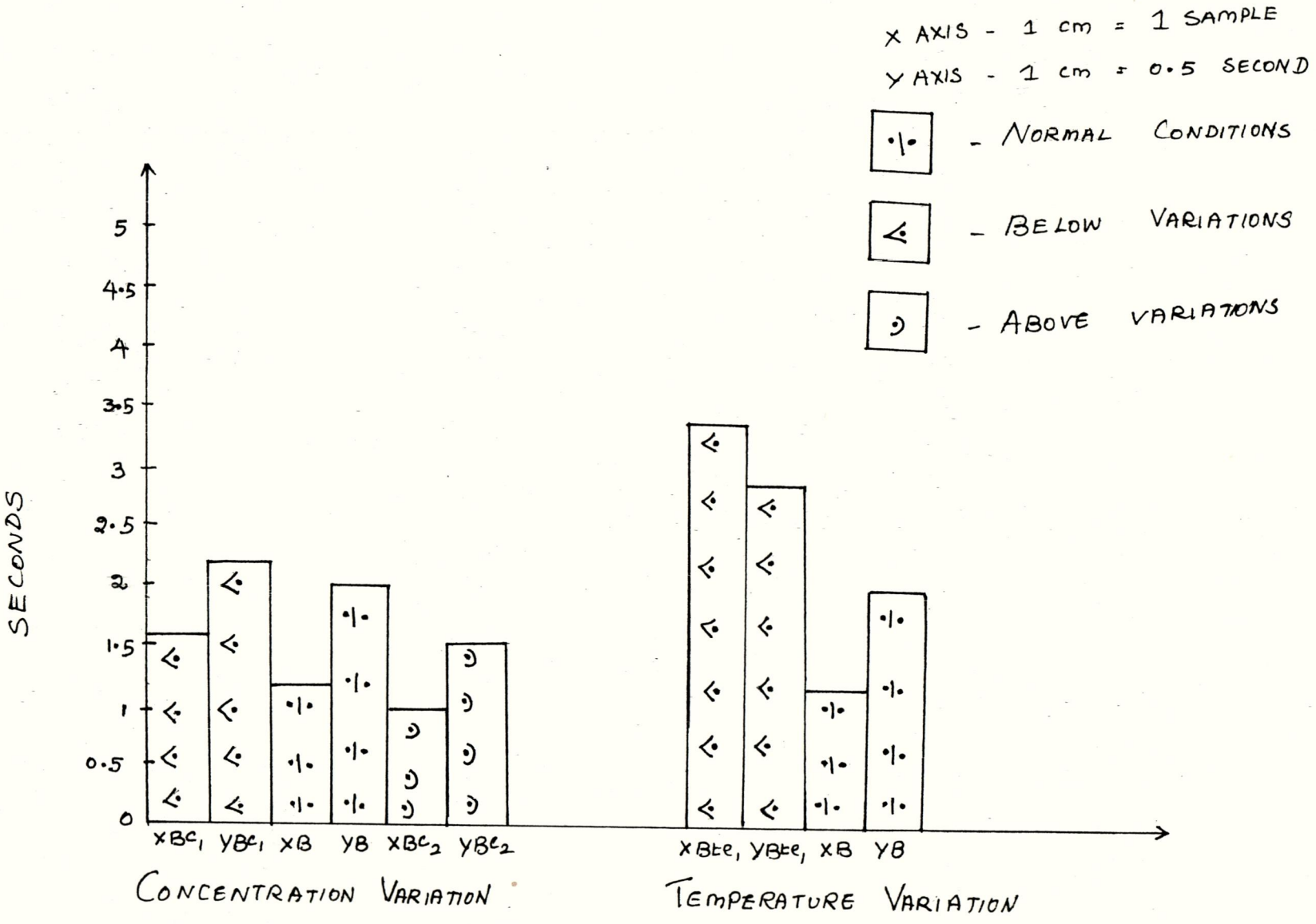


FIGURE II B

ABSORBANCY OF THE BLEACHED SAMPLES

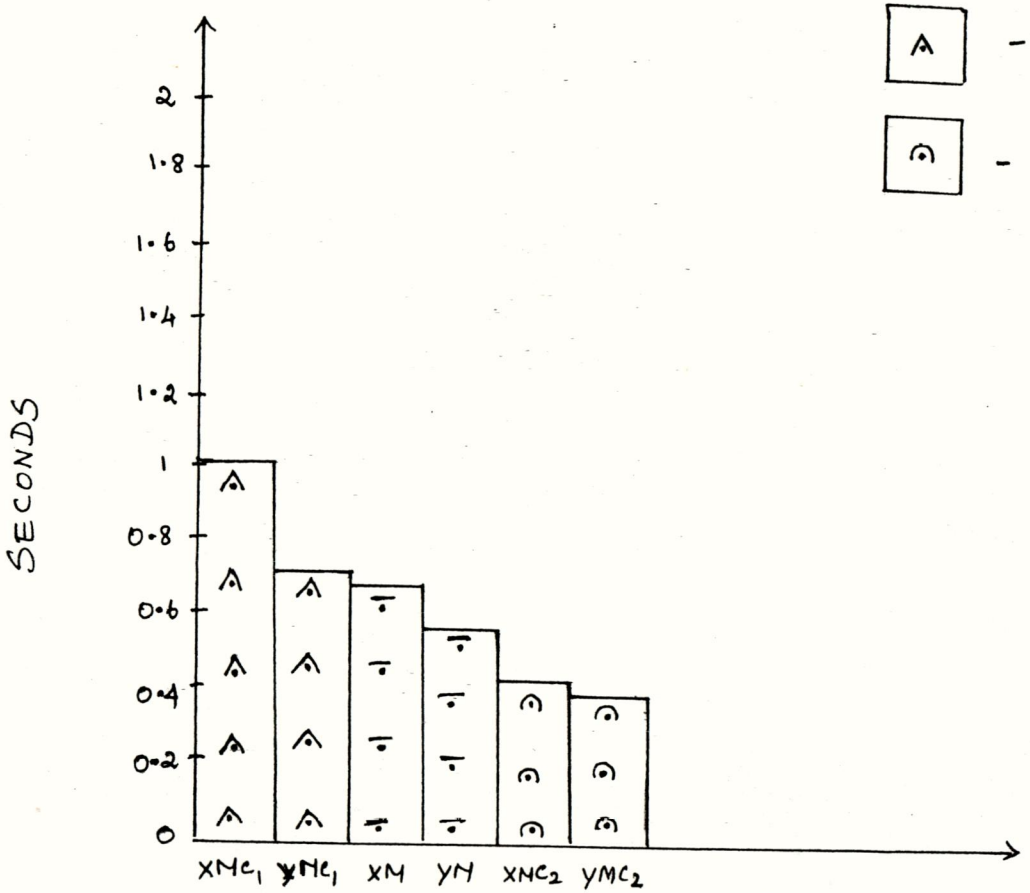
X AXIS - 1 cm = 1 SAMPLE

Y AXIS - 1 cm = 0·2 SECONDS

- NORMAL CONDITIONS

- BELOW VARIATIONS

- ABOVE VARIATIONS



CONCENTRATION VARIATION

FIGURE II C

ABSORBANCY OF THE MERCERISED SAMPLES

C. HARISSION WHITENESS OF THE BLEACHED SAMPLES

The following Table III gives the Harrision whiteness of the bleached samples.

TABLE III

HARRISION WHITENESS OF THE BLEACHED SAMPLES

S.No.	Name of the samples	Harrision whiteness in %
1.	XB , YB	93.61 , 93.29
2.	XBC_1 , YBC_1	88.81 , 87.26
3.	XBC_2 , YBC_2	94.49 , 94.67
4.	$XBte_1$, $YBte_1$	90.05 , 89.06

Recommended norms for bleached materials whiteness at 550 nm) < 80

From the above table it is obvious that the samples bleached with higher concentration have the higher percentage of whiteness followed by the samples bleached with normal conditions. Figure III illustrates the same fact. But, the higher concentration may increase the cost of bleaching. Hence it could be stated that the samples may be bleached under the normal conditions.

X AXIS - 1 cm = 1 SAMPLE

Y AXIS - 1 cm = 10 PERCENT

- NORMAL CONDITIONS
- BELOW VARIATIONS
- ABOVE VARIATIONS

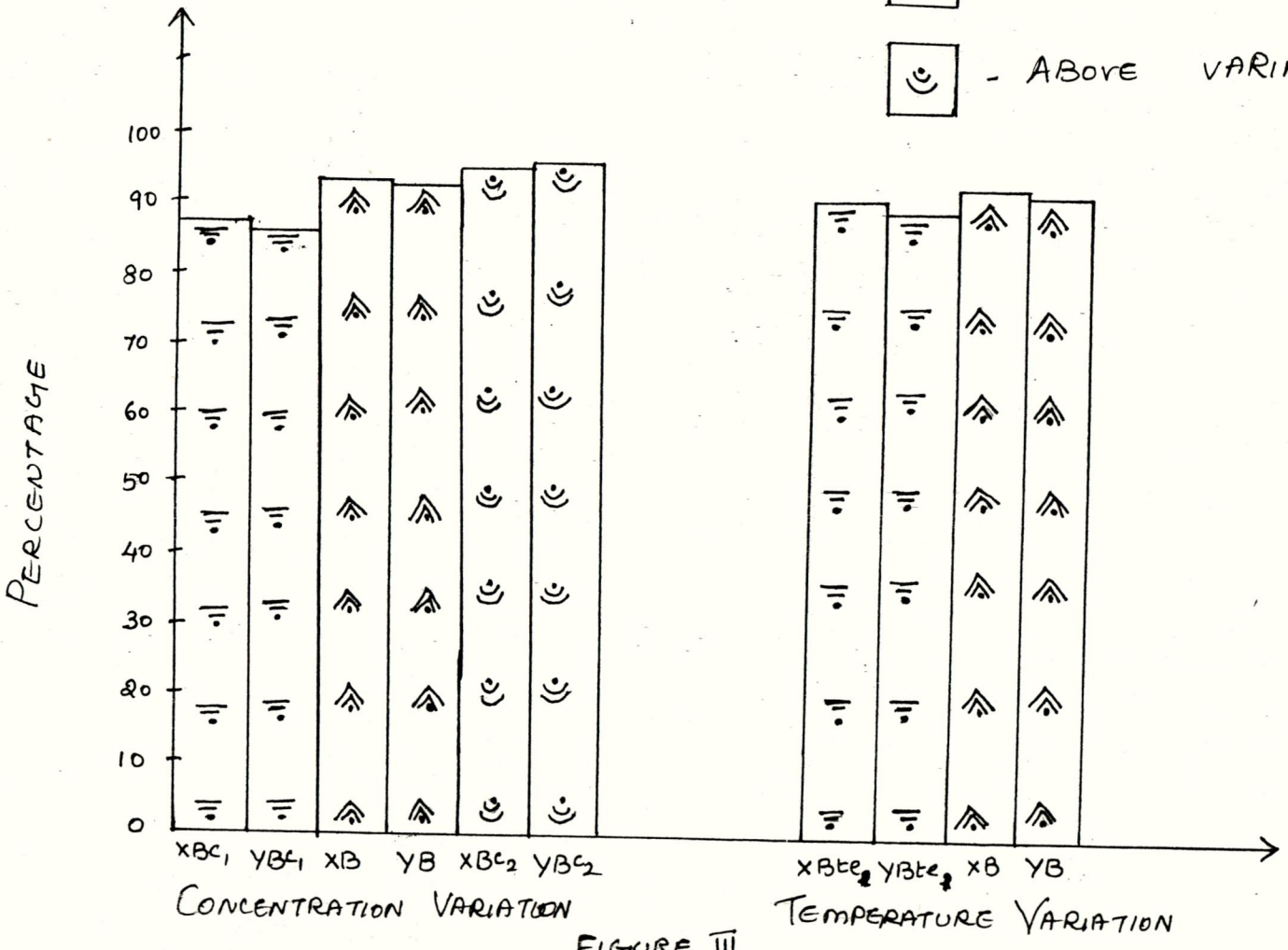


FIGURE III

HARRISION WHITENESS OF THE BLEACHED SAMPLES

D. BARIUM ACTIVITY NUMBER OF THE MERCERISED SAMPLES

Table IV gives the barium activity number of the mercerised samples.

TABLE IV

BARIUM ACTIVITY NUMBER OF THE MERCERISED SAMPLES

S.No.	Name of the samples	Barium activity number
1.	XM , YM	132.55 , 141.93
2.	XMC_1 , YMC_1	111.6 , 109.67
3.	XMC_2 , YMC_2	146.51 , 161.29

Recommended norms of Mercerised materials

Barium activity number (Fabric) 115 - 130

The recommended norms of mercerised materials for barium activity number (fabric) is given as 115 - 130, but the table indicates either lower values (lower concentration) or higher values (normal and higher concentration). It is noted that the samples mercerised under normal conditions perform better when compared to the other two categories. The above fact is depicted in Figure IV. Hence it could be stated that the samples may be mercerised under normal conditions.

E. TEAR STRENGTH

The tear strength of the desized, scoured, bleached and mercerised samples are discussed below.

1. Tear strength of the desized samples.

The tear strength of the desized samples are given in Table V.

TABLE V

TEAR STRENGTH OF THE DESIZED SAMPLES

S.No.	Name of the samples	Meantear strength in Kgs	
		warp direction	weft direction
1.	XD , YD	2.22 , 2.816	1.642 , 1.92
2.	$XDte_1$, $YDte_1$	2.73 , 2.922	2.176 , 2.09
3.	$XDte_2$, $YDte_2$	2.048 , 2.688	1.62 , 1.77
4.	XDW_1 , YDW_1	2.282 , 2.794	1.728 , 2.112
5.	XDW_2 , YDW_2	1.941 , 2.602	1.946 , 1.834
6.	XDt_1 , YDt_2	2.026 , 3.05	1.706 , 2.368
7.	XDt_2 , YDt_2	1.6 , 2.773	1.322 , 2.048

The above table reveals that there is an increase in the tear strength of the samples due to lower temperature and lower wet pickup irrespective of the direction. This increase may be due to the remaining starch in the samples. Hence it could be stated that normal conditions may be more suitable for desizing process.

The results of the analysis of variance (nested design) for tear strength (warp and weft) are given in the following tables. Table VA, VB, VC, VD, VE, VF.

X AXIS - 1 cm = 1 SAMPLE

Y AXIS - 1 cm = 20 BARIUM ACTIVITY NUMBER

- NORMAL CONDITIONS

- BELOW VARIATIONS

- ABOVE VARIATIONS

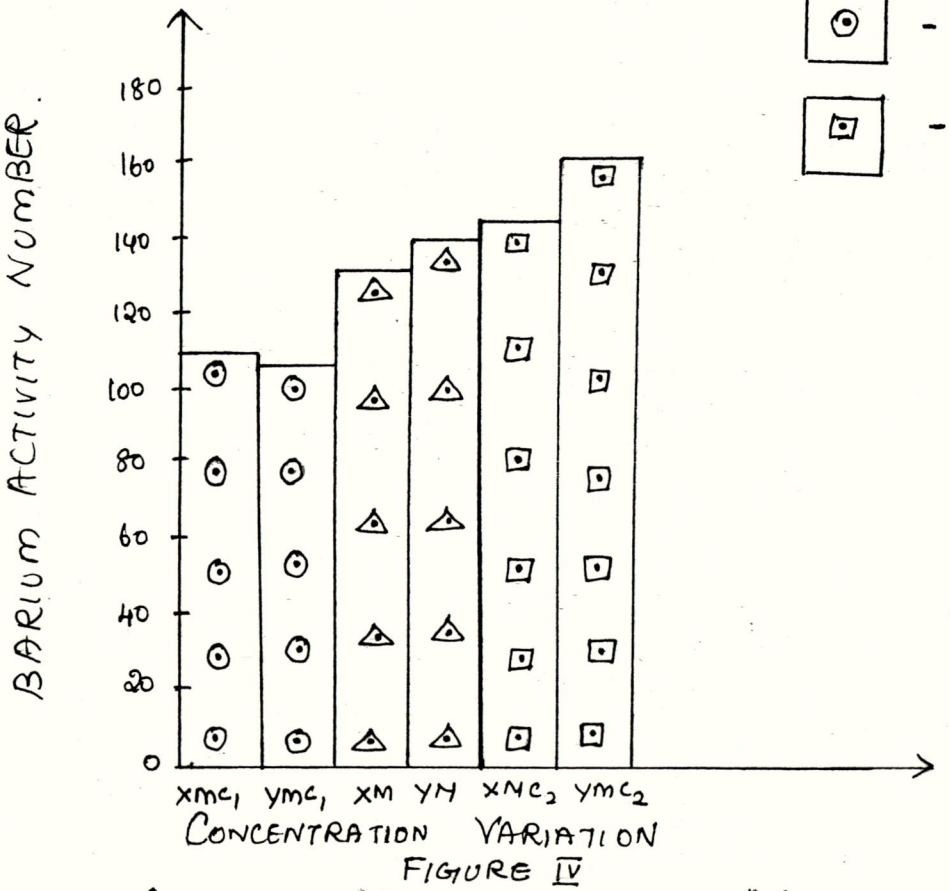


FIGURE IV

BARIUM ACTIVITY NUMBER OF THE MERCERISED SAMPLES

TABLE VA

ANALYSIS OF VARIANCE - WARP

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	1.02149	1.02149	2.7426	6.6079	16.258
Between temperature	5	1.86164	0.3724	12.9875 **	3.1059	5.0643
Error	12	0.3440	0.02867			
Total	17	2.2057				

** Significant at a 5 percent and 1 per cent level

TABLE VB

ANALYSIS OF VARIANCE - WEFT

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.5947	0.05947	0.3668	6.6079	16.258
Between temperature	5	0.80964	0.16193	2.7173	3.1059	5.0643
Error	12	0.71510	0.0596			
Total	17	1.52474				

** Significant at a 5 percent and 1 per cent level

TABLE VC

ANALYSIS OF VARIANCE - WARP

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	1%
Between counts	1	1.56763	1.56763	4.2415	6.6079	16.258
Between wet pickup	5	1.84798	0.36959	12.122 **	3.1059	5.0643
Error	12	0.36591	0.0305			
Total	17	2.2139				

** Significant at 5 percent and 1 percent level

TABLE VD

ANALYSIS OF VARIANCE - WEFT

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	1%
Between counts	1	1.31449	1.3144	1.4856	6.6079	16.258
Between wet pickup	5	4.4245	0.88474	6.2801 **	3.1059	5.0643
Error	12	1.6905	0.1409			
Total	17	6.1145				

** Significant at 5 percent and 1 per cent level

TABLE VE

ANALYSIS OF VARIANCE - WARP

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.00023	0.00023	0.000028	6.6079	16.258
Between reaction time	5	41.45505	8.2910	265.712 **	3.1059	5.0643
Error	12	0.3744	0.0312			
Total	17	41.8295				

** Significant at 5 percent and 1 percent level

TABLE VF

ANALYSIS OF VARIANCE - WEFT

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	1.3846	1.3846	3.5356	6.6079	16.258
Between reaction time	5	1.9579	0.3916	23.8996 **	3.1059	5.0643
Error	12	0.1966	0.0164			
Total	17	2.1545				

** Significant at 5 percent and 1 percent level

The above analysis proves the following facts.

a. The difference in the tear strength (weft) due to temperature variation is not significant.

b. The difference in the tear strength (warp and weft) due to wetpickup variation is significant at 1% level.

c. The difference in the tear strength (warp and weft) due to reaction time variation is significant at 1% level.

2. TEAR STRENGTH OF THE SCOURED SAMPLES

The tear strength of the scoured samples are given in Table VI.

TABLE VI

TEAR STRENGTH OF THE SCOURED SAMPLES

S.No.	Name of the samples	Meantear strength in Kgs	
		warp direction	weft direction
1.	X_D , Y_D	1.664 , 2.197	1.34 , 1.792
2.	X_{SC_1} , Y_{SC_1}	1.258 , 2.09	1.002 , 1.45
3.	X_{SC_2} , Y_{SC_2}	1.621 , 2.41	1.642 , 2.026
4.	X_{Ste_1} , Y_{Ste_1}	1.258 , 2.133	0.9173, 1.365
5.	X_{St_1} , Y_{St_1}	1.578 , 2.069	1.152 , 1.728
6.	X_{St_2} , Y_{St_2}	1.856 , 2.73	1.365 , 2.197

The above table clearly indicates a reduction in the tear strength due to lower temperature and lower timing and an increase in tear strength due to higher concentration and higher timing irrespective of the direction. The increase in strength due to higher concentration and higher timing may increase the expenditure, hence it could be stated that normal conditions may be better suitable for the scouring process.

The results of the analysis of variance (nested design) for tear strength (warp and weft) are given in the following tables. Table VIA, VIB, VIC, VID, VIE, VIF.

TABLE VIA

ANALYSIS OF VARIANCE - WARP

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	2.2213	2.3213	4.1776	6.6079	16.258
Between Concentration	5	2.7782	0.5556	21.6046 **	3.1059	5.0643
Error	12	0.3086	0.02572			
Total	17	3.0869				

** Significant at 5 percent and 1 percent level.

TABLE VIB

ANALYSIS OF VARIANCE - WEFT

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	2.6542	2.6542	3.4525	6.6079	16.258
Between Concentration	5	3.8439	0.7688	29.3774**	3.1059	5.0643
Error	12	0.3140	0.02619			
Total	17	4.157895				

** Significant at 5 percent and 1 percent level

TABLE VIC

ANALYSIS OF VARIANCE - WARP

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	1.4868	1.4868	10.3333	10.128	34.116
Between temperature	3	1.73943	0.5798	2.3297	4.0662	7.5910
Error	8	1.9852	0.24814			
Total	11	1.9852				

** Significant at a 5 percent and 1 per cent level

TABLE VID

ANALYSIS OF VARIANCE WEFT

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.60211	0.60211	1.5731	10.128	34.116
Between temperature	3	1.4825	0.38275	13.1004 **	4.0662	7.5910
Error	8	0.22665	0.02833			
Total	11	1.3749				

** Significant at 5 percent and 1 percent level

TABLE VIE

ANALYSIS OF VARIANCE WARP

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	1.8025	1.8025	3.3859	6.6079	16.258
Between reaction time	5	2.6617	0.53234	24.6354 **	3.1059	5.0643
Error	12	0.2593	0.0216			
Total	17	2.9210				

** Significant at 5 percent and 1 percent level

TABLE VIE

ANALYSIS OF VARIANCE - WEFT

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	1.7235	1.7235	3.9280	6.6079	16.258
Between reaction time	5	2.1939	0.4388	16.2241**	3.1059	5.0643
Error	12	0.3168	0.02641			
Total	17	2.51062				

** Significant at 5 percent and 1 percent level.

The above analysis proves the following facts :

a. The difference in the tear strength (warp and weft) due to concentration variation is significant at 1% level.

b. The difference in the tear strength (warp) due to temperature variation is not significant.

c. The difference in the tear strength (warp and weft) due to reaction time variation is significant at 1% level.

3. TEAR STRENGTH OF THE BLEACHED SAMPLES

Table VII gives the tear strength of the bleached samples.

TABLE VII

TEAR STRENGTH OF THE BLEACHED SAMPLES

S.No.	Name of the samples	Meantear strength in Kgs	
		warp direction	weft direction
1.	XB , YB	1.621 , 2.517	1.706 , 2.005
2.	XBC_1 , YBC_1	1.557 , 2.282	1.408 , 1.578
3.	XBC_2 , YBC_2	1.856 , 2.389	1.685 , 2.24
4.	$XBte_1$, $YBte_1$	1.621 , 2.73	1.578 , 2.282

From the above table it is evident that the samples bleached under normal conditions perform better regarding tear strength (warp and weft) when compared to the other samples of varied parameters.

Tables VIIA, VIIB, VIIC, VIID give the results of the analysis of variance (nested design) for tear strength (warp and weft).

TABLE VIIA

ANALYSIS OF VARIANCE - WARP

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	2.3213	2.3213	4.5472	6.6079	16.258
Between concentration	5	2.5523	0.5105	9.5063**	3.1059	5.0643
Error	12	0.6444	0.0537			
Total	17	3.1969				

** Significant at 5 percent and 1 percent level.

TABLE VIIB

ANALYSIS OF VARIANCE - WEFT

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.5243	0.5243	1.9200	6.6079	16.258
Between concentration	5	1.3653	0.2731	9.6774**	3.1059	5.0643
Error	12	0.3386	0.2822			
Total	17	1.7039				

** Significant at 5 percent and 1 percent level

TABLE VIIC

ANALYSIS OF VARIANCE - WARP

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.8878	0.8878	1.6328	10.128	34.116
Between temperature	3	1.6313	0.5437	8.3842**	4.0662	7.5910
Error	8	0.5188	0.0649			
Total	11	0.51883				

** Significant at 5 percent and 1 percent level

TABLE VIID

ANALYSIS OF VARIANCE - WEFT

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.75400	0.75400	2.5303	10.128	34.116
Between Temperature	3	0.89395	0.2979	11.4869**	4.0662	7.5910
Error	8	0.20753	0.02594			
Total	11	1.1015				

** Significant at 5 percent and 1 percent level

The above analysis proves the following facts

a. The difference in the tear strength (warp and weft) due to concentration in significant at 1% level.

b. The difference in the tear strength (warp and weft) due to concentration is significant at 1% level.

4. TEAR STRENGTH OF THE MERCERISED SAMPLES

The tear strength of the mercerised samples are given in the following Table VIII.

TABLE VIII

TEAR STRENGTH OF THE MERCERISED SAMPLES

S.No.	Name of the samples	Meantear strength in Kgs	
		warp direction	weft direction
1.	XM , YM	1.984 , 2.026	1.856 , 1.493
2.	XMC_1 , YMC_1	1.664 , 2.24	1.728 , 2.005
3.	XMC_2 , YMC_2	2.069 , 2.346	2.112 , 2.069

From the above table it is clear that the samples mercerised under normal conditions perform better regarding tear strength (warp and weft) when compared to the other samples of varied parameters.

The results of the analysis of variance (Nested design) for tear strength (warp and weft) are given in the following tables. Table VIIIA and VIIIB.

TABLE VIIIA

ANALYSIS OF VARIANCE - WARP

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.35364	0.35364	2.1495	6.6079	16.258
Between Concentration	5	0.8226	0.16452	17.4063 **	3.1059	5.0643
Error	12	0.11343	0.00945			
Total	17	0.03605				

** Significant at 5 percent and 1 percent level.

TABLE VIIIB

ANALYSIS OF VARIANCE - WEFT

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.018432	0.018432	1.4297	6.6079	16.258
Between Concentration	5	0.06446	0.012892	0.1299	3.1059	5.0643
Error	12	1.19096	0.09924			
Total	17	1.255424				

The above analysis proves that the difference in tear strength (weft) due to concentration is not significant.

F. BURSTING STRENGTH

The bursting strength of the desized, scoured bleached and mercerised samples are discussed below :

1. BURSTING STRENGTH OF THE DESIZED SAMPLES

The bursting strength of the desized samples are given in Table IX.

TABLE IX

BURSTING STRENGTH OF THE DESIZED SAMPLES

S.No.	Name of the samples	Mean bursting strength in Kgs/cm^2
1.	XD , YD	11.400 , 11.600
2.	$XDte_1$, $YDte_1$	12.000 , 12.200
3.	$XDte_2$, $YDte_2$	11.800 , 12.000
4.	XDW_1 , YDW_1	11.600 , 11.800
5.	XDW_2 , YDW_2	12.200 , 12.400
6.	XDt_1 , YDt_1	12.200 , 12.000
7.	XDt_2 , YDt_2	12.520 , 12.600

The above table illustrates an increased bursting strength in all the samples which are desized with varying parameters like temperature, wetpickup and reaction time when compared to the samples desized under normal conditions. This increase in strength may be due to the

excess starch or redeposition of starch in the samples. For evaluating the desizing process, the desizing efficiency only is to be studied. Since the desizing efficiency of the samples desized under normal condition proved to be good, it could be stated that the normal conditions may be followed in the desizing process.

Results of the analysis of variance (nested design) regarding bursting strength of the desized samples are given in the following tables. Table IXA, IXB and IXC.

TABLE IXA

ANALYSIS OF VARIANCE

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.3000003	0.3000003	1.2462	5.1174	10.561
Between Temperature	9	2.16667	0.2407	0	2.3928	2.4567
Error	20	0	0			
Total	29	2.1667				

TABLE IXB

ANALYSIS OF VARIANCE

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.3000003	0.3000003	0.7168	5.1174	10.561
Between Wetpickup	9	3.7667	0.4185	5.2315**	2.3928	3.4567
Error	20	1.6	0.08			
Total	29	3.7667				

** Significant at 5 percent and 1 percent level.

TABLE IXC

ANALYSIS OF VARIANCE

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.0053343	0.005334	0.0082	5.1174	10.561
Between Reaction time	9	5.8667	0.6519	271.6045**	2.3928	3.4567
Error	20	0.048	0.0024			
Total	29	5.91467				

** Significant at 5 percent and 1 percent level.

The above analysis proves the following facts.

a. The difference in bursting strength due to temperature variation is not significant.

b. The difference in bursting strength due to wetpickup variation is significant at 1 percent level.

c. The difference in bursting strength due to reaction time variation is significant at 1 percent level.

2. BURSTING STRENGTH OF THE SCOURED, BLEACHED AND MERCERISED SAMPLES

The results of the bursting strength of the scoured, bleached and mercerised samples are given in Table X.

TABLE X

BURSTING STRENGTH OF THE SCOURED, BLEACHED AND MERCERISED SAMPLES

S.No.	Name of the samples	Mean bursting strength in Kgs/cm^2
1.	XS , YS	11.300 , 11.250
2.	XSC_1 , YSC_1	12.000 , 10.600
3.	XSC_2 , YSC_2	13.200 , 12.000
4.	$XSte_1$, $YSte_1$	10.800 , 10.400
5.	XSt_1 , YSt_1	10.600 , 10.400
6.	XSt_2 , YSt_2	11.000 , 11.600
7.	XB , YB	11.700 , 12.300
8.	XBC_1 , YBC_1	10.650 , 11.600
9.	XBC_2 , YBC_2	12.000 , 12.500
10.	$XBte_1$, $YBte_1$	10.600 , 11.600
11.	XM , YM	12.400 , 12.400
12.	XMC_1 , YMC_1	11.500 , 10.800
13.	XMC_2 , YMC_2	12.950 , 14.000

From the above table it is obvious that there is an increase in bursting strength of the samples due to higher concentration irrespective of the processing method. It is also seen that there is a decrease in bursting strength of the samples when the parameters are set at a lower level.

The increase in bursting strength may cause an additional expenditure in the processing method, hence it could be stated that for scouring, bleaching and mercerising processes normal conditions may be followed.

The results of the analysis of variance for bursting strength are given in the following tables.
Tables XA, XB, XC, XD, XE, XF.

TABLE XA

ANALYSIS OF VARIANCE

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	8.3246	8.32464	4.038	5.1174	10.561
Between Concentration	9	18.554	2.06155	18.2762**	2.3928	3.4567
Error	20	2.256	0.1128			
Total	29	20.81				

** Significant at 5 percent and 1 percent level.

TABLE XB

ANALYSIS OF VARIANCE

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	1.152	1.152	1.6766	5.1174	10.561
Between Temperature	9	6.184	0.68711	3.0457 **	3.0204	4.9424
Error	10	2.256	0.2256			
Total	19	8.44				

** Significant at 5 percent level.

TABLE XC

ANALYSIS OF VARIANCE

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.02134	0.02134	0.0233	5.1174	10.561
Between Reaction time	9	8.2507	0.91674	13.223 **	3.0204	4.9424
Error	20	1.38667	0.06933			
Total	29	1.39724				

** Significant at 5 percent and 1 percent level.

TABLE XD

ANALYSIS OF VARIANCE

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	3.33334	3.33334	2.9123	5.1174	10.561
Between Concentration	9	10.2987	1.14436	1.4923 **	2.3928	3.4576
Error	20	15.336	0.7668			
Total	29	25.6347				

** Significant at 5 percent and 1 percent level.

TABLE XE

ANALYSIS OF VARIANCE

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	3.042	3.042	3.9213	5.1174	10.561
Between Temperature	9	8.2507	0.91674	13.223 **	3.0204	4.9424
Error	10	0.48	0.048			
Total	19	7.462				

** Significant at 5 percent and 1 percent level.

TABLE XF

ANALYSIS OF VARIANCE

Source of Variation	Degree of freedom	Sum of squares	Mean sum of squares	Variance Ratio		
				Fo	Fe 5%	Fe 1%
Between counts	1	0.1333	0.1333	0.0386	5.1174	10.561
Between Concentration	9	31.0507	3.45007	718.7645**	2.3928	3.4567
Error	20	0.096	0.0048			
Total	29	31.1467				

** Significant at 5 percent and 1 percent level.

The above analysis proves the following facts.

a. The difference in the bursting strength due to concentration variation is significant at 1% level.

b. The difference in the bursting strength due to temperature variation is significant at 5 percent level.

c. The difference in the bursting strength due to concentration variation is not significant.

d. The difference in the bursting strength due to concentration variation is not significant.

e. The difference in the bursting strength due to temperature variation is significant at 1 percent level.

f. The difference in the bursting strength due to concentration variation is significant at 1 percent level.

G. Colour fastness to washing and sunlight.

The dyed samples which were tested for the colour fastness to washing and sunlight showed no change in colour and staining. Hence, it could be stated that dyed samples have good colour fastness to washing and sunlight.

Summary and Conclusion

V SUMMARY AND CONCLUSION

Quality control is aimed to provide assurance about the specified quality standards of final product manufactured and has its root in process control. Process controls are devised to maintain quality standards at each constitutent process and aim to reduce variations and damages in the final product. The importance of quality control in textile industry cannot be minimised. In textile finishing the quality of the pretreatment is essential for the quality of the final product. However today as we face the challenges for ISO-9000 we will surely realise that the need of the coming decades is "Quality for the masses".

The objectives of the study are,

- to find out the difference in the qualities of the finished material with standard parameters and materials with those of slight variations.
- to compare the effect of dyeing on the finished (scoured and mercerised) materials of varied parameters and
- to ascertain that the quality and control measures have great impact on the quality of the finished products.

The experimental procedure of the study included selection of the yarn (cotton yarn of 20's and 40's count), and preparation of the samples according to the requirements. The samples were desized by enzymatic desizing

process under normal conditions and by varying the parameters. The desized samples were scoured, bleached and mercerised under normal conditions and by varying parameters. The scoured and mercerised samples were evaluated for various characters like desizing effeciency, absorbancy power, whiteness, barium activity number, tear strength, bursting strength and colour fastness to washing and sunlight.

The findings of the study are :

1. The samples desized under normal conditions have greater desizing efficiency. So for desizing normal conditions may be followed. The quality of the material gets affected when the conditions in the process control are changed.
2. The change in temperature affects the absorbancy of the bleached samples and where as the change in connection do not have any effect on the absorbancy of the bleached and mercerised samples.
3. The normal condition in the processing provide better results regarding the absorbancy power of the scoured, bleached and mercerised samples.
4. The samples bleached with higher concentration have the highest percentage of whitness followed by the samples bleached with normal conditions.

5. The samples mercerised under normal conditions show better results when compared to the other samples with varied parameters.
6. There is an increase in the tear strength of the desized samples due to lower temperature and lower wet pickup.
7. There is a reduction in the tear strength of the scoured samples due to lower concentration, lower temperature and lower timing and an increase in tear strength due to higher concentration and higher timing.
8. The samples bleached under normal conditions perform better in tear strength (warp and weft) when compared to the other samples with varied parameters.
9. The samples mercerised under normal conditions perform better in tear strength (warp and weft) when compared to the other samples with varied parameters.
10. There is an increase in bursting strength in all the samples which are desized with varying parameters like temperature wetpickup and reaction time.
11. There is an increase in bursting strength of the scoured, bleached and mercerised samples due to higher concentration.
12. The dyed samples have good colour fastness to washing and sunlight.

CONCLUSIONS

The following conclusions could be drawn from the above findings.

1. In preparatory wet processing normal conditions provide better efficiency. The qualities of the finished fabrics get affected when the conditions in processing are changed. Hence it could be concluded that normal conditions may be followed in wet processing.
2. The increase in strength of the processed samples due to higher concentration, higher timing, lower temperature and lower wetpickup may be because of the remaining starch or redeposition of starch. Moreover, the above conditions like higher concentration and higher timing may increase the processing expenditure. Hence it could be concluded that for preparatory wet processing normal conditions may be better suitable.

RECOMMENDATIONS

1. The same study could be extended to the dyeing and printing processes.
2. Further study could be done in the finishing process such as water-proofing, water-repellency, moth-proofing, flame-retrarding and crease-resitancy.

Bibliography

BIBLIOGRAPHY

Booth J.E.
1968
Principles of Textile testing,
Butter Worth Scientific, London
pp 441 - 443, 535 - 536.

British Standard Institution
1947
British standard for fraction Defective charts for Quality control,
British Standard House, London
P 6.

Betrabet et al
1985
BTRA Silver Jubilee monograph series,
Bleaching and mercerising,
The Bombay Textile Research Association,
Bombay.
pp 1 - 10.

Birrell .V.
1959
The Textile Arts
Harper and Brothers Publishers,
New York.
P 389.

Corbman .P.
1985
Textiles Fibre to Fabric,
McGraw - Hill Book Company,
New York,
pp 160 - 161.

Dantyagi
1991
Fundamentals of Textiles and their care
Orient Longman Limited,
New Delhi,
P 144.

Dudeja .V.D.
1981
Management of Textile Industry,
Textile Trade Press,
Ahmedabad,
pp 205 - 207.

Editors of American Fabric Magazine
1972
Encyclopedia of Textiles,
Prentice - Hall, Inc.
Engle Wood Cliffe .N.J.
pp 575 - 576.

Grover .B.
Hamby .D.S.
1969
Handbook of textile Testing and Quality control,
Wiley Eastern Private Limited,
New Delhi,
pp 1, 550 - 551.

Gohl .E.P.C.
Vilensky .L.D.
1985
Textile Science,
Longman Cheshire Private Limited,
Melbourne, Australia,
P 125.

Gacula .R.
Jagbir Singh
1984
Statistical methods in Food and
Consumer Research,
Academic Press, Inc., London,
P 79.

Juran .J.M.
1974
Quality Control Handbook,
McGraw - Hill Book Company,
New York,
pp 2 - 11.

Kosti .R.S.
1975
Chemical processing of cotton and
polyester cotton blends,
The Textile Association (India),
Ahmedabad,
P 38.

Kulkarni et al
1986
Textile dyeing operations,
chemistry, equipment, procedures
and environmental aspects,
Noyes publications, New York,
U.S.A.
P 90.

Marjory .L.
1980
Essentials of Textiles,
Hot, Rinchart and Winston,
New York,
P 229.

Mittal .C.M.
Trivedi .S.S.
1983
Chemical Processing of Polyester/
cellulosic Blends, ATIRA.,
Ahmedabad,
pp 44 - 51.

Modi .J.R.
Garde .A.R.
1975
Chemical Processing of cotton and
polyester cotton blends,
The Textile Association (India),
Ahmedabad,
pp 1 - 12.

Needles .L.
1986
Textile Fibres, Dyes, Finishes and
processes., A concise guide,
Noyes Publications, U.S.A.,
pp 169 - 170.

Skinkle 1972 — Textile Testing, Physical, Chemical and Microscopical, D.B. Taraporevala Sons and Co., Private Limited, Bombay, P 145.

Schrock .E.M. 1979 — Quality Control and Statistical methods, Reinhold Publishing Corporation, New York, Chapman and Hall Ltd., London pp 1 - 5.

Vaidya .A.A. Trivedi .S.S. 1975 — Textile Auxillaries and Finishing Chemicals, ATIRA, Ahmedabad, pp 9 - 20.

JOURNALS AND MAGAZINES

Bille 1987 — Textile dyer and Printer, Vol. XX. No. 8, 'Correct Pretreatment', A Sevak Publications, Bombay, P 19.

Bechter — Colourage, Vol XXVII. no. 21, Colour Publications Private Limited, Bombay, P 28.

Dixit .M.D. 1982 — Colour Chronicle, 'Pretreatment of Cotton Fabrics', A Sandoz Publications for the Textile and Leather Processing Industries, pp 19 - 31.

Desai .N.F. 1981 — Refresh your Wet Processing, 'Quality Control in Textile Industries', The Textile Association (India), Bombay unit. pp 1 - 4.

Dixit .M.D. 1981 — Refresh your Wet Processing, 'Conventional Bleaching', The Textile Association (India), Bombay unit. pp 5 - 16.

Dickinsion Thompson 1983
Textile dyer and Printer,
Vol. XVI. No. 1,
A Sevak Publications,
Bombay,
P 33.

Dickinsion Thompson 1980
Jailene Textracts, Vol. 5, No. 6,
'Optimising Desizing with peroxygens',
Swadeshi Polytex Limited,
Ghaziabad, (U.P)., India,
P 2.

Doshi .S.M.
Shah .H.A.
1984
Quality and Process Control,
Chemical processing Tablet IX,
The Textile Association India,
pp 1 - 18.

Gupte .V.C.
1984
Colourage, Vol. XXXI, No. 11,
Colour Publications Private Ltd.,
Bombay,
pp 15, 16, 20.

Gebret
1978
Colourage Annual,
'Uniformity of pretreatment, the basis for level dyeing'
Colour Publications Private Limited,
Bombay,
pp 41 - 45.

Ishida .T.
1977
An Introduction to Textile Technology,
JTN (Japan Textile News)
Osaka Senen Ltd.,
P 74.

Mahesh Sharma
1981
Refresh your Wet Processing,
'Quality Control in a Composite mill',
The Textile Association, (India),
Bombay unit.
P 140.

Mehra .R.H.
1981
Refresh your Wet Processing,
'Role of Auxillary chemicals in the process house',
The Textile Association (India),
Bombay unit.
P 156.

Modi .J.R.
1984
Mercerization,
Chemical Processing Tablet 1,
The Textile Association India,
P 4.

Narisian .M.G.
1978
Colourage, Vol XXv, No. 5,
Colour Publications Private Ltd.,
Bombay,
pp 40 - 41.

Patil .D.P.
Paharia .G.B.
1981
Refresh your Wet Processing,
'J-Box and open width Bleaching',
The Textile Association (India),
Bombay unit.
pp 17 - 33.

Patwardhan .V.C.
1981
Colourage, Vol. XXVIII, No. 21,
Colour Publications Private Ltd.,
Bombay,
P 3.

Pandit .C.M.
1991
Textile Induatry and Trade Journal,
Vol. No. 29,
pp 63 - 64.

Parikh .M.R.
1976
btra - scan, Vol. VII. No. 3,
'Novel Bleaching Process for cotton
and Polyester/Cotton Blend Fabrics'.
P 10.

Patel et al
1979
Colourage, Vol. XXVI, No. 11
'Role of a scouring assistant in
Wet Processing of cotton',
Colour Publications Private Ltd.,
Bombay,
pp 27 - 31.

Shah
1984
The Indian Textile Journal,
Vol. XCIV. No. 12,
Business Press Private Limited,
Bombay,
P 42.

Sitver .A.
1980
American Dye Stuff Reporter,
Vol. 69, No. 7
'Mercerisation Know-How',
pp 24 - 31.

Saraiya .N.S.
1981
Refresh your Wet Processing,
'Process Control measures in a
Dye House',
The Textile Association (India),
Bombay unit.
pp 135 - 139.

Tantillo .A.
1980 American Dye Stuff Reporter, Vol. 69 No. 7, 'Practical open width continuous preparation', pp 15 - 18.

1979 Colourage, Vol. XXVI, No. 8 'New Techniques in Wet Processing of Textiles with emphasis on cotton', Colour Publications Private Limited, Bombay, pp 31 - 34.

1981 Colourage, Vol. XXVIII, No. 23 'A Bleachers Handbook - I', Colour Publications Private Ltd., Bombay, pp 10 - 13.

1982 Colour Chronicle, 'Pretreatment of Cellulosic Fibre Fabrics : more than Necessity ?', A Sandoz Publication for the Textile and Leather Processing Industries, pp 1 - 14.

MAGAZINE

Gopalakrishnan .P.
1986 The Hindu 18th January, P 18.

Appendices

APPENDIX - I

Details about the selection of materials

Cotton 40's Count

Width - 127 Cms

Cost per metre - Rs. 12.50

Cotton 20's Count

Width - 127 Cms

Cost per metre - Rs. 12.50

APPENDIX - II

RECIPES FOR DESIZING

The recipe followed for the desizing samples are as follows

Recipe for XD and YD

Weight	-	10 g
Zymax	-	10.0 gpl
Salt	-	10.0 gpl
Wettol R	-	2.0 gpl
Water	-	1000 cc
Temperature	-	60 ^{o}c
Time	-	8 hours
Wetpickup	-	100 %

The same recipe is followed for all the other desizing samples with slight variation. For an example

Recipe for $XDte_{1}$ and $YDte_{1}$

Weight	-	10 g
Zymax	-	10.0 gpl
Salt	-	10.0 gpl
Wettol R	-	2.0 gpl
Water	-	1000 cc
Temperature	-	Room Temperature
Time	-	8 hours
Wetpickup	-	100 %

Recipe used for X and Y bulk desizing under normal conditions.

Zymax	-	300 gpl
Salt	-	300 gpl
Wettol R	-	60 gpl
Water	-	30000 cc
Temperature	-	60 ^{o}c
Time	-	4 hours

APPENDIX III(A)

RECIPES FOR SCOURING

The general recipe used for scouring was

Caustic	-	4 %
DTC	-	0.4 %
Material Liquor ratio	-	1 : 5
Temperature	-	Boiling
Time	-	1 hour

According to the weight of the sample the recipe is prepared.

Example :

Recipe for XSe_1

Weight	-	97.3 gms
Caustic (1%)	-	0.973 gms
DTC	-	0.3892 gms
Water	-	390 cc
Temperature	-	Boiling
Time	-	1 hour

The recipe used for bulk scouring for X and Y under normal conditions was

Caustic	-	480 gpl
DTC	-	48 gpl
Water	-	12000 cc
Temperature	-	Boiling
Time	-	1 hour

APPENDIX - III(B)

RECIPES FOR DYEING

According to the weight of the scoured samples which are scoured with varied parameters were dyed with the following recipe.

Samples of X

Weight	-	310 gms
Remzol Brilliant Red 5B	-	20.0 gpl
Sodium Hydroxide	-	90.0 gpl
Urea	-	40.0 gpl
Sodium Hydroxide	-	2.8 gpl

The same recipe was followed for the samples of Y.

Hydrogen peroxide	- 50 cc
Vica bleach	- 15 gms
Soda ash	- 25 gms
DTC	- 10 gms
Temperature	- Boiling
Time	- 1 hour
Water	- 5000 cc

APPENDIX - IV

RECIPES FOR BLEACHING

The genral recipe for Peroxide Bleaching was

Hydrogen peroxide	-	20 cc/l
Vica Bleach	-	5 gpl
Soda ash	-	5 gpl
DTC	-	2 cc/l
Neosof AS	-	2 cc/l
Material liquor ratio	-	1 : 6
Temperature	-	Boiling
Time	-	1 hour

According to the weight the sample the recipe was prepared for bleaching

Example :

Recipe for YBC$_1$

Weight	-	95 gms
Hydrogen peroxide (10gpl)	-	5.7cc
Vica Bleach	-	1.14 gms
Soda ash	-	1.71 gms
DTC	-	1.14 cc
Neosof AS	-	1.14 cc
Water	-	570 cc
Temperature	-	Boiling
Time	-	1 hour

The recipe used for bulk bleaching X and Y was

APPENDIX - V (A)

RECIPES FOR MERCERISING

The general recipe used for mercerising was

Caustic Lye	- 50° TW (281 gpl)
Auximerc Nc	- 2 cc

The recipes used for mercerised samples were followed the above general recipe with slight variations.

example

Recipe for XMC_2

Caustic Lye	- 510 gpl (80° Tw)
Auximerc Nc	- 2 cc

APPENDIX - V (B)

RECIPES FOR DYEING

According to the weight of the samples the recipe for dyeing was prepared.

Samples of X

Weight	- 20 gms
Remzol Brilliant Red 5 B	- 1.29 gpl
Sodium silicate	- 5.80 gpl
Urea	- 2.58 gpl
Sodium hydroxide	- 0.18 gpl

The same recipe is followed for the samples of Y which are mercerised with slight variations.

APPENDIX - VI (A)

RECIPES AND CALCULATIONS OF TOTAL SIZE AND RESIDUAL SIZE

TOTAL SIZE

To calculate the total size the initial weight and final weight of the grey samples of X and Y was taken.

The recipe used for totalsize was

Zymax	- 4.0 gpl
Salt	- 4.0 gpl
Weholr	- 2 gpl
Water	- 2 gpl
Temperature	- 60 C
Time	- 4 hours
Wetpickup	- 100%

Total size was claculated by using the following formula.

$$\text{Total size} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Final weight}} \times 100$$

Example

Initial weight of x

Xa = 1.9361 gms

Xb = 1.9440 gms

Final weight of X

Xa = 1.7381 gms

Xb = 1.9268 gms

$$\text{Therefore Total size (Xa)} = \frac{1.936 - 1.7381}{1.7381} \times 100$$

$$= 11.391 \text{ gms}$$

$$\text{(Xb)} = \frac{1.9440 - 1.7268}{1.7268} \times 100$$

$$= 12.578 \text{ gms}$$

$$\text{The average total size} = \frac{11.391 + 12.578}{2}$$

$$= 11.9845$$

Therefore total size of x = 11.9845 gms

RESIDUAL SIZE

To calculate the residual size the initial and weight of the desized samples were taken.

The recipe used for residual size was

Zymax	- 15 gpl
Salt	- 15 gpl
Wettol R	- 3 gpl
Water	- 1500 cc
Temperature	- 60° C
Time	- 4 hours

Residual size was calculated by using the following formula

$$\text{Residual size} = \frac{\text{Initial weight - Final weight}}{\text{Final weight}} \times 100$$

Example

Initial weight o6 x D

xDa = 2.5966 gms

xDb = 2.6280 gms

Final weight o6 x D

xDa = 2.5444 gms

xDb = 2.5976 gms

Therefore residual size $(xDa) = \frac{2.5966 - 2.5444}{2.5444} \times 100$

$= 2.051$ gms

$(xDb) = \frac{2.6280 - 2.5976}{2.5976} \times 100$

$= 1.1703$ gms

The average residual size $06 \times D = \frac{2.051 + 1.1703}{2}$

$= 1.61065$ gms

Therefore residual size o6 x D = 1.61065 gms

APPENDIX - VI (B)

CALCULATION OF DESIZING EFFICIENCY

DESIZING EFFICIENCY

Desizing efficiency was calculated by using the following formula

$$\text{Desizing efficiency} = \frac{\text{Total size} - \text{Residual size}}{\text{Total size}} \times 100$$

Example

Total size of x = 11.9845 gms

Residual size of xD = 1.61065 gms

$$\text{Therefore Desizing efficiency} = \frac{11.9845 - 1.61065}{11.9845} \times 100$$

$$= 86.56$$

Desizing efficiency of xD = 86.56%

APPENDIX - VII

CALCULATION OF BARIUM ACTIVITY NUMBER

BARIUM ACTIVITY NUMBER

Barium activity number is calculated by using the following formula

$$\text{Barium activity number} = \frac{a - b}{a - c} \times 100$$

where

a = Quantity in ml of hydrochloric acid required for the blank.

b = Quantity in ml of hydrochloric acid required for the test sample.

c = Quantity in ml of hydrochloric acid required for the unmercerised sample.

Example

Barium activity number of YM

a = 26.3

b = 23.2

c = 21.9

$$\text{Therefore barium activity number of YM} = \frac{26.3 - 21.9}{26.3 - 23.2} \times 100$$

$$= \frac{4.4}{3.1} \times 100$$

$$= 141.93$$

Therefore barium activity number of YM = 141.93

APPENDIX - VIII

Using the following nested design model the nested design for the study was formulated and calculated by using the formulated and calculated by using the formula given below.

Model of nested design

		I			I	
(A)						
		A1			A2	
(B)	B1	B2	B3	B1	B2	B3
	a	d	g	j	m	p
	b	e	h	k	n	q
observations	c	f	i	l	o	r
	(T1)	(T2)	(T3)	(T4)	(T5)	(T6)
		(C1)			(C2)	

T = total

$$Xij = \quad + Ci + Tj.i + Eij$$

$$SS = \frac{C1^2 + C2^2}{9} - CF$$

$$CF = \frac{(C1 + C2)^2}{18}$$

$$SS(v) = \frac{(T1^2 + T2^2 + \ldots\ldots + T6^2)}{3} - CF$$

$$SSE = (a)^2 + (b)^2 + \ldots\ldots + (r)^2 - \frac{(T1^2 + T2^2 + \ldots\ldots + T6^2)}{3}$$

TSS = (a) + (b) + ... + (r) - CF

CF - Correction factor

SS - Sum of squares

SS(v) - Sum of squares between A and B

SSE - Sum of squares of error

TSS - Total sum of squares

The ANOVA (RBD in two way analysis) was formed by the following way (example).

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Fo	Fe 5%	Fe 1%
Between counts	1	0.3000003	0.3000003	0.71625	5.1174	10.561
Between Wetpickup	9	3.76667	0.418518	5.2315 **	2.3928	3.4567
Error	20	1.6	0.08			
Total	29	3.766667				

** Significant at 5 percent and 1 percent level

CF = 4200.833333

SSc = 4201.13333 - 4200.833333

= 0.3000003

SS(w) = 4204.6 - 4203

= 1.6

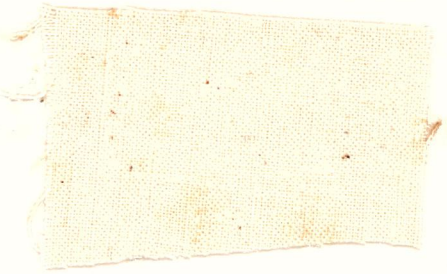
TSS = 3.766667

APPENDIX IX

PROCESSED SAMPLES

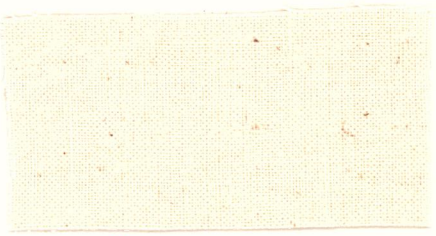
XD

YD

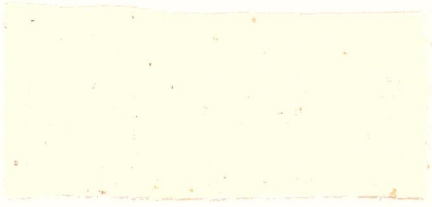


XDte1

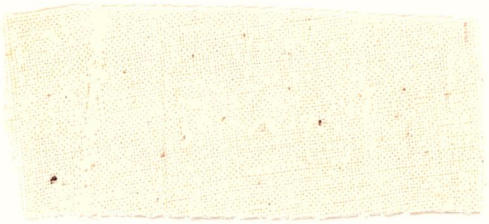
YDte1



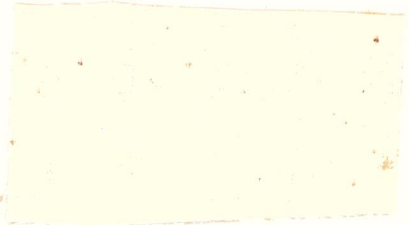
XDte2



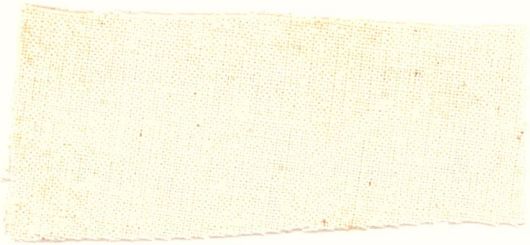
YDte2



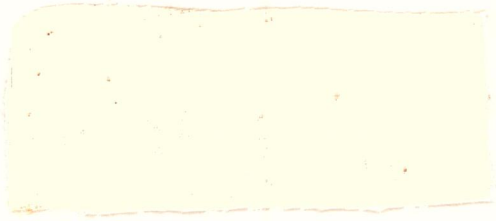
XDw1



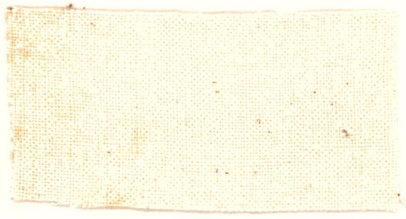
YDw1



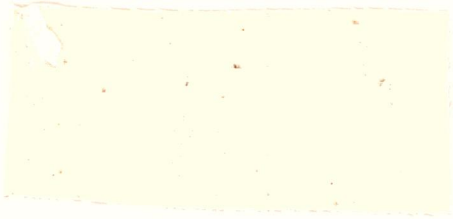
XDW2



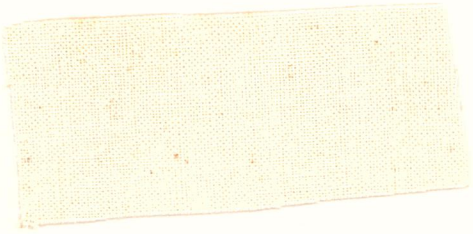
YDW2



XDT1

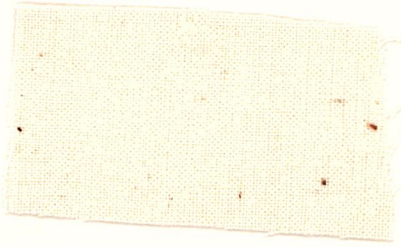


YDT1

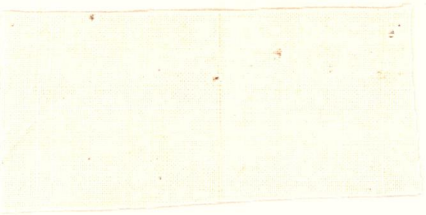


XDT2

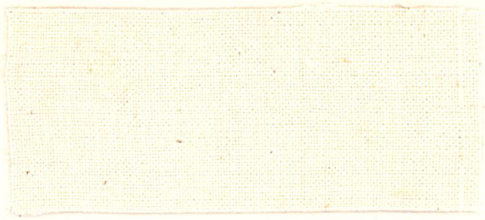
YDT2



xs



ys



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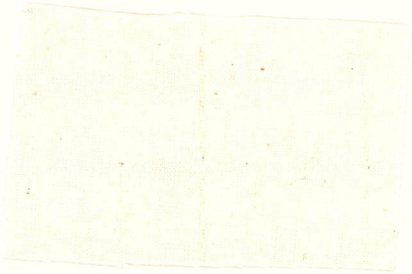

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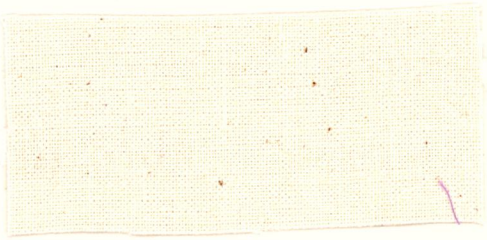

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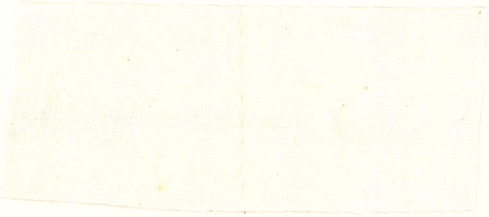

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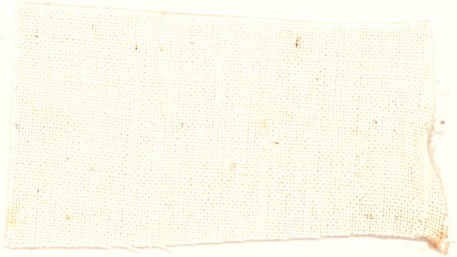
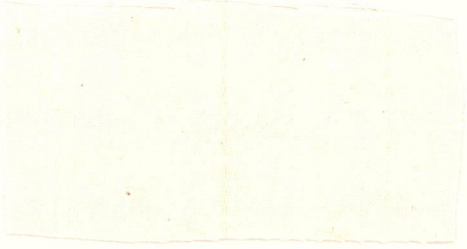


xste1



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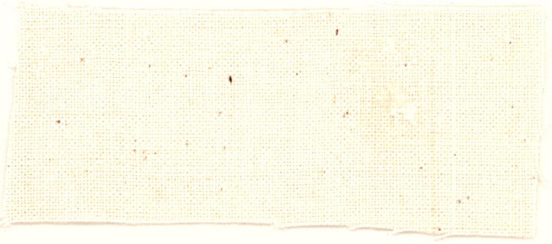

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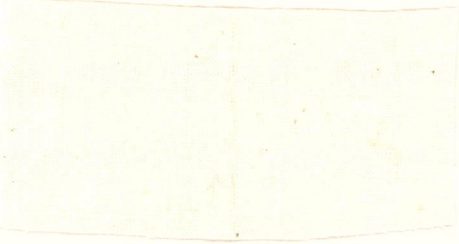
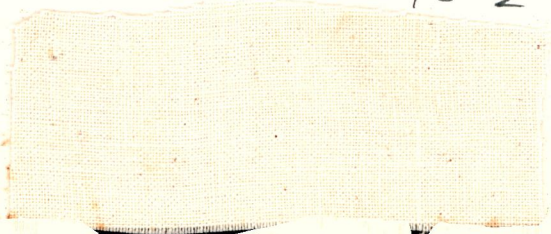


yst1

xst2

yst2



XB

YB

XBC1

YBC1

XBC2

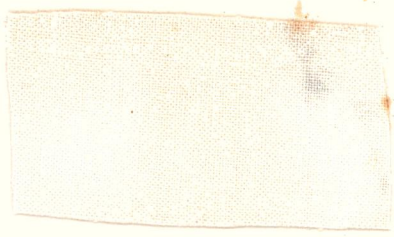
YBC2

XBtel

YBtel

x_m

y_m



x_{mc_1}

y_{mc_1}

x_{mc_2}

y_{mc_2}