QUALITY CONTROL :

ITS ROLE AND EFFECTIVENESS IN THE JUTE MILLS OF BANGLADESH

A Project Thesis

By

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Submitted to the Department of Industrial and Production Engineering, Bangladesh University of Engineering and Technology, Dhaka in partial fulfilment of the requirements for the degree of MASTER OF ENGINEERING from the DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING.

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

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CERTIFICATE

This is to certify that this work has been done by me and it has not been submitted elsewhere for award of any degree or diploma or for publication.

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A B S T R A C T

Present project work intends to make an analysis of the quality control systems that exist in different Jute mills of the country, the central quality control department of Bangladesh Jute Mills Corporation and Bangladesh Jute Research Institute.

From the record of the claims settled by the buyers of jute products of Bangladesh, the various defects usually come across have been found out. After careful observation and analysis the factors responsible for low quality products have been identified. These are related to raw materials, machinery and equipment, production processes, personnel, test procedures etc. The approximate relative contribution of each factor was also determined.

A regression analysis has been carried out to establish whether any relationship exists among the properties of the jute goods.

Control charts have been constructed for the means and ranges of weights of specified amount of in-process jutes at different stages.

For various tests, the sampling procedure was analysed and the sample sizes were calculated on a statistical basis.

Lastly, some specific recommendations have been suggested to improve the existing quality control systems of the jute mills of Bangladesh.

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CHAPTER ONE

INTRODUCTION

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INTRODUCTION

1.1 General Introduction

Bangladesh earns more than 50% of the total export earnings from jute. Its jute products had a great demand in the world market. But the world demand is gradually declining. Now-a-days jute has to face a hard competition with its substitutes, the synthetic Fibres. Armed with some irresistible advantage as cheapness, lightness, inertness, durability and a steady domestic supply, synthetic fibres are marching on. The incremental market share is shown by the following table.

Table 1.1: Incremental demand of synthetic fibre[3]

Output of the synthetic fibres of the World				
Year	1964	1968	1973	1980
Increment by percentage	7%	31%	16%	20%

The worldwide output of synthetic fibre advanced by 31% in 1968 and by a further of 16% in 1973, which in the later years accounted for 20% of the overall production of industrial fibres, compared to 7% in 1964. These products are polypropylene, polyethylene, polyester, polyolefin, polymide ([illegible]), and other petrochemical products. For most of the 1960s, jute enjoyed pride of place, both as primary and secondary backing for tufted carpets. Now jute, as a primary backing fibre, faced a serious challenge from woven and non-woven polyolefins and lost the grounds. The use of jute as secondary backing fibre is also being challenged by a variety of synthetic foam backings. As a result, the global consumption of jute goods which remained static for the last fifty years, is now going down.

Synthetic fibres are expanding their market through their own demand and also as the substitutes of jute. As a result of vigorous research and development, synthetic fibres are coming uncomfortably closer to the jute goods in quality and price. If jute is to survive and maintain its dominance over its substitutes in the days to come, proper consideration must be given on the diversification and quality improvement of the jute products. Otherwise Bangladesh may have to suffer a substantial loss in export earnings and bring about a great instability in its economy.

The present study mainly concentrates on different aspects of quality assurance and improvement of the Jute Products of our Country. Before stating the main objectives of this project work, some conceptual discussions on the various aspects of quality and quality control have been presented in the following sections.

1.2 What is Quality

Product quality can be defined as the composite product characteristics that determine the degree to which the product in use will meet the expectations of the customers. Any feature which is desired to achieve fitness for use is a quality characteristic. This is the basic building block on which fitness for use is built. The quality characteristics exist in several subspecies, such as technological, psychological and ethical. Each of these species has a different appeal to the consumers for different products. But technologically defined product quality is the prime concern because it contributes more to the customer satisfaction.

Product quality which was once the interest of a few technical men, has become today the primary concern of an increasingly large number of managers, engineers and statisticians.

1.3 Quality and Cost

In attempting to implement the quality standards the quality control function is faced with a major problem of balancing incremental gains and incremental losses. By increasing the effort to control the quality of incoming raw materials, processes and final product performance, one can reduce costs due to scrap, rework and customer dissatisfaction. On the other hand, increasing the quality control effort in itself is expensive and increasingly so, because of more inspection, machine maintenance, set up costs, labour idle time due to control interference etc. Thus there is some optimal effort which balances the two opposing cost pressures.

The figure 1.1 presents a hypothetical relationship between quality, Cost and Value of product.

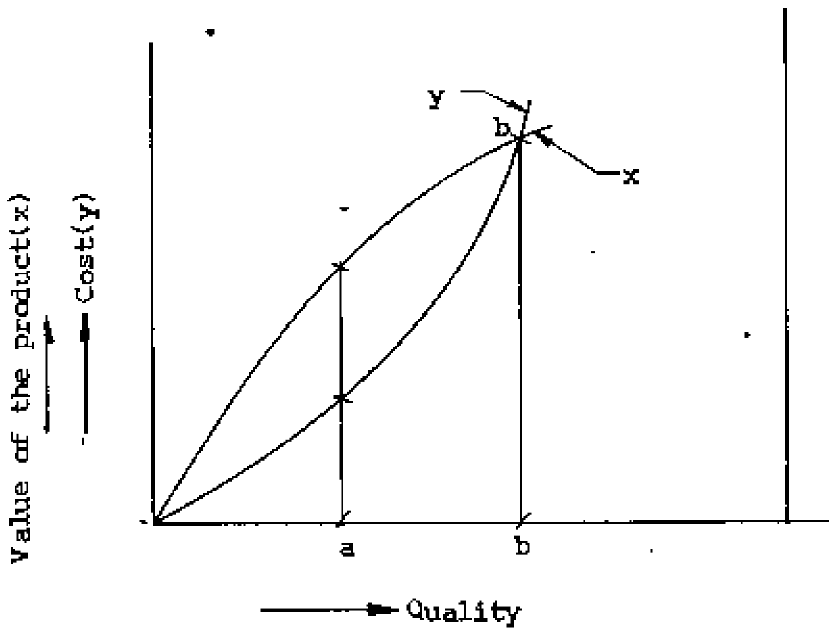

Figure 1.1: Relationship between the cost and value of the product with quality

At a point 'b' where the two curves intersect each other, the cost and the value of the product are same i.e. this quality of the product cannot earn profit. In fact the maximum distance between the two curves corresponds to the maximum profit. The corresponding quality is the optimum quality. (Point 'a').

1.4 Total Quality Cost

Total Quality Cost includes two elements, namely (i) Cost of appraisal and (ii) Cost of failure.

When the cost of appraisal and prevention is zero, the product is 100% defective. To improve conformance, these costs are increased until perfection is approached. Here the prevention costs rise asymptotically, becoming infinite at 100% conformance. As non conformance sets in failure costs rise until at 100% nonconformance, the product is 100% defective where the failure cost per good unit becomes infinite. The figure 1.2 explains the above situations.

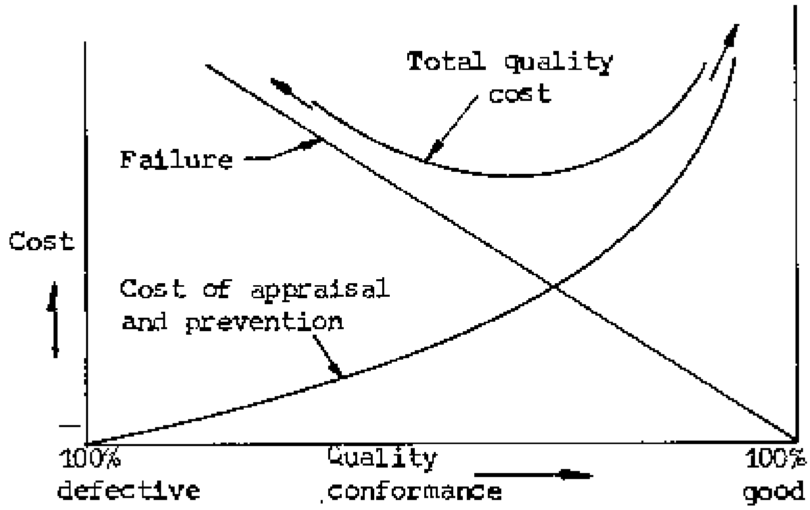

Figure 1.2: Model for optimum quality cost(1)

The figure 1.3 shows the three distinct zones of the total quality costs. The zones are:

i) zone of improvement projects

ii) zone of indifference and

iii) zone of perfectionism.

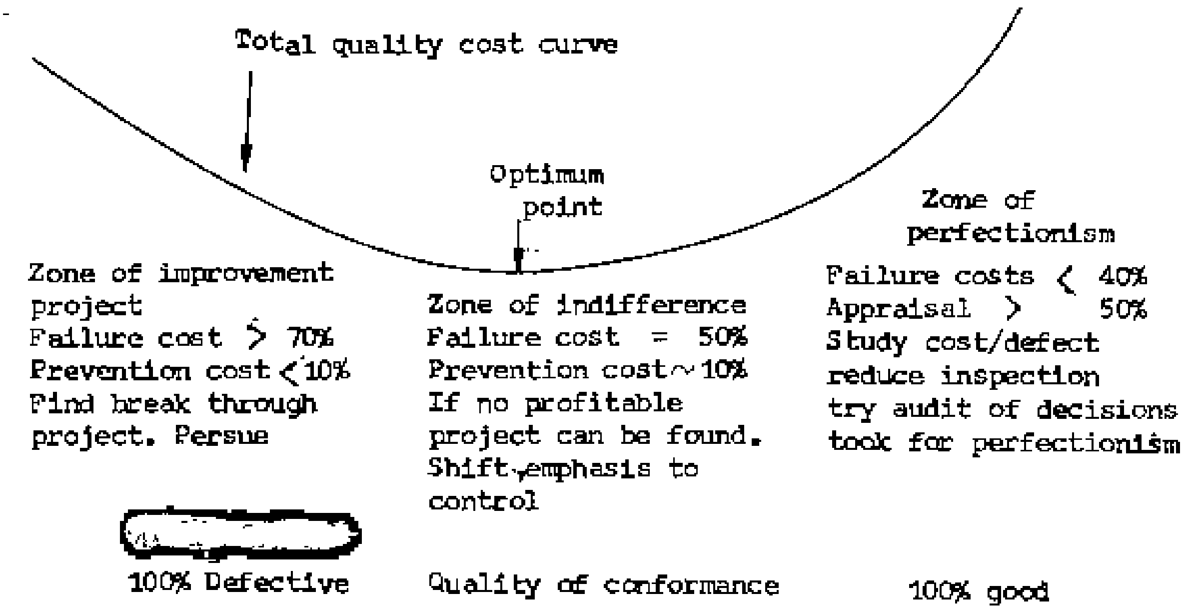

Figure 1.3: Optimum segment of quality cost model

These zones are discussed below:

Quality improvement zone:

The usual distinguishing features are that failure costs constitute over 70% of the total quality costs, while prevention costs are under 10%. In such cases, there are profitable improvement projects waiting to be persued.(1)

Perfectionism zone:

It is charectirized by the fact that appraisal costs exceed failure costs. The improvement projects consist of discovering and removing the undue costs of perfectionism. This may be done by programs such as:

a) Studying the cost of detecting defects compared to the damage done if they are not detected.

b) Reviewing the quality standards to see if they are realistic in relation to fitness for use.

c) Seeing if it is feasible to reduce inspection through use of process capability and preserving the order.

Indifference zone:

It is characterised by the fact that about half the quality costs are failure costs while prevention costs are about 10% of all quality costs.

The situations at which each type of cost elements reaches its optimum value is discussed below:

1. Failure costs are at their optimum when it is difficult to identify profitable projects for reducing them.

2. Appraisal costs are at their optimum when

   a) failure costs have been brought down to optimum,
   b) identification of profitable projects is difficult for further reducing appraisal costs and
   c) good work methods and standards have been established for inspection and test and are meeting those standards.

3. Prevention costs are at their optimum when

   a) the bulk of prevention work is being directed to authorized improvement projects.

b) prevention work itself has been subject to analysis for improvement, and

c) the non project prevention work is controlled by sound budgeting.

1.5 Quality Control

Quality control is a process through which actual quality performance is measured, compared with standards and actions are taken on the differences. This process consists of a series of functions which when applied to problems of quality, can be listed as follows.[7]

Programming:

This includes defining the sequence in which measurements are to be performed, the equipment to be used for measuring the individual quality characteristic the procedure to be adopted for measurements and the expected results.

Selecting:

This includes selecting the material, part or product that is to be tested or inspected. The connections to it, the input signals to be applied,, the output terminals required and the measuring devices applicable.

Measuring:

This function refers to actual performance of measurement of the product or process quality characteristics.

Data recording and processing:

This includes recording pertinent information obtained from the measurement of the quality characteristics and then tabulating this information in usuable form for analysis purposes.

Information Analysis and Decision:

This refers to the computations of certain parameters for the measurement information, comparing these with the required results for conformance determining their acceptability. This function also includes establishing the corrective or controlling action desired.

Feed Back:

Non conformance detected for analysis is to be communicated to the proper controlling areas for taking necessary actions.

Controlling:

From the feed back information, required corrective or controlling action is performed, as necessary on product design, the manufacturing process, materials, etc.

The interrelationship of the above functions has been presented in figure 1.4.

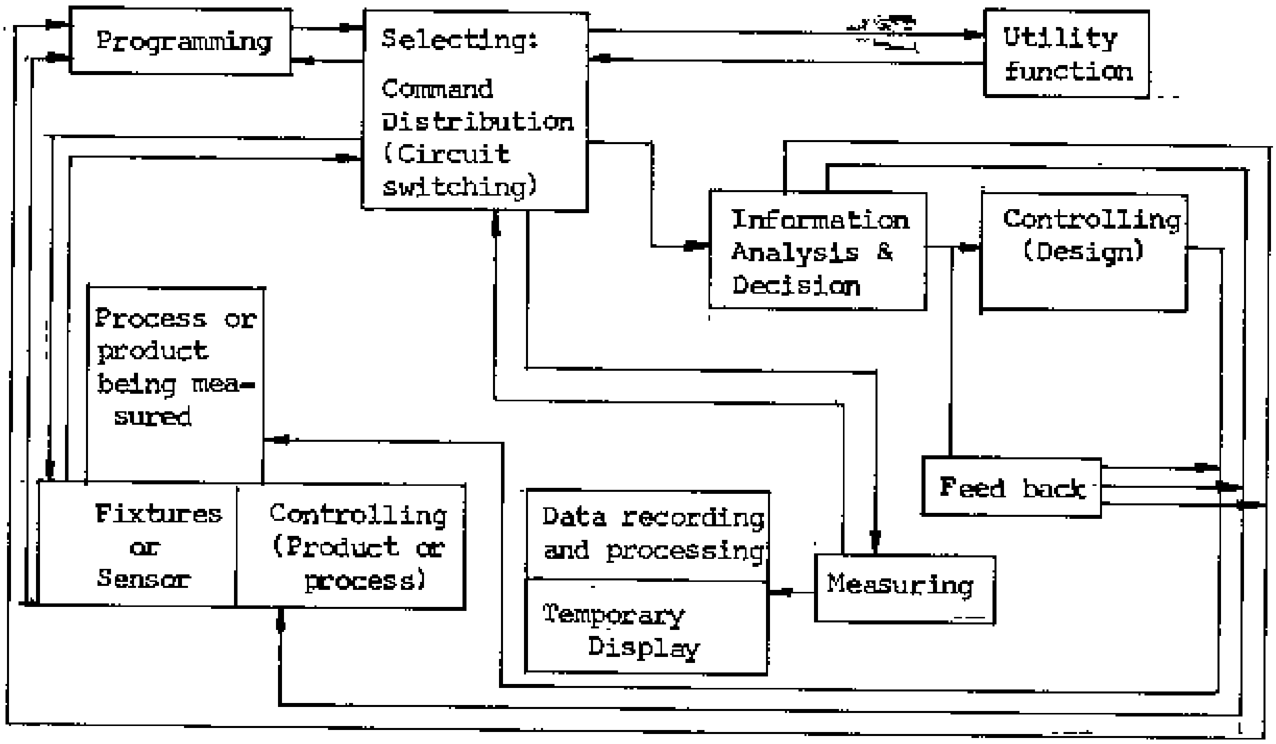

Figure 1.4: Functions of Quality Control

The analysis of the above functions reveal that quality control for its efficient running depends on many other factors of the organization. These are sound costing, a detailed maintenance program of the machineries, proper skill and training of the involved personnels etc. To conclude this section, quality control may broadly be defined as a process which refers to an effective system for integrating the quality development, quality maintenance and quality improvement efforts of various groups of an organisation so as to enable production and services to be carried out at the most economic level which allows full customer satisfaction.

1.6 Objectives of the Research Work

As mentioned earlier, jute industries of the country have been passing a crucial period in respect of capturing world market specially due to the development of different synthetic products. In order to have same export market from further contraction, along with various development programs, quality assurance for the products should be given a prior emphasis. To ensure that the final product conforms to the desired specifications of the buyer, quality control schemes should be developed at all stages.

In the context of above requirements, the objectives of this project paper may be laid down as follows:

i) To study the existing quality control system in enterprizes, BJMC central Q.C. department and at Bangladesh Jute research institute.

ii) To analyze the claims of the buyers and then to identify the defects of the jute products and recommend their possible remedies.

iii) To make a statistical analysis in order to establish if any relationship exists among the different properties of the jute goods and thereby to explore the possibility of reducing the number of tests that are being presently carried out at different phases.

iv) To construct the control charts for the existing machine.

v) To study the sampling procedures and determine the required sample sizes for a given accuracy.

vi) To suggest specific recommendations for the improvement of the existing quality control systems of the jute mills of Bangladesh.

CHAPTER TWO

SALIENT FEATURES OF JUTE MILL

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SALIENT FEATURES OF JUTE MILL

2.1 Production Process in a Jute Mill

Preliminary processing of jute includes softening and maturing which are accomplished in the spreader. Carding removes foreign matter and brushes the fibres and prepares them for further processing. Spinning converts the fibres into twisted yarns for weaving in the looms. These operations are shown in the figure 2.1 and the stage wise flow chart is shown in figure 2.2.

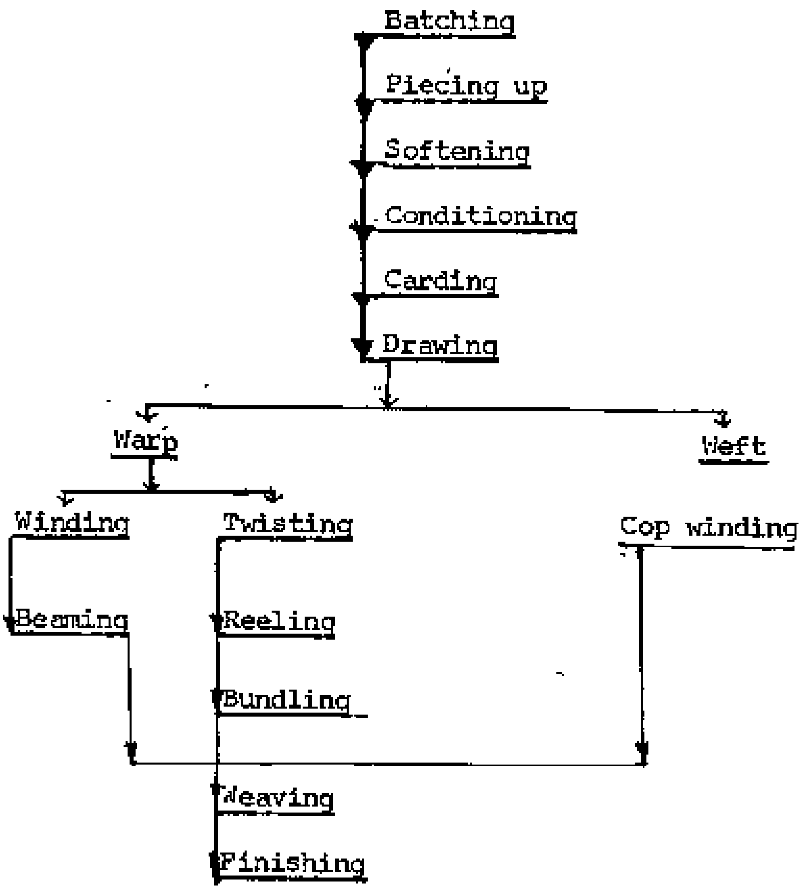


Figure 2.1: Operations in a jute mill

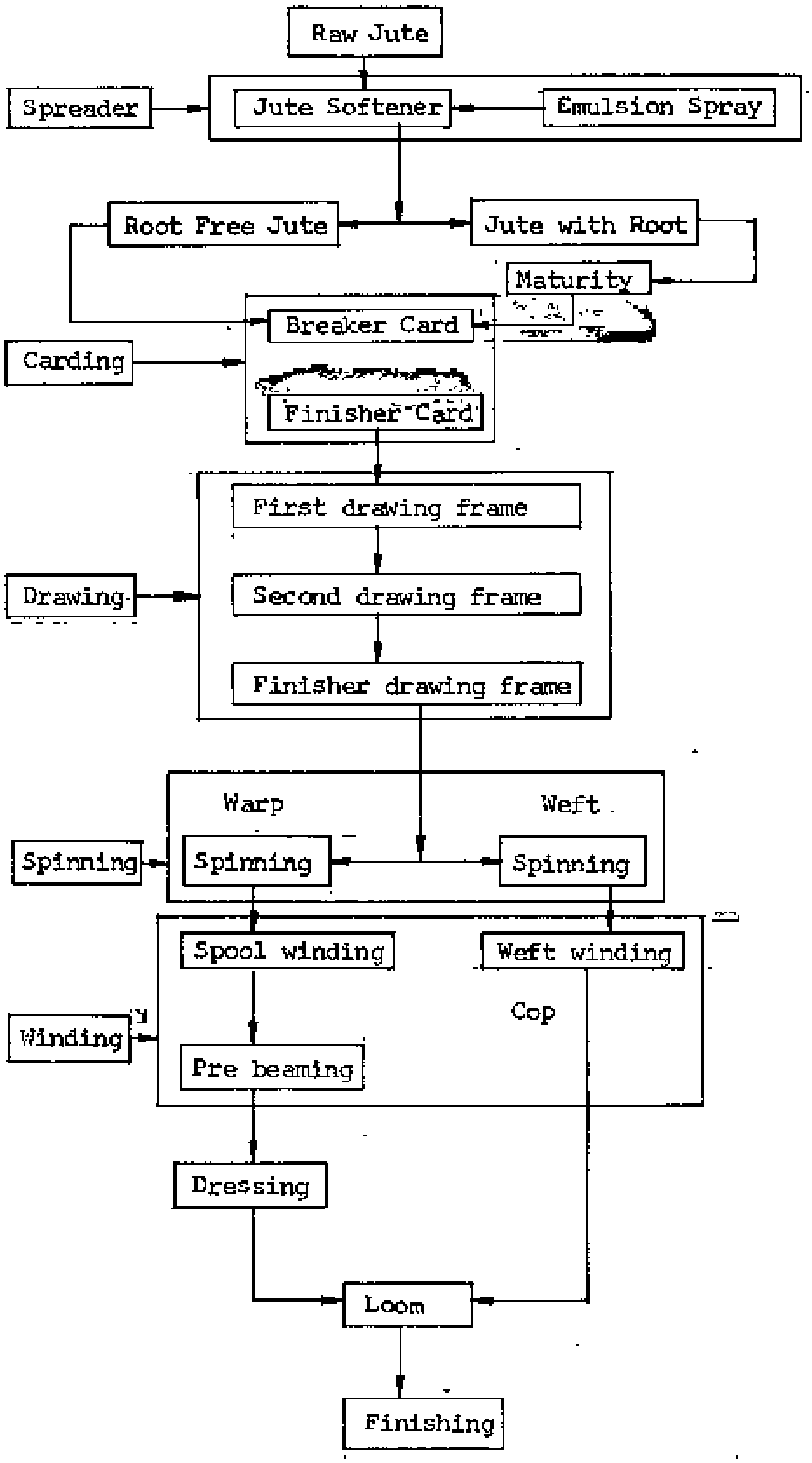


Figure 2.2: Production process chart for a jute mill

Raw jute is unloaded on jetty, weighed on trolleys and carried to the godowns. From the godown, this jute is brought to jute assorting shed, where grading is done according to their quality. Main grades are Tossa and white with subdividions as Mid-bottom, B-bottom, C-bottom, X-bottom, L-X bottom etc. In the next step, the various grades of jute are mixed up with a specified batch composition.

An emulsion is prepared from jute batching oil (J.B.O), nonident P-40 and water. Oil lubricates the fibres and helps their free movement while water gives required dampness and flexibility.Jute is fed into spreader or softener through which the emulsion is applied. The materials delivered from softener machines are arranged in layers into a pile and covered by a heavy cloth for a certain period to help gas formation and bacterial growth for softening. In the preparation section, soft jute is subjected to carding operation, which is a process by which long stricks of Jute while passing through high speed pinned rollers are broken down in an 'angled mass' and converted into a 'sliver' of suitable weight per unit length. The product is delivered in a ribbon form. The carding operation is carried out through two sets of machines (i) Breaker card & (ii) Finisher Card. In the breaker card, the fibres are hackled within slower and faster rollers. In finisher card, different qualities of jute that go into a batch are properly mixed to form a single roll from eleven rolls of different specific 'qualities'. To subject it for more fineness to make it suitable for spinning, drawing and doubling are done. Drawing elongates the sliver, making it light and more uniform while doubling combines two or more slivers into one. First, second and third drawing are done successively on a single sliver.

The yarn on bobbin is next taken for winding which is of two types, namely, spool winding and cop winding. The former type is carried out for warp and the later for weft.

Next, spool goes to beaming section and cop threads are taken for inserting in shuttles. Dry beaming is done on heavier yarns for sacking. Pre beaming is done on better quality yarns which are then taken to Dresser. Dresser means coating of warp yarns with some adhesive substance during beaming. Tamarind seed, powder, parafin wax, gum, starch powder etc. are used as ingredients for dressing. Finally beams with concentrated yarn wrapped on it are shifted to weaving department.

After weaving operation some minor defects are repaired the finishing section.

2.2 Quality Control Personnel

There is a seperate quality control department in every jute mill where the quality of incoming, inprocess and outgoing jute quality are checked on a definite schedule. They have the following organogram.

Organogram of enterprise-level quality control department.
(Taken from KARIM JUTE MILLS)

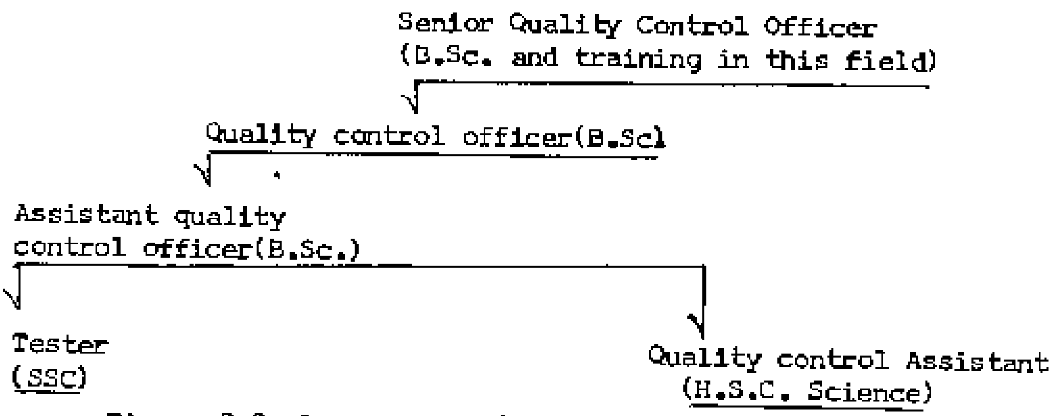


Figure 2.3: Organogram of quality control dept.

2.3 Existing Policy on the Inspection

In a jute mill the manufacturing process involves a series of operations. So inspection is done at different stages to check the deviation of properties from some standard values. The quality inspection is carried out mainly at the following levels.

Inspection of Quality

1. Moisture in raw jute:

   For every 100 bales, 5 bales are selected at random and from each bale 5-readings 4 from sides and 1 from bales end are taken. During testing, loose morrah should be twisted to maintain compactness of fibre and from each morrah 3 readings are taken i.e. from top, middle and bottom.

2. Morrah weight:

   At random 10% assorter is selected for checking.

3. JBO:

   Colour, smell and viseosity of the JBO are taken for inspection before preparing emulsion, once in each shift of production.

4. Emulsion:

   Oil % and emulsifier % used in preparing emulsion are checked 8 hourly.

5. Pile checking:

The maturity of the pile is checked once daily and pile temperature 8 hourly by taking 6 readings from each pile - 2 from its side, 1 from one foot down from the top layer, 1 from one foot from the bottom layer and 1 at the middle of the layer.

6. Batch checking:

Quality wise batch is checked 4 hourly.

7. Sliver test:

Sliver is tested quality wise at random or i.e cyclic order. 5 samples from four rolls of card each of 10 yds from one card - 4 hourly. For third finisher drawing sliver test, a test length of 25 yds is taken. Moisture regain delivery rate, weight etc. of slivers are tested periodically.

8. Yarn test:

Quality wise spinning frame is selected at random or in cyclic order. For count testing 10 bobbins are selected at random from one frame and one hank of 100 meter from each bobbin 4-hourly. For strength same bobbin is used and test length is selected after discarding few meter, 5 test from each bobbin - 4 hourly has to be performed. For twist testing 2 test per bobbin has to be taken 4 hourly.

9. Cop inspection:

The cop has to be inspected in cyclic order in 10% of the cop winders. Dimension, compactness and taper/nose end of the cop as well as yarn knots are tested.

10. Starch test:

Viscosity and temperature of starch at mixing tank and sow box is tested twice in each shift. The temperature and steam pressure of the drying cylinders as well as yarn speed are maintained at such a balanced level so that the dressed beam does not become brittle or remain wet.

11. Beam test:

One beam of each quality is checked 4 hourly for both numbers of yarn/ends and uniformity of distribution and moisture regain % in beam. To check the products for preassigned specification about 20 cuts of hessian and 20 bags of sacking are tested per shift.

2.6 Present Policies of Testing

At the enterprise-level the existing testing policies are as follows:

Weight of cloth:

A square meter of cloth is to be weighed for each sample piece and the same has to be conditioned to standard 65% R.H. and temperature of 22°C prior to weighing. In the absence of the required conditioning the actual weight of the cloth may be converted to the required regain according to the following relation. Assuming 16% contract regain for hessian and 20% contract regain for sacking, the weight corrected for regain is given by [redacted]

$$\text{Weight/meter at 16\% regain} = \text{Actual wt.} \times \frac{116}{100 + \text{obs MR\%}}$$

$$\text{Weight/bag at 20\% regain} = \text{Actual wt.} \times \frac{120}{100 + \text{obs M.R\%}}$$

Width of the cloth:

A sample of full length of a cut or roll is passed over an inspection machine and width is measured at 7 points.

Porter and shot:

The sample is laid out on a smooth surface and porters and shots are measured with a porter gauge

Warp way tensile strength:

Samples of one meter long from any three of the first five cuts and also from the last five cuts of a shift are taken strips are then cut into 15 cm by 12.5 cm respectively in the warp and weft way direction. The width of the strip is then reduced to 10 cm by taking out threads from both sides. At least five strips from each master sample after properly getting conditioned at 65% R.H. and 22^{o}C are tested on any vertical type strength testing machine.

Weft way tensile strength:

Sample of 15 cm in weft way and 10 cm wide in warp direction is taken. Sampling and Test procedure are same as that of warp way tensile strength. For sacking bags 12 warp, 12 weft way and 12 seam strength tests are taken from 6 bags

Moisture regain:

It is expressed as the percentage weight of the material i.e.

$$M.R. = \frac{\text{Original weight} - \text{Dry weight}}{\text{Dry weight}} \times 100$$

The test is done in a conditioning even or rapid tester for small samples. A sample is placed in a perforated container and is dried with circulation of hot air at 110°C by a thermoregulator. The difference between the weights of the specimen before and after drying gives an estimate of the regain in relation to the dry weight of the sample. Now-a-days, Probe type electronic moisture meters are widely used for direct estimation of regain by electric resistance.

At least 10% of the rolls or bags are selected at random and observations are made at five places and average is taken.

Oil content:

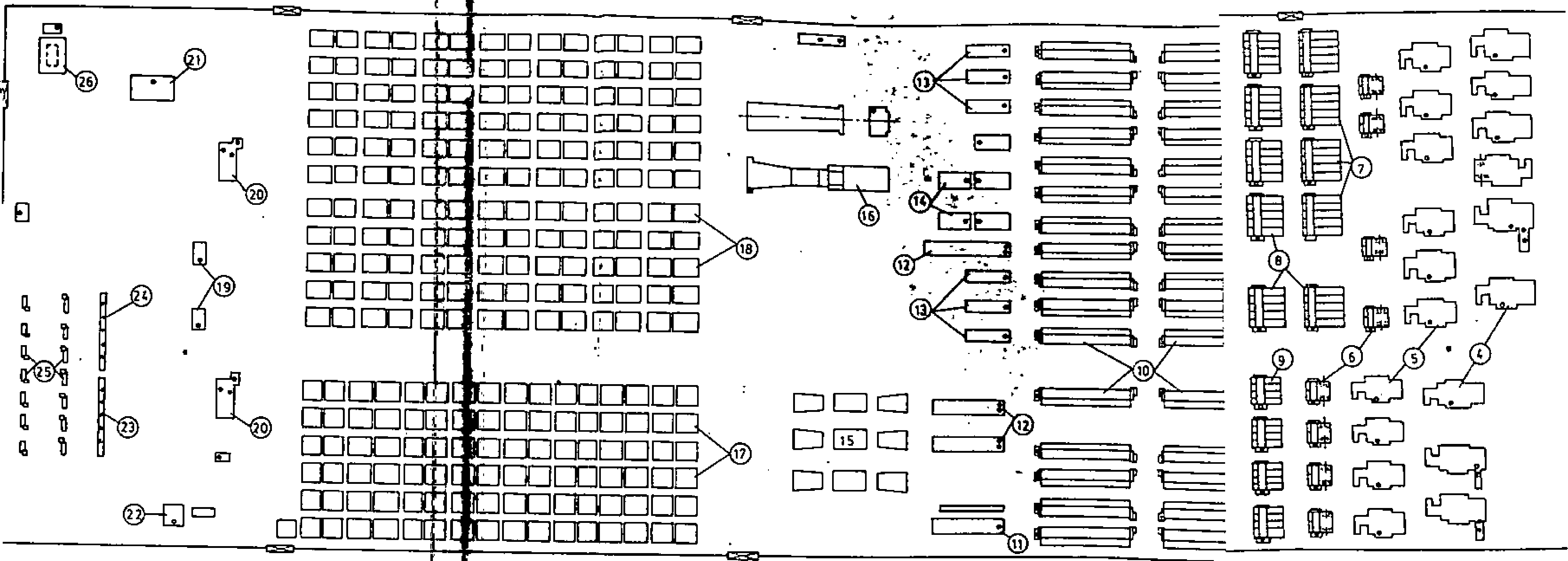
A portion from each of the cuts representing first and last two hours productions of the shifts is tested by soxhlet extraction method on dry deoiled material basis using Dichloromethane as a solvent.

$$\% \text{ of oil content} = \frac{100 \times \text{oil wt. in sample}}{\text{Oven dry wt. of sample}}$$

2.5 Layout plan of machinery for a medium sized Jute Mill

For the application of quality control models the machinery layout plan is to be analysed to make it in a systematic way. The layout of various machineries of a medium sized jute mill has been given in figure 2.4

MACHINERY LAYOUT PLAN



1. Emulsion plant
2. Softner machine
3. Hard waste T/card
4. Breaker card machine
5. Finisher card machine
6. 1st Drawing
7. 2nd Drawing
8. 3rd Drawing
9. Finisher drawing
10. Spinning frame
11. Twist frame
12. Low cop machine
13. Mack roll machine
14. Mack cop machine
15. Dry beaming machine
16. Hibbert dressing machine
17. Sacking loom
18. Hessian loom
19. Damping machine
20. Calender machine
21. Lapping machine
22. Cutting machine
23. Hemming sewing machine
24. Herrackle sewing machine
25. Overhead sewing machine
26. Bal press machine

Fig 8.24

CHAPTER THREE
DATA COLLECTION

3.1 Introduction

3.2 List of Essential Testing Equipment for Quality Control of Jute

3.3 The Tests and Records for Inprocess Jute

3.4 Permissible Range of Various Quality Parameter

CHAPTER : THREE

DATA COLLECTION

3.1 Introduction

To develop an effective and cost optimal quality strategy, proper data collection and subsequent analysis are essential. But before launching a data collection program, one must consider several important questions, which are listed below:

a) What is the objective of data collection ?

b) Which data should be collected ?

c) Where will they be available in desired forms ?

d) How should they be collected ?

e) What are the best methods in approaching towards a definite conclusion objectively ?

f) Can the results of all these efforts be presented in a meaningful way ?

Answer to these questions are not straight forward; mostly they are inter-dependent and require modifications of the system after careful reviews of the effectiveness. Moreover data collection and data processing are often an expensive business, but the benefits to be gained from assurance of high quality jute goods are tremendous and very frequent quality checks at all stages of production are already in practice. So, the main question is in what format data should be collected and presented. Typical but standard record formats have been discussed in following sections. The formats have been prepared from there existing data collection format in the Jute Mills.

3.2 List of the essential testing equipment for quality control of jute

The essential equipments required for performing various tests are given below:

1. Moisture meter.
2. Sliver tester.
3. Warp reel (yarn)
4. Twist tester.
5. Yarn tensile strength machine.
6. Fabric tensile strength machine.
7. Brightness tester.
8. Hydrometer.
9. Conditioning oven.
10. Viscometer.
11. Rapid oil extractor.
12. Chemical balance.
13. Weighing scale.
14. Yarn inspection winder.
15. Roto thermometer

Besides the above mentioned equipments, some auxiliary instruments are also required, e.g. tachometer, breaker, test tube etc.

3.3 The Tests and Records for In-process Jute

The record formats of various tests are given in the following tables:

Table 3.1 : Moisture test

The moisture content in the raw jute and inprocess jute goods are recorded by this test

Moisture contained %					Average	
1	2	3	4	5	M.C%	Moisture regain

Table 3.2 : Morrah test

Standard weight range is 2-2.5 lbs

Weight	Mean	Range	S.D.	Cost of variation

Table 3.3 : J.B.O. test

It is the test of the specifications of the jute batch oil

Colour	Smell	Viscosity at °C

Table 3.4 : Emulsion test

Emulsion test is performed to keep the oil and water percentage constant

Wt. of dry jute	Wt. of jute after appln. of Emulsion	Wt. of Emulsion	Oil % on jute	Oil % in Emulsion Tank	Oil % in Emulsion Tray	Emulsion stability (hr.)

Table 3.5 : Pile checking

Jutes are kept in piles for a certain period of time at a particular temperature. Checks are made to ensure desired maturity.

Piling date and time	Temperature checking time	Average temperature of pile	Opening date & time of pile	[illegible] piling hrs.	Opening tempe- rature of pile	Piling condi- tion

Table 3.6 : Batch checking

Quality	Approved Batch	Batche used	Remarks
Hessian Warp			
Hessin weft & Sacking warp			
Sacking weft			
C.B.C. warp			
C.B.C. weft			
Any other quality			

Table 3.7 : Sliver test report

At Breaker Card weight is taken in lbs/100 yds.

At Finisher Card weight is taken in lbs/100 yds.

At Finisher drawing weight is taken in lbs/spy.

Quality	Stage	Std. wt.	Actual average wt.	Range of wt.	Actual M.R. %	Std. M.R%	Corrected sliver wt.
Hess. Warp	B. Card Fin. card Fin. Drg.						
Hess. Weft	B. Card Fin.Card Fin. Drg.						
Sacking Warp	B. Card Fin. Card Fin. Drg.						
CBC Warp	B. Card Fin. Card Fin. Drg.						
CBC Weft	B. Card Fin. Card Fin. Drg.						

Table 3.8 : Yarn test

		Count					Strength		Quality Ratio		Twist			Remarks
Quality	Frame no.	Standard count	Actual count	C.V. %	Actual M.R. %	Corrected count at M.R.%	Breaking load	C.V. %	Actual Q.R. %	Std. Q.R. %	T.P.I.	C.V. % of T.P.I	Oil %	

Table 3.9 : Delay study of spinning

Frame no.	Ends down	Sliver short	Bobbin short	Mechanical troubles	Cotton tape	Electric troubles	Piecing up	Oiling	Total down	Summary of the study

Table 3.10 : Starch test report

Before Starching					After Starching				Starch Composition					Temperature			Remarks
Quality of Yarn	Actual Count	M.R. % 'x'	Corrected count at x	Q.R. %	Corrected count at % moisture regain	Starch uptake	Q.R. %	Strength gain %	Starch powder %	Gum %	Wax %	Antiseptic %	Water %	Tank	Sow box	Viscosity of starch solution at 40°C	

Table 3.11 : Beam inspection report

Standard yarn in beam	Yarn found in beam	Number of yarn-Excess/ short	Compan-sated by	Number of Hanging yarn	Yarn Dis-tribution beam	Average M.R %

Table 3.12 : Cloth inspection

Shot/3"	Porter	Width

Under shot %
Over shot %
Narrow width%
Over width %

Table 3.13 : Heavy/Light test report

Porter & shot	Width	Oz/yds	No. of tested cloth	Total yds	Actual weight	Stan-dard weight	Heavy	Light
							On corrected wt.	

Table 3.14 : Bag/Bundle inspection

Length of bag/ cloth	Width of bag/ cloth	Porter/ shots	Sewing/ Heming condtns.	Condition of sewing twin yarn	Major weaving defect

- Standard bag wt.
- Standard bundle wt.
- Average M.R. % from 10 bundle
- Hvy/Lt on corrected weight from 10 bundle
- Range of heavy/light

Table 3.15 : Carpet backing finished rolls inspection

Length of roll	Radius of roll	Actual volume	Standard volume 3.5 cm/1000 kg.	Under/over size	Yards of rolls	Standard Net weight	Actual net weight	M.R. %	Heavy/Light	Compactness	Side Allignment	Condition of core ends	Pack sheet condition	Stitching

Table 3.16 : Daily cloth inspection
(After repairing/Before reparing)

Reed mark	Minor Gaw	Bed selved	Double warp/ single warp	Over shotting/under shotting	Loose warp	Loops	Broken warp	Bias & Bow	Shuttle smash	Scub	Snar	Calender cuts/Pin mark	Bad repairing	Knife, cut

3.4 Permissible Range of Various Quality Parameters

It has been mentioned earlier that quality means conformity of a parameter value with a standard or specified value. For jute industry, there are already set limiting values for various parameters and checks are performed only to ensure that these limiting values are not violated. The limiting specifications for in-process jute goods at various stages are as follows:

No.	Item	Quality of Jute		
		Hessian	Sacking	C.B.C.
1	2	3	4	5
1	Moisture content (max.)	16%	16%	16%
2	Morrah weight (Range)	2 - 2.5 lbs	2 - 2.5 lbs	2 - 2.5 lbs

1	2	3	4	5
3	Batch Composition (a) Warp	W.C. bottom 4 rolls T.C. bottom 2 rolls W.X. bottom 4 rolls Sliver + threads 1 roll 11 rolls	W.X.bottom 5 rolls W.C.bottom 3 rolls N-cuttings 2 rolls Sliver + threads 1 roll 11 rolls	B.T.C. 3 rolls B.W.C. 2 rolls MestaB 1 roll 6 rolls or B.T.C. 2 rolls B.W.C. 2 rolls MestaB 2 rolls 6 rolls
	(b) Weft	W.X. bottom 5 rolls W.C. bottom 3 rolls 8 rolls	N.cuttings 9 rolls S.M.R. 2 rolls 11 rolls	
4	Emulsion			
	(a) Stability	24 hours (min.)	24 hours (min.)	24 hours (Min.)
	(b) Emulsifur (Non ident P-40)	.1 %	.1 %	.05 %
	(c) Oil in Emulsion	5.5 %	7.5 %	3.5 %
	(d) Emulsion applied long jute cutting	18-22 % 30-35 %	22-25 % 35-40 %	20-25 %
5	Piling long jute cutting	3-5 days 6-7 days	3-4 days 6-7 days	2-3 days
6	Dollap wt.	32 lbs. (max)	32-34 lbs.	28-32 lbs.
7	Sliver Condn. Delivery wt. in			
	(a) B/Cards M.R. %	16-18 lb/100 yds 31%	21 lbs/100 yds 33%	
	(b) Fin. Cards M.R. %	13-15 lbs/100 yds 28 %	12-14 lb/100 yds 32 %	
	(c) Fin. drg. M.R. %	145-150 lbs/spy 25 %	200 lbs/spy 28 %	

1	2	3	4	5
8	Ends down	10 % (max.)	12 % (max.)	5 % (max.)
9	Yarn test			
	(a) Count			
	Warp	8 lbs. - 8.25 lbs	10.25 lbs	7.75
	Weft	9.5 " - 11 lbs	34 lbs.	Specified
	M.R.	20%	22 %	16%
	(b) Tensile Strength			
	Warp	9.5 - 11 lbs		
	Weft	7.5 - 9.5 lbs		
	C.V.	12 % (max.)		
	(c) Quality Ratio			
	Warp	82–85 (min.)		
	Weft	75–80 (min.)		
	(d) T.P.I.			
	Warp	4.25		
	Weft	3.80		
10	Fabric Preparation			
	(a) Composition of Starch	Tammarind Kernel Powder - 20% Gum - .08% Paraffinwax .04% Antiseptic .02% Water 97.86 %		Tarrarind Kernell Powder - 2% Gum - .08% Parrafin wax .04% Antiseptic .02% Water 97.86%
	(b) Temperature in sow box	50–55°c		50–55°C
	(c) Steam pressure	35–40 psi		40–45 psi
	(d) Cop size:			
	- Length	10.5"	11"	10.5"
	- Diameter	1.5"	1.87"	1.75"
	(e) Porter: Tolerance	As per specific ± 4 %	As per specific ± 2 %	As per sp.
	(f) Shots tolerance	As per specific ± 4%	As per specific ± 2 %	As per sp.

CHAPTER FOUR

OBSERVATIONS ON THE COMPLAINTS AND CLAIMS SETTLED

CHAPTER : FOUR

OBSERVATIONS ON THE COMPLAINTS AND CLAIMS SETTLED

4.1 Introduction:

The defects found in the exported jute goods are generally claimed by the buyer. It is quantified in terms of money value and settled against the export value. In this chapter the defects and quality claims and their causes are shown by some tables in the following sections.

4.2 Complaints of the Buyers

Generally the foreign buyers settle three types of claims

a) Excess freight:

This is due to the packing size and weight when the space and weight exceed the given specifications then the excess freight is claimed on the Exporters.

b) LSP (Late Shipment Penalty):

It is generally due to the delay to meet the shipment date. It may be caused by slow production rate or by interruption in the production process.

c) Quality claims:

This is the claim settled for the defects of jute goods. This may be caused by machines, process, materials, personnel involved or by some other reasons. This study is mainly on the third one, i.e. quality claim.

4.3 Claims settled against enterprises and their values

In the following sections the type of quality claims has been discussed. The causes of quality defects, their responsible factors i.e. possible sources have also been discussed.

Table 4.1 : The claims settled against the defects of the jute goods

Year	Sl.	Name of Mills	Nature of claim	£	$	Tk.
1	2	3	4	5	6	7
1972	1	Hafiz	Short width	832.1		
	2	Latif	Defective sewing	974.57		
	3	Bangladesh	Sub. Standard Quality	1000.00		
	4	Amin	Short width	2544.00		
	5	Askari	Inferior cloth	508.00		
1973	6	Cooperative	Under weight			3150.00
	7	Latif	Under weight			11918.40
	8	Adamjee	Short width and water damage	1500.00		
	9	Amin	Mashed core		120.00	
	10	Platinum	Continuous length instead of standard cuts	50.00		
	11	Khan	Short pieces	173.2		

1	2	3	4	5	6	7
	12	Jabbar	Inferior quality	916.2		
	13	Pubali	Under weight	1000.00		
	14	Maqbul	Under weight	1000.00		
1974	15	Anwara	Mashed/Collapsed core		86.98	
	16	Bawa	Mfg. defect		1197.90	
	17	Crescent	Narrow width		85.00	
	18	R.R.	Short width		2817.67	
	19	Bangladesh	Short width	114.25	900.00	
	20	Hafiz	Narrow width		2353.00	
	21	Peoples	Under weight	945.7		
1975	22	Nishat	Sub. Standard Quality	8000.00		
	23	Crescent	Light weight	88.1		
	24	Latif	Defective bag	2790.00		
	25	Amin	Narrow width	720.00		
	26	Anwara	Narrow width	62.5		
	27	Ashraf	Wrong size of bag	1751.00		
	28	Jessore	Narrow width		2181.00	
	29	Platinum	Short length		79.96	
1976	30	Bangladesh	Short length damaged	[illegible]	195.45	
	31	Victory	Bad	656.98		
	32	Alhaj	Short weight	731.8		
	33	Amin	Bad		309.2	

1	2	3	4	5	6	7
	34	R.R.	Narrow		125.64	
	35	SKM	2nd quality		77.64	
	36	Nishat	Narrow		110.64	
	37	National	2nd quality		2041.26	
	38	Gul Ahmed	Narrow, Inferior		12727.4	
	39	Taj	Narrow		6134.5	
	40	Cooperative	Water stained	547.98		
1976 (Contd)	41	UMC Jute	Narrow width		333.76	
	42	Latif Bawany	Short weight		2232.00	
	43	Chittagong	Defective	1083.00		
	44	Eastern	Narrow		2000.00	
	45	Peoples	Quality		552.74	
	46	Anwara	Faulty sewing	551.65		
	47	Dawood	Narrow & defective		33205.18	
	48	R.R.	Improper rolling	120.56		
	49	Bangladesh	Short in length	135.45		
	50	Jessor	Short in length	106.6		
	51	United	Inferior	541.42		
1977	52	Platinum Jubilee	Short in length	904.96		
	53	Amin	Under weight		3932.66	
	54	Star	Short in length	229.00		
	55	Sonali	Short in length	517.00		
	56	Rajshahi	Short in length	255.00		
	57	W. Rahman	Short in length	89.00		

1	2	3	4	5	6	7
	58	Peoples	Quality (Unspecified)	300.00		
	59	N.A.Maleque	Short weight	1823.00		
	60	Anwara	Shortage of bag	313.79		
	61	Qaumi	Under Weight	1700.00		
	62	Munwar	Quality claim		6065.55	
	63	Karim	Quality claim (length)		12.00	
	64	Ashraf	- do.- (unspecified)		74.00	
	65	Adamjee	- do -		190.50	
1978	66	Noapara	- de -		3798.50	
	67	Platinum	- do -		7.00	
	68	Eastern	- do -		544.50	
	69	Star	- do -		638.50	
	70	Quashem	- do -		442.00	
	71	Hafiz	- do -		848.00	
	72	Chittagong	- do -		1563.50	
	73	Moqbular	- do -		335.00	
	74	Victory	- do -		2916.00	
	75	Sonali	- do -		3358.00	
	76	A.K. Khan	- do -		1617.50	
	77	Gul Ahmed	- do -		1769.50	
	78	Amin	- do -		2934.00	
	79	Delta	Quality claim	210.00	942.50	
	80	Cooperative	Faulty sewing		1000.00	
	81	Karnaphuly	Short yardage	44.95		

1	2	3	4	5	6	7
	82	Bangladesh	Quality claim	58.73		
1979	83	Quami	Quality claim		680.00	
	84	Karnaphuly	Quality claim	682.2		
	85	Crescent	Short weight	39.40	361.01	
	86	Aleem	Quality claim	1985.00		
1980	87	R.R.	Quality claim		305.50	
	88	Daulatpur	Quality claim	800.00		
	89	Hafiz	Quality claim		846.40	
1981	90	Aleem	Quality claim	3000.00		

Table 4.2 : Claims settled from the year 1972 - 1980.

In this table the total claim and the quality claim are shown with their money value

	Claims	Nos.	£ Pound sterling	US $	Tk.	[illegible]
1972	Quality	8	6451.50			
	Total	65	9098.70	524.00		
1973	Quality	9	1905.90	120.00	27,904.60	
	Total	83	4242.17	1982.50		
1974	Quality	8	2916.20	1369.80		
	Total	322	6298.18	8427.00		
1975	Quality	9	2725.50	6070.70		
	Total	268	111793.00	14043.00		
1976	Quality	28	7122.60	63533.00		
	Total	298	12227.40	73881.00		
1977	Quality	15	6008.00	3933.00		
	Total	98	7925.00	8113.20	1,736.21	
1978	Quality	28	3392.00	29684.00		
	Total	85	10250.00	32773.60		
1979	Quality	3	741.00	680.00		
	Total	68	1634.30	5910.81		
1980	Quality	6	2824.40	1514.00		
	Total	39	2952.00	3013.00		
1981	Quality	1	3000.00			
	Total	3	3000.00			

Table 4.3 : Statement of settled claims - Zone wise
From July 1977 to June 1981

Name of zone	U.K. £	US $
K-B zone	313.97	4607.02
Chittagong zone	1109.58	11681.55
Khulna zone	504.02	6036.26
Dhaka zone	-	-
Adamjee zone	-	11670.43
Mymensingh zone	1700.00	7886.20
Jessore zone	93.67	1191.00
N-G zone	-	-
Demra Kanchan zone	-	7342.05

Table 4.4 : Claims from April '82 to June '83

The claims settled as the percentage of that lot are shown in this table.

	Name of Mill	Nature of complaints	Quantity	% of total
1	Adamjee	Bias and Baggy	3 rolls out of 177 rolls CBC	1.7 %
2	Star	Short length	100 bales out of 100 bales	100 %
3	Askari	Short size	50 bales out of 100 bales	50 %
4	SKM	Bias and baggy	11 rolls out of 11 rolls	100 %
5	Peoples	Down graded cloth as low grade jute used	6 rolls out of 27 rolls	22 %
6	Purbachal	Bias and baggy	3 rolls out of 790 rolls	0.4 %
7	Hafiz	Spots of greases	20 rolls out of 100 rolls	20 %
8	Latif Bawany	Short width	20 bales out of 30 bales	57 %
9	Karnafully	Defective	12 rolls out of 36 rolls	33 %
10	Moqbular	Short sizes bags	40 bales out of 100 bales	40 %
11	Delta	Short sizes bags	40 bales out of 100 bales	40 %
12	Amin	Narrow width	2 rolls out of 70 rolls	2.8 %
13	Star	Mfg. fault	25 bales out of 25 bales	100 %
14	Amin	Short width	1 roll out of 437 rolls	0.23 %

(Contd. of Table 4.4)

	Name of Mill	Nature of complaints	Quantity	% of total
15	Ashraf	Excessive lint in cloth	36 rolls out of 150 rolls	24 %
16	Star	Sewing defect	25 bales out of 25 bales	100 %
17	Mymensingh	Mfg. defects	5 bales out of 25 bales	20 %
18	UMC	Bias	40 bales out of 40 bales	100 %
19	UMC	Mfg. defects	25 bales 25 bales	100 %

4.4 Major Claims Against Quality

Generally the following claims are settled by the buyers. In this section these complaints are discussed with their nature, causes.

1. Bias and Baggy:

It is the distortion of the yarn in weaving from its expected arrangement. This may be angular displacement or bow type.

2. Wrong Packing:

This is the defects of packing i.e. packing is not done according to the given specifications of the buyers.

3. Short width:

The shortness from the specified given width of the fabric. It is due to the high tension in weaving and setting in loom.

4. Joint cores:

In rolling of the jute cloth some times the paper core is found as joint of two or more pieces.

5. Short length:

The shortness of the total length of the cloth. It is mainly caused by measurement and cutting process.

6. Short sizes of bag:

Sometimes the bag is made short and out of specifications.

7. Down graded cloth:

The quality i.e, strength, weaving, brightness, fineness, weight, moisture and ingredients like starch, oil etc. may be sometimes deflected from their standard expectations.

8. Bursting of bags:

It is the defect arise from the strength of the fabric which is the ultimate cause of yarn and sewing of the bags.

9. Improper lapping:

In folding the long fabric sometimes the lapping is made improper. There may be the scratching of yarn from the fabric.

10. Damaged carpet:

Carpet or CBC may be found damaged after shipment because the product might be stored improperly. Weather can effect largely in the internal rotting, sometimes it is caused by the improper emulsifying and improper starching.

11. Faulty and tearing:

This defect is caused at root. Quality of jute, Batching, Feeding and twisting may affect on the effectiveness and tearing strength of the yarn as well as fabric.

12. Manufacturing fault:

Weaving defect, present of knots, Ends down of yarn and calendering are mainly the cause of this defect.

13. Light weight:

Shortage from the standard weight may be caused by -

i) Shortage of length
ii) Shortage in feeding
iii) More twisting
iv) More tension in calendering
v) More tension in weaving
vi) Emulsifying and starching improperly.

14. Poor rolling:

Loose adjustment and discontinuous care may cause loose or over tight rolling of the CBC.

15. Untuftable:

Sometimes CBC becomes rigid and hard which is less tuftable or untuftable for carpet making. It is due to weaving defect and emulsification wrongly.

16. Sewing defect:

This defect is caused by the wrong and bad quality sewing and use of less strengthful thread.

17. Tellow stains:

This defect may be caused due to stacking and storing for a long time or in an unconditioned places.

18. Short in piece:

Shortage of number is caused by improper counting and checking of the packing personnels.

4.5 Analysis of the depending factors of the claims

The complaints and their probable causes are discussed with the involved personnels in the enterprises. These are also analysed and compared with the BJMC quality control department and BJRI research officers. In view of the above discussion and personal observation of the author the causes may be quantified hypothetically. Neverthe-less this quantification is not so dependable. These approximations are shown in the table 4.5.

Table 4.5 : Nature of complaints and their probable causes

	Nature of complaints	Machine	Material & process	Personnel
1	Bias and Baggy	Power loom 40% Calender: 5% Lapping: 5%	Adjustment of the loom: 20%	Weaver attentive-ness : 30%
2	Wrong packing	-	Packing & finishing process: 30%	Packing persons: 70%
3	Short width	Loom : 20% Calender: 10%	Finishing: 5 % Tensioning: 10 % Adjustment of loom: 20%	Weaver: 30% Calendering personnel : 5 %
4	Joint cores	-	Rolling process: 20%	Rolling & Finishing personnels: 80 %
5	Short length	Cutting machine: 10%	Measurement : 20% Material shortness : 20%	Personnel : 50%
6	Short sizes of bags	Loom: 10%	Weaving: 10% Cutting: 20% Sewing: 20%	Weaver: 20% Sewing operator: 20%
7	Down graded cloths	Emulsion plant : 20% Calender: 5% Starching m/c: 20% Weaving: 5%	Emulsion: 10% Adjustment in weaving : 5% Starch: 10% Jute itself : 10%	Weaver: 10% Other perso-nnel : 5%

	Nature of complaints	Machine	Material & process	Personnel
8	Bursting of bag	Feeding m/c: 10% Twsiting machine: 10% Sewing: 10% Loom: 10%	Process of feeding: 10% Twisting process: 5% Weaving: 10% Jute quality : 10%	Weaver: 5% Sewing man: 10% Feeding man: 10%
9	Improper Lapping	Lapping machine: 40%	Lapping process: 20%	Lapping attendent personnel : 40 %
10	Damaged carpet	Starching m/c: 5% Emulsion plant: 5%	Stacking: 50% Jute: 10% Packing: 10%	Stacking and packing personnel: 20%
11	Faulty and tearing	Twsiting m/c: 10% Loom: 10% Feeding: 10%	Jute: 20% Weaving: 10% Feeding: 10%	Twisting personnel: 20%
12	Manufacturing fault	Loom: 40%	-	Weaver: 60%
13	Light weight	Carding machine: 10% Loom: 10% Calender: 10%	Carding: 10% Twisting: 15% Weaving: 5% Calendering: 10%	Carding personnel: 10% Other personnel : 20%
14	Poor rolling	Rolling machine: 30%	Rolling process: 10%	Rolling m/c Operator: 60%
15	Untuftable	Loom: 10% Emulsion plant: 20% Starching machine: 10%	Emulsion: 20% Starch: 10% Weaving: 10%	Involved personnel: 30%
16	Sewing defects	Sewing machine : 10%	Thread: 20% Sewing: 10%	Personnel involved: 50%
17	Yellow stains	-	Stacking: 50% packing: 20%	Stacking personnel: 30%
18	Short in piece	-	Packing: 20%	Packing personnel : 80%

4.6 Percentage of Quality claims to the Total Export Value

To evaluate the quality defects as compared to the total export value. It can also help to allocate the budget for quality maintenance. This figure is shown in the table 4.6.

Table 4.6: Quality claims and total export value

(In million Taka)

Year	Value of Export					Total	% of quality claim for quality on total export
	Hessian	Sacking	CBC	Carpet	Others		
1964 - 65	130.4	171.1	-	-	25.9	327.4	
1965 - 66	196.9	335.5	-	-	45.7	578.1	
1966 - 67	188.2	342.0	-	-	65.7	595.4	
1967 - 68	224.7	295.5	-	-	82.9	603.1	
1968 - 69	304.7	274.7	-	-	97.7	677.1	
1969 - 70	413.4	251.3	-	-	108.7	773.4	
1970 - 71	302.0	232.5	-	-	133.3	667.8	
1971 - 72	160.6	167.5	-	-	122.5	450.6	.02
1972 - 73	443.0	634.1	330.0	-	30.0	1440.1	.004
1973 - 74	632.3	581.2	265.1	—	74.0	1552.6	.006
1974 - 75	733.7	755.0	215.7	-	81.3	1785.7	.009
1975 - 76	1057.6	1001.0	511.0	-	68.8	2638.4	.04
1976 - 77	1019.0	1005.6	563.5	-	98.1	2686.2	.007
1977 - 78	1475.8	1467.7	678.5	-	111.2	3733.2	.016
1978 - 79	1789.1	1531.2	805.5	-	73.2	4199.0	.008
1979 - 80	2713.4	2190.2	997.7	-	48.7	4950.0	.002
1980 - 81	2475.9	2345.5	982.0	3.7	28.5	5835.6	.001
1981 - 82	2264.0	2654.2	730.8	12.4	17.9	5679.3	

From the above figure it is evident that the value of the quality claim settled is really very small percentage of the total export value.

CHAPTER FIVE
DATA ANALYSIS

CHAPTER : FIVE [redacted]

DATA ANALYSIS [redacted]

5.1 Introduction

The tests and their results are observed carefully. To establish some statistical basis some approaches are taken. Among those, control charts for the existing machine performance is an approach. This can help to keep the specification within two limits.

Another approach was to find out the number of sample to be taken for each batch for assurance upto a certain confidence level. Next a regression analysis is done on the different properties at different stages of the in process jute. This has been attempted to find the relationship of the properties, with a view to reduce some intermediate tests, if at all possible.

5.2 Conceptual framework of control charts

The control chart, which is a chronological (hour by hour, day by day) graphical comparison of actual product quality characteristics with limits reflecting the ability to produce, as shown by past experience on the product quality characteristics. When the curve of the graph approaches or exceeds the limits, some change is suggested in the process that may require investigation. This tool may be used to maintain control over a process after the frequency distribution has shown that the process is in control.

The control-chart technique is used for in-process control to give an hour-by-hour or day-by-day picture of the process to the shop personnel and the process control engineer. By use of these charts, the control limits of the process are established, and control of the process is maintained by periodic sampling and plotting the results. By observing the charts, any out-of-control condition of either the central tendency or the spread of the distribution can be detected. Through study of the data plotted on a control chart, advance indications can often detect a process that is tending toward an out-of-control condition. Further investigation and analysis has to be made to determine the cause. Then corrective action has to be taken, preferably before a nonconforming product is made.

Control charts can be used to control such processes as machining, finishing, assembly, chemical processing, and any other process where the quality characteristics are measurable.

Control chart compares actual production variation of manufactured parts with the control limits that have been set up for those parts.

When these limits have been computed and then judged acceptably for use in production the control chart takes up its major role-aiding in the control of the quality of materials, batches, parts, and assembling during their actual manufacture.

5.2.1 Kinds of Control Chart

a) Control chart for variable: When the parameter under control is some measurement of a variable.

b) Control charts for attributes: When parameter under control is a proportion or fraction.

c) Control charts for the number of defects per unit.

To construct a control chart for the means, standard values for $\bar{x}$ (sample mean) and σ_x (sample standard deviation) will have to be established first. Means of subsequent samples are plotted again and action would be called for, if a sample mean should fall out side the control limits.

$\bar{x}$ charts: A table of factors is used to calculate directly the upper and lower control limits. The procedure required is simply to determine the range for each of the samples and then to determine $\bar{R}$, (the mean of ranges)

limits are given by $\bar{\bar{x}} \pm A_2\bar{R}$

where, $\bar{\bar{x}}$ = mean of sample means i.e. $\bar{x}$.

A_2 = a factor depending on the size of samples

The value of A_2 can be obtained from any standard handbook on quality control(6). For a sample of $n > 25$, $A_2 = 3/\sqrt{n}$.

$\bar{R}$ charts: The control limits of R chart are given as follows:

upper control limit $UCL_R = D_4\bar{R}$

lower control limit $LCL_R = D_3\bar{R}$

where $D_3 = 1 - 3\frac{d_3}{d_2}$

$D_4 = 1 + 3\frac{d_3}{d_2}$

and d_2 and d_3 are some factors depending on sample size. The values of d_2, d_3, D_3 and D_4 can be obtained from any standard handbook on quality control.

Control charts for attributes (P charts):

Here the population is divided into two classifications: defective parts versus good parts in a production process. The mean $\bar{P}$ and standard deviation Sp are given by $\bar{P} = \frac{x}{n} = \frac{\text{no. in classification}}{\text{total no. observed}}$

$\bar{P}$ = Average error function $sp = \frac{\bar{P}(1 - \bar{P})}{n}$

Control limits are set at $\bar{P} \pm 3$ sp.

5.3 Establishment of Control Chart

In this section limits of control charts have been calculated for the means and ranges of weights of specified amount of in-process jutes at different machine stages, e.g. breaker card, finisher card, first drawing, second drawing, etc. The means and ranges have been calculated from sample raw data given in Appendix I (Table Three) and shown in Table 5.1. It should be mentioned that in each sample of Table 5.1, five readings were taken. The mean wt is the average of these five readings and the range is the difference between maximum and minimum recorded value. In table 5.2 UCL and LCL values are given for the mean, $\bar{x}$ and range R for the above mentioned cases.

Table 5.1: Calculation to establish control charts

No. of Sample	Range of the sample in the breaker card	Range of the sample in the finisher card	Range of the sample in the 1st drawing	Range of the sample in 2nd drawing	Range of the sample in the 3rd drawing	Mean of the sample in the breaker card	Mean of the sample in the finisher card	Mean of the sample in the 1st drawing	Mean of the sample in the 2nd drawing	Mean of the sample in the 3rd drawing
1	1.3	0.4	0.16	0.2	8.76	18.6	13.36	7.46	4.48	143.42
2	1.7	0.8	0.64	0.4	14.4	17.36	13.34	7.42	4.39	146.3
3	1.3	0.9	0.52	0.16	8.64	17.96	13.8	8.6	4.19	142.27
4	3.4	0.6	0.32	0.48	5.76	17.68	13.12	7.7	3.8	140.54
5	1.9	0.4	0.25	0.2	8.7	19.52	12.84	7.2	5.23	134.2
6	1.0	0.3	0.2	0.4	8.24	18.24	12.66	7.3	3.96	142.8
7	0.8	0.5	0.29	0.3	8.76	18.62	13.9	9.07	5.3	155
8	9.5	0.7	0.17	0.16	6.8	18.56	13.3	9.15	5.25	156.5
9	2.2	0.4	0.31	0.22	11.4	18.32	12.9	9.13	3.96	142.9
10	2.2	0.9	0.4	0.23	5.8	18.38	13.78	7.42	4.18	142.2
11	0.9	0.7	0.6	0.28	8.6	18.56	13.2	7.8	4.36	145
12	0.8	0.6	0.32	0.32	5.74	18.6	12.8	7.3	3.8	141.2
13	0.8	0.6	0.16	0.4	6.24	18.52	13.7	7.21	3.9	142
14	1.4	0.6	0.3	0.8	4.2	18.62	12.9	7.1	3.6	142.2
15	0.5	0.2	0.16	0.7	11.2	18.6	12.6	7.28	4.1	146

Table 5.2: UCL and LCL values for $\overline{x}$ and R - chart

Stages	Mean of the sample mean $\bar{\bar{x}}$	Mean of the sample range $\bar{R}$	UCl for $\bar{x}$ chart ($\bar{\bar{x}}$+$A_2\bar{R}$)	LCl for $\bar{x}$ chart $\bar{\bar{x}}-A_2\bar{R}$	UCl for R chart = $D_4\bar{R}$	LCl for R chart = $D_3\bar{R}$
Breaker card	17	1.4	17.31	16.75	2.31	.487
Finisher card	13.2	0.57	13.3	13.1	.941	.198
First drawing	7.8	0.32	7.87	7.74	.528	.111
Second drawing	4.46	0.35	4.53	4.39	.578	.121
Third drawing	142.8	8.21	144.63	141.92	13.56	2.85

Table 5.2: UCl and LCl values for $\overline{x}$ and R - chart

Values of A_2 = 0.223 for n = 15

D_3 = 0.348 $A_2 = 3/\sqrt{n} = \frac{3}{\sqrt{20}} = .67$

D_4 = 1.652

d_2 = 3.472

d_3 = 0.755

A sample control chart is shown in figure 5.1

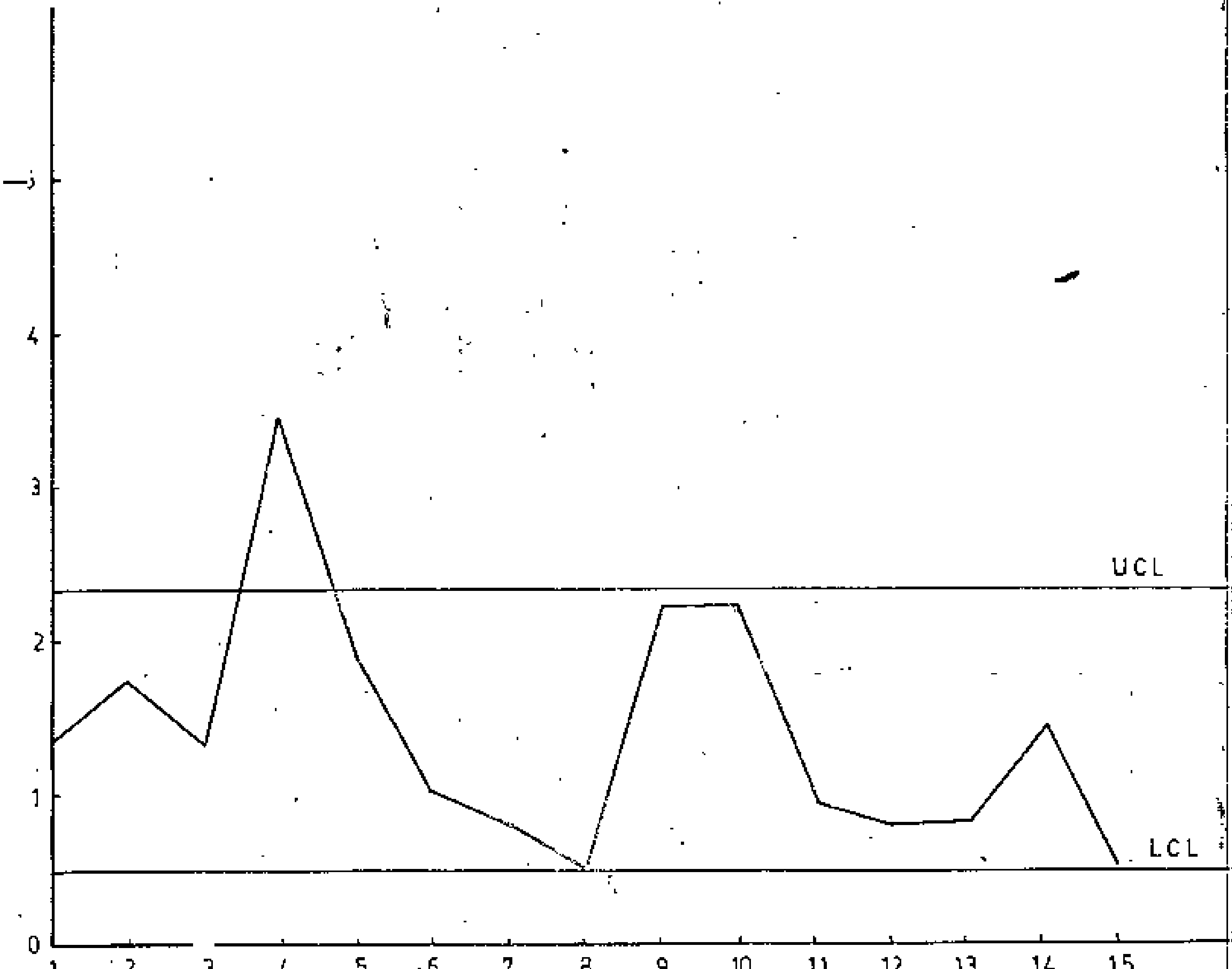


Fig. 5.1(a) Control chart at breaker card

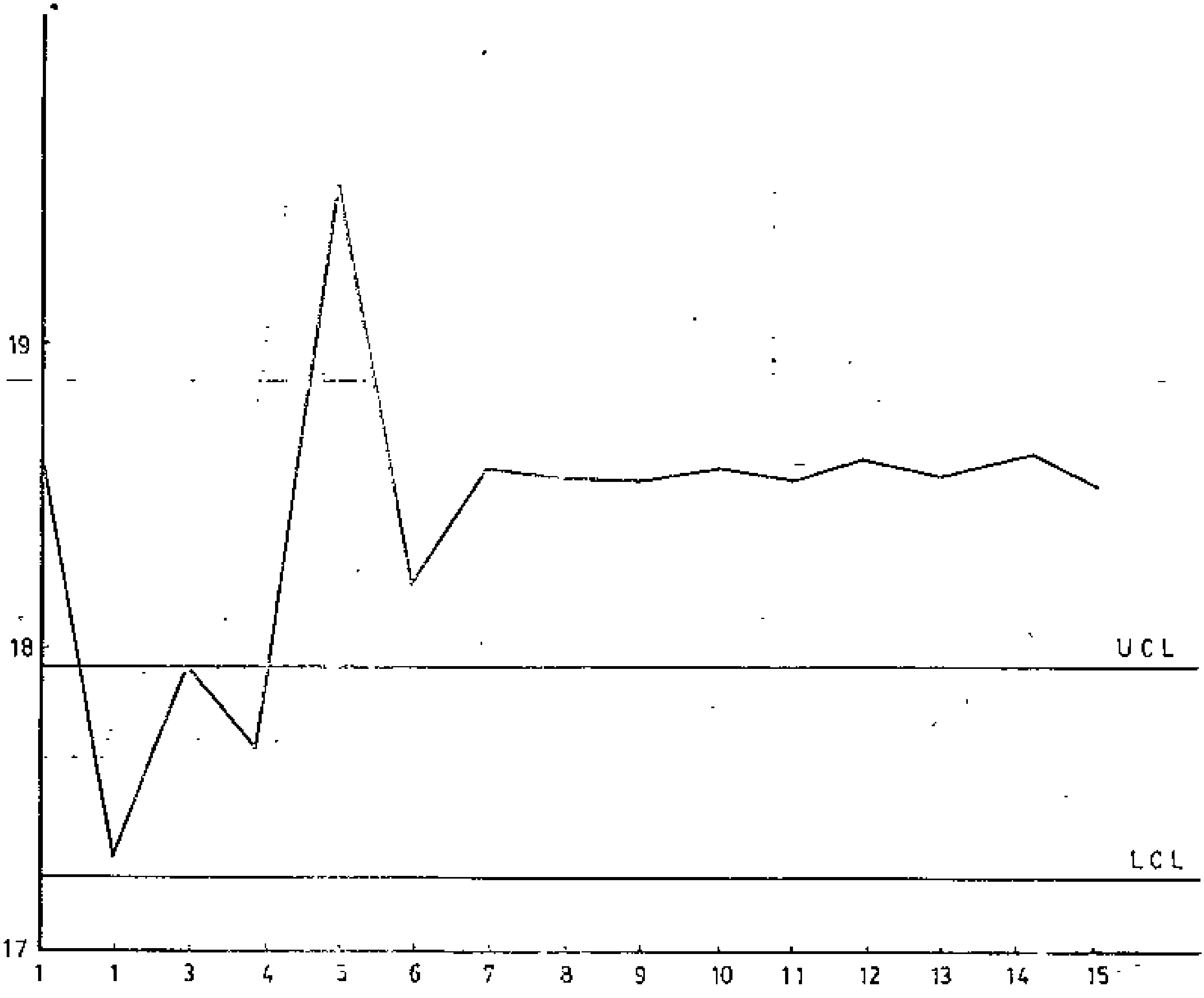


Fig. 5.1(b) Control chart at breaker card

5.4 Determination of Sample Size for Various Tests

Adequacy of sample size is determined by an estimation on the performance rating. The precision desired will determine now many observations will be required. From basic formula of sample size it can be calculated.

$$n = \left[\frac{Z_{\alpha/2} \cdot \sigma}{E}\right]^2 = \left[\frac{1.96\,\sigma}{E}\right]^2$$

n = Sample size

$Z_{\alpha/2}$ = Normal curve area

σ = Standard deviation

E = $\bar{x} - \mu$ i.e. the magnitude of the error of the estimate i.e. the difference of the values of population mean and the sample mean.

The samples have been taken from the existing data from Appendix-1 and the required sample size were calculated which are shown in the table 5.3.

Table 5.3: Calculated sample size for different properties of the process jute

Weight of Jute in lb. at	Sample Mean	St. dev.	Prop. mean	Value of E	Calculated sample size
Br. card	18.28	1.16	18.5	0.22	107[illegible]
Finisher card	13.16	0.321	14	0.84	[illegible]
First drg.	7.48	0.222	8.5	1.02	[illegible]
2nd drg.	4.22	0.288	4.56	0.34	[illegible]
3rd drg.	142.38	4.3	148.0	5.62	[illegible]

To be 95% confident for each properties that these values are within the value of E the samples should be taken as the calculated value.

It is observed that to be confident 95% with the existing operative capacity and reliability the numbers of samples to be taken as above. The calculated numbers of sample are practically inconsistent. This may be caused by the improper batching and carelessness in the machine setting. It is necessary to improve the machine performance and reliability through BMRE.

5.5 Establishment of relationship among the properties:

The properties of in-process jute are mostly responsible for the final quality of the product. An observation is done on these properties. Some major properties these are closely related to the claims of the buyer have been selected as critical. These are :

i) Breaking strength of jute yarn
ii) Weight at breaker card
iii) Weight at Finisher card
iv) Weight at First drawing
v) Weight at Second drawing
vi) Weight at Third drawing
vii) Strength before starching
viii) Strength after starching

The approach to establish and to observe the relationship among the properties is tested through the computer programming. This is shown as follows.

From any standard statistical table the values of the 'F' statistics are as follows. For 95% confidence level.[1]

DF	1/38	2/37	3/36	4/35	5/34	6/33	7/32
F	4.1	3.27	2.87	2.65	2.5	2.4	2.3

From the multiple regression analysis the obtained values of 'F' are:

Degrees of Freedom	'F' Statistics	Values of 'F'
1/38	7.55382	3.970
		0.907
		0.090
		0.098
		0.413
		0.019
2/37	6.05701	1.933
		0.027
		0.011
		0.237
		0.035
3/36	4.78410	1.919
		1.393
		0.177
		0.054

Degrees of Freedom	'F' Statistics	Value of 'F'
$\frac{4}{35}$	4.159	0.007
		0.110
		0.258
$\frac{5}{34}$	3.30	0.000
		0.173
$\frac{6}{33}$	2.71889	0.000

Except the first one, all the values of 'F' statistics are very poor compared to the standard values. It indicates that the relationship among the properties are not satisfactory. If there exists any definite relationship among these properties then it can be concluded that there is a uniformity in the production process which can save some intermediate steps of tests.

```
SPSS BATCH SYSTEM                                                                              04/11/84          P

 PSS FOR OS/360, VERSION H, RELEASE 9.0, OCT 22, 1981

                                        CURRENT DOCUMENTATION FOR THE SPSS BATCH SYSTEM
ORDER FROM MCGRAW-HILL   SPSS, 2ND ED. (PRINCIPAL TEXT)          ORDER FROM SPSS INC.     SPSS STATISTICAL
                         SPSS UPDATE 7-9 (USE W/SPSS,2ND FOR REL. 7, 8, 9)                KEYWORDS  THE SP
                         SPSS POCKET GUIDE, RELEASE 9
                         SPSS PRIMER (BRIEF INTRO TO SPSS)


DEFAULT SPACE ALLOCATION..        ALLOWS FOR..   1065 TRANSFORMATIONS
WORKSPACE      74500 BYTES                        4260 RECODE VALUES + LAG VARIABLES
TRANSPACE     106500 BYTES                       17042 IF/COMPUTE OPERATIONS

                  1 RUN NAME          REGRESSION ANALYSIS FOR QUALITY CONTROL OF THE JUTE PRODUCTS
                  2 DATA LIST         FIXED(1)/1 BS 1-4(2),BC 8-11(2),FC 14-17(2),FD 20-23(2),
                  3                   SD 26-29(2),TD 32-37(2),SBS 46-49(2),SAS 53-56(2)

THE DATA LIST PROVIDES FOR    8 VARIABLES AND  1 RECORDS ('CARDS') PER CASE. A MAXIMUM OF   56 COLUMNS

LIST OF THE CONSTRUCTED FORMAT STATEMENT..
          (F4.2,3X,F4.2,2X,F4.2,2X,F4.2,2X,F4.2,2X,F6.2,8X,F4.2,3X,F4.2)

                  4 INPUT MEDIUM      CARD
                  5 N OF CASES        43
                  6 VAR LABELS        BS       BREAKING STRENGTH OF THE TWISTED JUTE YARN
                  7                   BC       WEIGHT OF THE JUTE AT THE STAGE IN THE BREAKER CARD
                  8                   FC       WEIGHT OF THE JUTE AT THE STAGE IN THE FINISHER CARD
                  9                   FD       WEIGHT OF THE JUTE AT THE STAGE OF FIRST DRAWING MACHINE
                 10                   SD       WEIGHT OF JUTE AT THE STAGE OF SECOND DRAWING MACHINE
                 11                   TD       WEIGHT OF THE JUTE IN THE THIRD DRAWING MACHINE
                 12                   SBS      STRENGTH OF JUTE BEFORE STARCHING
                 13                   SAS      STRENGTH OF JUTE AFTER STARCHING
                 14 CONDESCRIPTIVE    ALL

 ***** GIVEN WORKSPACE ALLOWS FOR **** VARIABLES FOR CONDESCRIPTIVE PROBLEM *****

                 15 STATISTICS        ALL
                 16 READ INPUT DATA

ERROR NUMBER 1760
INPUT ITEM   4 (PROBABLY FD       ) READ AS BLANKS.   INPUT DATA = '7.4.'
READ FOR CASE       3) OF SUBFILE NONAME

RECRESSION ANALYSIS FOR QUALITY CONTROL OF THE JUTE PRODUCTS                                  04/11/84          F

FILE    NONAME   (CREATION DATE = 04/11/84)

VARIABLE  BS          BREAKING STRENGTH OF THE TWISTED JUTE YA

MEAN               6.562              STD ERROR         0.211                      STD DEV              1.3
                   1.799              KURTOSIS         -0.549                      SKEWNESS             0.1
```

IABLE BC

AN	18.270	STD ERROR	0.141	STD DEV	0.893
IANCE	0.798	KURTOSIS	1.294	SKEWNESS	-0.006
GE	4.600	MINIMUM	16.000	MAXIMUM	20.600
	730.800				

LID OBSERVATIONS - 40 MISSING OBSERVATIONS - 0

IABLE FC

AN	13.180	STD ERROR	0.069	STD DEV	0.434
IANCE	0.188	KURTOSIS	-1.003	SKEWNESS	0.076
GE	1.600	MINIMUM	12.400	MAXIMUM	14.000
	527.200				

LID OBSERVATIONS - 40 MISSING OBSERVATIONS - 0

IABLE FC

AN	7.470	STD ERROR	0.210	STD DEV	1.329
IANCE	1.766	KURTOSIS	26.929	SKEWNESS	-4.634
NCE	9.050	MINIMUM	0.0	MAXIMUM	[illegible]
	299.120				

LID OBSERVATIONS - 40 MISSING OBSERVATIONS - 0

LE NONAME (CREATION DATE = 04/11/84)

IABLE SC

AN	4.349	STD ERROR	0.080	STD DEV	0.515
IANCE	0.255	KURTOSIS	-0.176	SKEWNESS	0.773
NCE	1.920	MINIMUM	3.520	MAXIMUM	5.440
	173.970				

LID OBSERVATIONS - 40 MISSING OBSERVATIONS - 0

IABLE TC

```
RIABLE   TC

AN            142.534     STD ERROR     0.960     STD DEV       6.071
RIANCE         36.861     KURTOSIS      1.415     SKEWNESS      0.727
NGE            31.680     MINIMUM     129.600     MAXIMUM     161.280
M            5701.370

LID OBSERVATIONS -     40          MISSING OBSERVATIONS -      0
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

RIABLE   SES

AN              6.939     STD ERROR     0.210                   1.381
RIANCE          1.919     KURTOSIS     -0.371     SKEWNESS     -0.309
NGE             5.000     MINIMUM       4.000     MAXIMUM       9.000
M             277.550

LID OBSERVATIONS -     40          MISSING OBSERVATIONS -      0
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

RIABLE   SAS

AN              8.561     STD ERROR     0.208     STD DEV       1.315
RIANCE          1.729     KURTOSIS      0.309     SKEWNESS     -0.473
NGE             6.000     MINIMUM       5.000     MAXIMUM      11.000
M             342.440

LID OBSERVATIONS -     40          MISSING OBSERVATIONS -      0
```

```
EGRESSION ANALYSIS FOR QUALITY CONTROL OF THE JUTE PRODUCTS        04/11/84        PAGE

LAPSED TIME REQUIRED..   19.61 SECONDS

            17 FREQUENCIES     GENERAL=ALL
            18 STATISTICS      ALL

IVEN WORKSPACE ALLOWS FOR  32767 VALUES AND  24172 LABELS PER VARIABLE FOR 'FREQUENCIES'
```

REGRESSION ANALYSIS FOR QUALITY CONTROL OF THE JUTE PRODUCTS 04/11/84 PAGE

FILE NONAME (CREATION DATE = 04/11/84)

- - - - - - - - - - - - - - P E A R S O N   C O R R E L A T I O N   C O E F F I C I E N T S - - - - - - - - -

	BS	BC	FC	FD	SD	TD	SBS	SAS
BS	1.0000 (40) P=*****	-0.3000 (40) P=0.030	-0.0619 (40) P=0.352	-0.1694 (40) P=0.148	0.1424 (40) P=0.190	0.0855 (40) P=0.300	-0.4072 (40) P=0.005	-0.0850 (40) P=0.301
BC	-0.3000 (40) P=0.030	1.0000 (40) P=*****	-0.1848 (40) P=0.127	-0.0653 (40) P=0.336	-0.2201 (40) P=0.086	-0.0908 (40) P=0.289	0.0391 (40) P=0.405	0.1715 (40) P=0.145
FC	-0.0619 (40) P=0.352	-0.1848 (40) P=0.127	1.0000 (40) P=*****	0.4554 (40) P=0.002	0.7132 (40) P=0.000	-0.0389 (40) P=0.405	-0.1088 (40) P=0.252	-0.0296 (40) P=0.428
FD	-0.1694 (40) P=0.148	-0.0653 (40) P=0.336	0.4554 (40) P=0.002	1.0000 (40) P=*****	0.4631 (40) P=0.001	-0.0249 (40) P=0.439	0.0758 (40) P=0.321	-0.2733 (40) P=0.044
SD	0.1424 (40) P=0.190	-0.2201 (40) P=0.086	0.7132 (40) P=0.000	0.4631 (40) P=0.001	1.0000 (40) P=*****	-0.0040 (40) P=0.490	-0.2374 (40) P=0.070	-0.0907 (40) P=0.289
TD	0.0855 (40) P=0.300	-0.0908 (40) P=0.289	-0.0389 (40) P=0.406	-0.0249 (40) P=0.439	-0.0040 (40) P=0.490	1.0000 (40) P=*****	0.0257 (40) P=0.437	-0.1802 (40) P=0.133
SBS	-0.4072 (40) P=0.005	0.0391 (40) P=0.405	-0.1688 (40) P=0.122	0.0758 (40) P=0.321	-0.2374 (40) P=0.070	0.0257 (40) P=0.437	1.0000 (40) P=*****	0.1580 (40) P=0.165
SAS	-0.0850 (40) P=0.301	0.1715 (40) P=0.145	-0.0296 (40) P=0.428	-0.2733 (40) P=0.044	-0.0907 (40) P=0.289	-0.1802 (40) P=0.133	0.1580 (40) P=0.165	1.0000 (40) P=*****

COEFFICIENT / (CASES) / SIGNIFICANCE) (A VALUE OF 99.0000 IS PRINTED IF A COEFFICIENT CANNOT BE CO

REGRESSION ANALYSIS FOR QUALITY CONTROL OF THE JUTE PRODUCTS 04/11/84 PAGE

ELAPSED TIME REQUIRED.. 14.64 SECONDS

24 SCATTERGRAM BS WITH BC TO SAS

REGRESSION ANALYSIS FOR QUALITY CONTROL OF THE JUTE PRODUCTS

FILE NONAME (CREATION DATE = 04/11/84)

* M U L T I P L E R E

DEPENDENT VARIABLE.. BS BREAKING STRENGTH OF THE TWISTED

VARIABLE(S) ENTERED ON STEP NUMBER 1.. SBS

MULTIPLE R	0.40721	ANALYSIS OF VARIANCE	
R SQUARE	0.16582	REGRESSION	
ADJUSTED R SQUARE	0.14387	RESIDUAL	
STANDARD ERROR	1.23712		

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BETA	STD ERROR B	F
SBS	-0.3941074	-0.40721	0.14339	7.554
(CONSTANT)	9.297113			

* *

VARIABLE(S) ENTERED ON STEP NUMBER 2.. EC

MULTIPLE R	0.49664	ANALYSIS OF VARIANCE	
R SQUARE	0.24665	REGRESSION	
ADJUSTED R SQUARE	0.20593	RESIDUAL	
STANDARD ERROR	1.19144		

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BETA	STD ERROR B	F
SBS	-0.3033430	-0.31606	0.13826	7.694
EC	-0.4258376	-0.28452	0.21373	3.970
(CONSTANT)	17.00247			

REGRESSION ANALYSIS FOR QUALITY CONTROL OF THE JUTE PRODUCTS

FILE NONAME (CREATION DATE = 04/11/84)

* M U L T I P L E R E

DEPENDENT VARIABLE.. BS BREAKING STRENGTH OF THE TWISTED

VARIABLE(S) ENTERED ON STEP NUMBER 3.. FC

MULTIPLE R	0.53389	ANALYSIS OF VARIANCE	
R SQUARE	0.28504	REGRESSION	
ADJUSTED R SQUARE	0.22546	RESIDUAL	
STANDARD ERROR	1.17470		

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BETA	STD ERROR B	F
SBS	-0.4190446	-0.43298	0.13889	9.103
BC	-0.4797879	-0.32057	0.21462	4.998
FC	-0.6250257	-0.20206	0.44957	1.933
(CONSTANT)	26.47371			

G R E S S I O N * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

JUTE YA

	DF	SUM OF SQUARES	MEAN SQUARE	F
	1.	11.56090	11.56090	7.55382
	38.	58.15785	1.53047	

------------ VARIABLES NOT IN THE EQUATION ------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
BC	-0.28452	-0.31128	0.99847	3.970
FC	-0.14388	-0.15470	0.98436	0.907
FD	-0.12928	-0.15206	0.99425	0.876
SD	0.04842	0.05196	0.94364	0.098
TD	0.09601	0.10508	0.99934	0.413
SAS	-0.02117	-0.02285	0.97503	0.015

* *

	DF	SUM OF SQUARES	MEAN SQUARE	F
E	2.	17.19621	8.59810	6.05701
	37.	52.52254	1.41953	

------------ VARIABLES NOT IN THE EQUATION ------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
FC	-0.20296	-0.22573	0.93283	1.933
FD	-0.16080	-0.18424	0.98902	1.265
SC	-0.01588	-0.01735	0.89915	0.011
TD	0.07646	0.08081	0.99789	0.237
SAS	0.02796	0.03125	0.94765	0.035

E G R E S S I O N * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

JUTE YA

	DF	SUM OF SQUARES	MEAN SQUARE	F
E	3.	19.87548	6.62416	4.78410
	36.	49.84827	1.38462	

------------ VARIABLES NOT IN THE EQUATION ------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
FD	-0.08671	-0.08971	0.76528	0.284
SC	0.24072	0.19567	0.47229	1.393
TC	0.06431	0.07091	0.98817	0.177
SAS	0.03423	0.03939	0.94671	0.054

* *

VARIABLE(S) ENTERED ON STEP NUMBER 4.. SD

MULTIPLE R	0.55894	ANALYSIS OF VARIAN	
R SQUARE	0.31241	REGRESSION	
ADJUSTED R SQUARE	0.23383	RESIDUAL	
STANDARD ERROR	1.17032		

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BETA	STD ERROR B	F
SBS	-0.3943154	-0.40743	0.13972	7.965
BC	-0.4470235	-0.25868	0.21525	4.313
FC	-1.126684	-0.36567	0.61686	3.336
SD	0.6368180	0.24072	0.53949	1.393
(CONSTANT)	29.54586			

REGRESSION ANALYSIS FOR QUALITY CONTROL OF THE JUTE PRODUCTS

FILE NONAME (CREATION DATE = 04/11/84)

* M U L T I P L E R

DEPENDENT VARIABLE.. BS BREAKING STRENGTH OF THE TWISTE

VARIABLE(S) ENTERED ON STEP NUMBER 5.. FD

MULTIPLE R	0.57237	ANALYSIS OF VARIAN	
R SQUARE	0.32761	REGRESSION	
ADJUSTED R SQUARE	0.22873	RESIDUAL	
STANDARD ERROR	1.17421		

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BETA	STD ERROR B	F
SBS	-0.3656428	-0.37780	0.14295	6.452
BC	-0.4372231	-0.25214	0.21626	4.069
FC	-1.007405	-0.32698	0.63371	2.527
SD	0.7649997	0.28917	0.56069	1.862
FD	-0.1468404	-0.14598	0.1675[illegible]	0.768
(CONSTANT)	28.13635			

* *

VARIABLE(S) ENTERED ON STEP NUMBER 6.. TD

MULTIPLE R	0.57489	ANALYSIS OF VARIAN	
R SQUARE	0.33050	REGRESSION	
ADJUSTED R SQUARE	0.20877	RESIDUAL	
STANDARD ERROR	1.18930		

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BET	STD ERROR B	F
SBS	-0.3670767	-0.37 [illegible]	0.14535	6.335
BC	-0.4293372	-0.28686	0.22003	3.807
FC	-0.9952686	-0.3[illegible]	0.64266	2.398
SD	0.7599575	0.28685	0.56812	1.785
FD	-0.1457302	-0.14487	0.16969	0.738
TD	0.1192406D-01	0.05415	0.03157	0.143
(CON	26.16374			

F- [illegible] TOLERANCE-LEVEL INSUFFICIENT FOR FURTHER COMPUTATION

STATISTICS WHICH CANNOT BE COMPUTED ARE PRINTED AS ALL NINES.

DF	SUM OF SQUARES	MEAN SQUARE	F
4.	21.78090	5.44522	3.97562
35.	47.93785	1.36965	

------------- VARIABLES NOT IN THE EQUATION -------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
FD	-0.14596	-0.14666	0.71323	0.768
TD	0.05526	0.06743	0.58758	0.155
SAS	0.04412	0.05166	0.54260	0.091

GRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

LIE YA

DF	SUM OF SQUARES	MEAN SQUARE	F
5.	22.84032	4.56806	3.31313
34.	46.87243	1.37878	

------------- VARIABLES NOT IN THE EQUATION -------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
TD	0.05416	0.06561	0.58729	0.143
SAS	0.00176	0.00197	0.63750	0.000

* *

DF	SUM OF SQUARES	MEAN SQUARE	F
6.	23.04214	3.84036	2.71510
33.	46.67661	1.41444	

------------- VARIABLES NOT IN THE EQUATION -------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
SAS	0.01234	0.01469	0.60765	0.007

CHAPTER SIX
DISCUSSION AND RECOMMENDATION

CHAPTER : SIX

DISCUSSION AND RECOMMENDATION

6.1 Introduction

The importance of producing quality jute goods in the face of stiff competition from other countries and of steadily increasing inroads of synthetic substitutes into the market has been emphasized in the introductory chapter. It has also been noted that quality can be achieved only through the use of proper material, machine, production process and personnel. Any deviation of these input variables from the specified conditions will affect quality. Some suggestive measures are discussed in this chapter in favour of quality control.

6.2 Quality Control Plan in the Production Process

In the discussion about the improvement of the quality control system the basic attempt should be made on the production process. The possible scope should be analysed and may be suggested to be approached. In this section a suggestion has been put for quality control in the production process by figure 6.1.

Actually the existing quality control policy and procedures are not so well organised in the enterprise level. From the observation on the overall quality defects eleven type controlling measures are suggested for their systematic approach to better quality. Now these measures are selected for particular stage in the flow process of the in-process jute. This will help in organising the test procedures and lead the policy in a logical manner. At some control stations the operators should be advised to measure the quality conditions very frequently because there is a possibility to deviate from the standard only for the carelessness of the attendent. At some points patrol inspection is needed to keep it within range from a major deviations. The properties of jute at some places are to be compared by some preselected control charts. At few points 100% inspection is preferred also. Somewhere sampling numbers should be calculated and the sampling must be done accordingly.

The policies for quality control are*

1) Operators will measure the conditions continuously.
2) Patrol inspection policy should be applied.
3) Record should be kept for further action on deviations
4) Sampling quantity should be calculated properly and controls should be done accordingly
5) Tests of the property should be done in the laboratory
6) Some preselected charts should be used
7) Measurement should be taken very frequently
8) Adjustment and settings of the machine should be checked frequently.
9) 100% inspection should be performed
10) Proper assortment should be done
11) Raw material property is to be checked.

* The numbers in the policy refers to the numbers mentioned in the figure

Production Process in a jute mill and the scope for Quality control

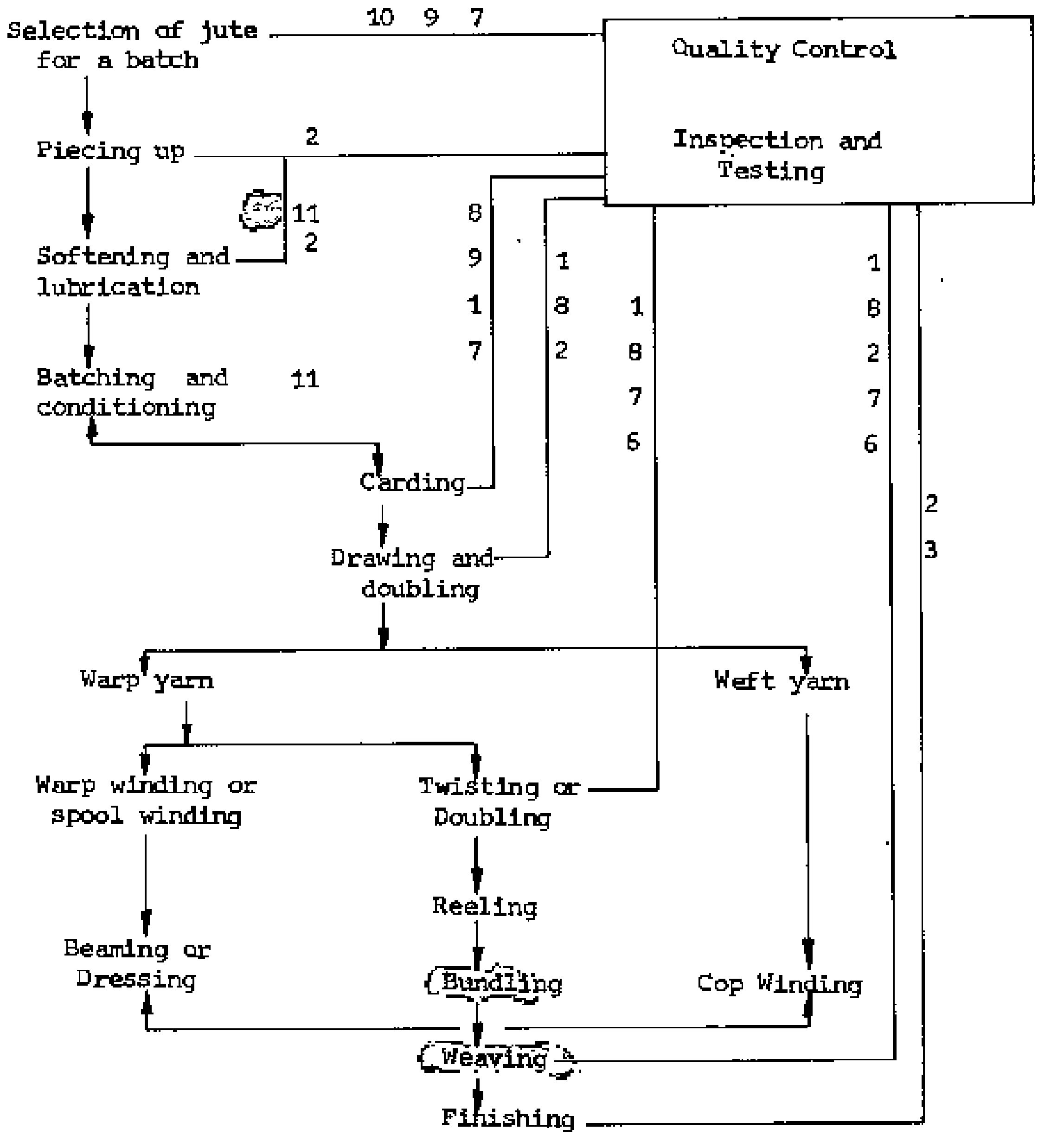


Figure: 6.1 - Diagram of the scope of quality control in the flow process of jute

6.3 Defects on Raw Materials

There are some quality claims which caused by the defect on the raw materials. In the scope of this paper these defects are mentioned only.

Moisture contents:
- It increases gross weight
- Imparts very harmful effect on the fibre
- Reduces its strength
- Reduces spinning quality

Moisture regain above 18% increases the activity of the microorganism and is liable to trigger fibre deterioration. But presence of moisture facilitates in weaving and some other process.

Rooty fibres, Specky fibres, Croppy fibres, Knotty fibres, Dazed or dead fibre, Runners, Sticky, Woody and shive fibres, Mossy fibres, Flabby or fluffy fibres and heart damaged fibres are the major defects in raw jute. All these defects can be eliminated at process of jute preparation which ensures better quality and improved charecteristics.

6.4 Suggestion:

On the overall observation and analysis some suggestion can be concluded on the process of production, machinery and personnel concerned. These are as follows:

In the quality control department at the jute mill level the equipment and the personnels are now insufficient.

There should be some effective and distinctive measures for improved quality control systems.

These are:

1) Personnel:

There lies a large vacuum in the need of trained and skilled personnel. So proper training facilities are badly required.

2) Equipment:

A mill should be well equipped with testing equipment to carry on routine tests and inspections. Because each test required some testing equipments.

3) Organisation:

(a) To check the deviation from the standards, group meetings of quality control and production personnel should be held at regular intervals to discuss the technical and manufacturing problems.

(b) By the standards given by the buyer, there should be fixed some intermittent standards at the key points of the production process, statistical tolarence and limits and action limit and control charts should be prepared. The derived results are generally consider 3σ limit.

4) Production process:

(a) Every property of jute is primarily dependent on the first sorting and batching of raw materials. So strict supervision is to be imposed to maintain right type of batch for blending in finisher card.

(b) Estimation of quantity of raw materials is also important. As the jute is a hygroscopic substance it has the tendency to absorb moisture from the atmosphere depending on the existing relative humidity and temperature.

So assessment of moisture is the matter for reporting

$$\frac{1}{M} - \frac{1}{R} = \frac{1}{100}$$

R = Moisture regain

M = Moisture content

(c) A lubricating agent,jute batching oil is used in jute processing to soften it for smooth opening in the cards to avoid major break down of the fibres. It also helps the fibre slipping pass the pins of drawing frame to ease parallelisation of the fibres. Uniformity of this agent can be desired by the uniformity of sizes of morrah of raw jute and the right quantity with right type of emulsion.

(d) Proper absorption and distribution of emulsion is to be checked. The stability of emulsion and its constituent has the influence on jute quality. So measures should be taken on this respect.

(e) Immaturity of jute cause improper opening in cards preceeded by damages to pins and staves and will result in excess wastage due to break down of its fibres and ultimately leads to irregular yarns with roots. Over maturity causes the deterioration in the strength of the fibre and so the product. It ultimately affect the efficiency. So to control the appropriateness of maturity period is a key point.

5) Tests and inspection:

(a) To ensure regularity in delivery from cards or frames proper feeding is necessary. For this, roll sizes, dollop weights, compactness, delivery weight per unit length and deviation from set standards should be reported regularly.

(b) Proper calibration of count with the moisture regain percentage should be established.

(c) Due to the irregular sliver mechanical defects, scubs and dirts in spinning diameter of a yarn may be uneven - Presence of roots may cause it also which is responsible for irregular twist at different portions of the yarn which results in weak tensile strength. So this measurement must be more frequent.

(d) Fineness of fibre is another quality to be expected which can be tested by gravimetric method or by Air flow method.

(e) Instron strength testing machine is to be applied for testing of tensile strength where movements are controlled electronically.

Yarns break at its weakest point so some weak point may be [illegible] overlooked. Good Braud's or James Heal yarn tensile strength machine are also used and statistical average should be taken.

(f) Slub is another irregularity which may be detected by slub counter (Photo electric cell type). It detects on the basis of electric pulse. For improved quality this test should be established at every mill.

(g) Brightness is a factor of the yarn or fabric. It is detected at central quality control department by the reflected light by photo-volt reflection meter using blue filter or tri-green filter. Carefulness in this test make it cent percent correct in result. This test is not so important for fabric quality and I think the central test is sufficient for control.

(h) Yarn has the tendency to catch loose fibres and dirt to form slubs on spinning frame. So blower can be used to keep the area clean. This will increase the quality.

(i) Twisting is an important factor of the yarn, less twist help penetration of dye and twist increases resistance to wear. So measurement of twist and standard setting is another important concern. So more test samples are to be required.

(j) Number of break yarn in spinning affect yarn quality due to increased number of piecing up. With higher rpm of flyer the tendency is to increase the yarn breakage and low rpm gives low productivity. So an optimum one should be calculated by proper observation. Properly fed yarn should not end down frequently.

(k) Knot is the most important factor in winding department. Big Knots creat problems in passing through mail eye on looms, bad cover in fabric and map creat holes in calendering. To eliminate this proper training and adequate supervision is required. For this existing supervision facilities are not sufficient. A patrol for frequent inspection may be provided.

(l) To avoid sinking of ends in winding pre beaming and beaming, adequacy and uniform yarn tension is required. Uniform application of tension and pressure is required to be checked. In-pre-beaming and beaming less number of ends may cause sinking which would then create problem in un winding. Beaming uniform application of starch should be ensured. It helps the ends pass through mail-eye smoothy other than added strength. For uniform penetration of starch to at least 1/5th of the radius of yarn uniform application of pressure of the pressing roller should be ensured. Fresh starch is to be used and 3% application is necessary.

(m) Picks may cause reed marks on a loom, So positioning of lease rods and raising of back rail may be necessary. A bad shuttle, improper setting or irregular tensions on weft in shuttle may cause bad selvedge. Looms fitted with Ecco-loader require proper adjustment at the time of loading a cop to release the rotchet to avoid formation of raw in fabric.

6.5 Special Measures in Inspection and Testing

Some special measures in inspection and testing can be suggested for better quality approach. These are as follows:

i) Care should be taken to ensure that the whole length of the probe of the moisture meter electrode is inserted inside the fibre in measuring the moisture content of the jute fibre.

ii) Stability of emulsion should be taken once daily from the application point which should be checked 4 hourly.

iii) The full length of the rotothermometer has to be inserted inside the pile for temperature recording.

iv) Moisture regain, delivery rate, weight etc. of the sliver has to be tested. The compactness of the sliver roll and its diameter should be checked periodically.

v) During the yarn testing proper care should be taken so that twist is not disturbed.

vi) In investigating the quality of jute all of the following characteristics are considered important.

a. weight of the cloth
b. width of the cloth
c. porter and shots
d. warp and weft way tensile strength
e. % oil content and moisture regain
f. brightness of cloth
g. weaving defects.

vii) In tensile strength test clamp size distance between clamps and other important setting of the machines are to be inspected before the actual test are being done.

These suggests for

- A sound costing based quality control system
- Design optimum processing condition

- Adequate machine maintenance
- A testing and inspection scheme with a statistical basis
- Training of personnel
- A satisfactory documenting system.

6.6 Inspection for Hessian Charecteristics

Sometimes for hessian charecteristics some special inspections can help to better quality. These are as:

I) Weft Bias: The bias or bowing in the weft yarns should be determined at least at five places in each sample. Amount is measured by the maximum deviation from imaginery straight line and expressed as the percentage ratio of maximum displacement of weft thread to the fabric width.

II) Cleanliness: An area of 4" x 4" are examined at 6 locations in each fabric sample and the graded speck population counted. The results is expressed as speck per sq. inch of sample fabric divided by 100 giving a "cleanliness factor" the higher the value the lower the degree.

III) Bursting strength: The sample is about half inch greater than the outside diameter of the clamp ring, 20 test pieces of each 5" x 5" are made from each stock sample and tests are carried out with the tester.

IV) Brightness: The reflectance of the diffused light of the sample are tested with the photovolt reflection meter using filter. A sample is examined at 15 places on each side.

V) Tensile strength of yarn: Yarn is dissected from the fabrics in both warp and weft way. Each type of yarns are made up into 6 bundles each 10 yarns of 9 cm length and the bundles are to weight individually. Single yarn each of 12 inch are then prepared from these bundles and at least 50 tests per bundle are to be taken by thread tester.

6.7 Some Recommendations on the Quality Control System

On the overall quality control approach the author has put some recommendations to improve and organize the existing policy. This is suggested after analysing a recommendation prepared by Asian Productivity Organization. These are as follows:

- Promotion of campaigns to increase the awareness of quality control concepts, product quality exceptions etc.
- Promotion of quality motivation by convincing the management on profitability of quality control practices.
- Emphasizing on education of workers on their role in maintenance and improvement of product quality.
- Induction of professional and industrial organizations to pool their resources to help in the spread of quality awareness and consciousness.

The contributing factors as:

- National level & international market and quality
- Inspection facilities.
- Quality systems.
- Calibration and Instrumentation.
- [redacted]

- Process control and charts.
- Quality awareness and manpower.
- Quality Personnel.
- Exchange of knowledge.
- International standards.
- Exchange of expertise.

Preventive policies and models

A defect can be replaced prior to be occured in order to prevent an unscheduled interruption, when it is functioning properly. It is the preventive policy, which involves a watchfull program of observation, servicing and replacement of plant facilities.

These can be achieved through:

- Clarification of environmental condition.
- Prevention of recurrent quality through feed back information system.
- Identification of failure mechanism and establishment of corrective action.

CHAPTER SEVEN
CONCLUSION

CHAPTER : SEVEN

CONCLUSION

7.1 Conclusion

Quality control of jute products is subjected to a total system of process of jute from cultivation to the finishing. Every attempt for the quality control of jute goods needs a proper basis of statistics. But in jute mills level these are not available according to the requirement.

To achieve the better quality of jute goods there are some responsible factors of them some are beyond the scope of the present research work. These are as follows;

a) Research on genetic engineering and biotechnical techniques and to examine the prospect of better basic characteristics of the raw jute which will affect the properties of the jute goods and also for product diversification. In this regard a chart of diversified products is shown in the appendix - II.

b) To sustain the quality, the quality control personnel should be more systematic, qualified and organised.

c) For quality improvement plan another major factor is the maintenance and reliability of the machinery. Maintenance of machinery and equipment is vitally important not only for industrial profitability but also for national economy. Machine of whatever type, however cheap or expensive, however simple or complex is liable to breakdown. Apart from breakdowns, machines tend to wear or deteriorate that naturally affects their efficiency which in turn affects the quality of the products and the reliability of the machines.

From the research regarding the applicability of quality control prolicies in jute mills, the following points have become apparent.

i) The claims settled against the defective quality of the jute goods stand as very small percentage of the total export value. So there must be a cost analysis to implement any quality control program only to have an examption from these complaints. But for further market expansion this control program may be extensive.

ii) Computer program shows that 'F' statistics values are not within satisfactory limit. So there is less possibility of uniformity of properties of jute goods at different stages of the production process. If a single bundle could be traced from the starting operation to the end then the properties might be uniform. This may lead to exemptany intermediate test or inspection to save the cost. But as the jute from breaker card to the weaving faces several mixing, so this conclusion could not be made authentically.

iii) The determined sample size can conclude a confident sampling to have a specified number.

iv) The control charts are prepared on the existing machine condition. Proper application of the control charts can systemize the control process.

v) An approximate quantification of the possible depending factors for the complaints of the buyer are prepared in table 4.5. This may be a tool for any attempt to rectify the causes of defects.

vi) On the observation of the author a quality control plan is suggested so that by implementing this policy better quality can be expected.

vii) Finally some specific and suggestive recommendation have been put on personnel, equipment, organisation and production which can improve the quality control approach.

7.2 Future Work

i) An analysis on the cost vs. quality should be done on the basis of existing claims of this paper.

ii) The approximation of the responsibilities against the claims should be justified with practical tests.

iii) Control charts should be applied to check whether they are really effective for better quality assurance.

iv) For checking the uniformity of the properties a regression analysis should be done by taking a particular bundle from starting to the last operation.

v) Next, on the basis of this paper a better quality control program can be prepared which will be the basic tool for quality control approach in the Jute Mills.

Appendix - 1
Table - 1

Spinning Random study report

	C.B.C. Warp						Hessian Warp						C.D.C. Weft				
Total spindle	700	800	800	800	600	700	800	600	700	700	700	600	1000	1100	1000	1000	1100
Total spindle idle	67	75	164	44	80	92	62	97	63	80	92	65	68	170	206	120	132
Idle %	9.57	9.37	20.5	5.5	13.3	13.1	12.4	16.17	9	11.4	13.14	10.83	6.8	15.45	20.6	12	12
Efficiency %	90.43	90.63	79.5	94.5	86.7	86.9	87.6	83.83	91	88.6	86.86	89.17	93.2	84.5	79.4	88	88
Bobbin short			12.5		2	1.2	10.6	14.67		5	3.04	3.1					5
Ends down	8.71	8.5	6.0	4.3	3.2	9.5	1.8	.87	8.57	5.7	10.1	6.5	5.7		10	6	
Sliver short	.86	.87	2.7	1.12	.6	1.9			.43			1.23	.7	13.8	10.0	5.2	6.8
Spinner short					.5	.4											
Mech. fault					.1					.7			.4	1.63	1.6	.8	.2
Mech. cleaning						.1											
Overhauling																	
Others					6.88												

Emulsion Application test
(Wt. of dry jute: 100 lbs)

Appendix – 1
Table – 12

Wt. of emulsion	Oil %	Wat. %	Emulsion breaking	
21	2.31	18.69	Oil %	11.00
			Wat %	20.00
22	2.2	19.8	Oil %	10.00
			Wat %	90.00
20	2.2	17.8	Oil %	11.00
			Wat %	89.00
21	2.52	18.48	Oil %	12.00
			Wat %	88.00
19	1.29	17.71	Oil %	11.00
			Wat %	89.00
18	2.34	15.66	Oil %	13.00
			Wat %	87.00
21	2.52	18.48	Oil %	12.00
			Wat %	88.00
21	2.1	18.9	Oil %	10.00
			Wat %	90.00
19	2.09	16.9	Oil %	11.00
			Wat %	89.00
20	2.00	18.00	Oil %	10.00
			Wat %	90.00
22	2.86	19.14	Oil %	13.00
			Wat %	87.00

(Contd./Table 2)

Wt. of emulsion	Oil %	Wat %	Emulsion breaking	
22	2.2	19.8	Oil %	10.00
			Wat %	90.00
22	2.64	19.36	Oil %	12.00
			Wat %	88.00
21	2.31	18.69	Oil %	11.00
			Wat %	89.00
20	2.4	17.6	Oil %	12.00
			Wat %	88.00

Appendix - 1
Table - 3

Heavy/Light inspection Report

Weight in lb.:

Draft constant = D.C. Twist constant = T.C. Std. yardags: 800 yds
Draft pinion = D.P. Twist pinion = T.P. Std. weight : 1.43 lb/yds
10 out of 700 to 1000

Actual yards	Actual weight	Actual yards	Actual weight	D.C.	D.P.	T.C.	T.P.	T.P.I.
784	1144	785	1150	600	38	180	40	4.5
777	1117	776	1115	426	28	136	32	4.25
779	1091	780	1092	600	39	180	42	4.29
804	1107	805	1108	600	39	184	43	4.28
781	1119	780	1120	600	36	180	40	4.00
771	1097	772	1100	600	36	180	43	4.29
780	1123	780	1080	425	26	136	30	4.53
779	1093	784	1090	600	41	180	42	4.29
786	1105	787	1112	600	41	184	43	4.28
787	1171	788	1120	600	37	180	40	4.50
782	1085	780	1085	426	30	136	32	4.25
779	1101	780	1112	600	41	180	42	4.29
820	1143	818	1098	600	41	180	43	4.28
791	1136	790	1120	600	39	180	40	4.5
788	1111	787	1109	426	29	136	32	4.25
801	1109	800	1108	600	38	180	42	4.29
810	1120	811	1140	600	37	184	43	4.28
798	1085	799	1106	600	39	180	40	4.50
792	1090	790	1092	426	29	136	32	4.25
781	1120	785	1130	600	39	184	43	4.28

Sliver Test Report

Equipment weight = $\frac{\text{Actual wt. x (100 + std. M.R)}}{\text{100 + Actual M.R.}}$

10 test/day among 550 rolls
wt. in lb of 14400 yrds (spindle) for 3rd drg.
wt. in lb of 100 yrds for Br. Card to 2nd drg.

	Br. card	Fin card	1st drg	2nd drg	3rd drg
Std. moist. Regain%	31	28	27	26	25
Std. weight lb.	18.5	14	8.5	4.56	148.00

Sl.	Breaker card	Finisher card	First drawing	Second drawing	Third drawing
1	2	3	4	5	6
1	18.5	13.4	7.44	4.4	146.88
2	18.7	13.4	7.6	4.6	146.88
3	19.3	13.6	7.52	4.44	138.24
4	18.4	13.2	7.36	4.60	141.12
5	18.0	13.2	7.50	4.4	144.00
M.R.%	33.33	33.33	28.21	31.58	28.21
1	16	13.4	7.52	4.40	149.76
2	17.7	13	7.68	4.20	146.88
3	19.4	13	8.04	4.60	138.24
4	18.5	13.5	7.92	4.32	144.00
5	16.8	12.7	7.40	4.44	152.64
M.R.%	29.87	25	28.2	25	20.48
1	16.5	13.4	7.64	4.12	144.00
2	17.5	13.8	7.52	4.20	146.88
3	18.2	12.9	7.36	4.20	144.00
4	17.8	13.2	7.12	4.28	138.24
5	16.8	13.4	7.50	4.16	138.24
M.R.%	31.58	25%	26.58	25	21.95

Table - 4 (Contd.)

1	2	3	4	5	6
1	18.7	12.5	7.36	3.92	138.24
2	20.6	13.1	7.44	3.52	141.12
3	20.1	12.8	7.28	3.68	144.00
4	19.8	13.0	7.12	4.00	138.24
5	18.4	12.8	7.28	3.92	141.12
M.R.%	26.58	19.05	21.95	21.95	20.48
1	17.5	13.8	8.6	5.28	135.36
2	18.8	14.0	8.5	5.28	138.24
3	17.8	13.60	8.56	5.12	132.48
4	18.2	13.8	8.75	5.32	135.36
5	17.50	13.8	8.60	5.16	129.6
M.R.%	23.46	23.46	25	25	21.95
1	18.20	12.8	7.2	4.16	144.00
2	17.5	12.5	7.36	4.00	138.24
3	18.6	12.8	7.28	3.92	138.24
4	18.4	12.6	7.28	3.76	149.76
5	18.5	12.6	7.40	4.00	144.00
M.R.%	23.46	23.46	21.95	23.46	21.95
1	19.0	13.7	9.25	5.32	152.64
2	18.7	14.2	9.00	5.25	152.64
3	18.4	13.8	9.12	5.16	155.52
4	18.2	13.8	9.04	5.44	161.28
5	18.8	14.0	8.96	5.36	152.64
M.R.%	29.87	25%	28.21%	25	23.46

Table - 4 (Contd.)

1	2	3	4	5	6
1	18.2	13.9	9.21	5.31	158.04
2	18.3	13.7	9.03	5.22	160.12
3	18.1	13.8	9.04	5.29	156.21
4	18.9	13.4	9.05	5.30	154.55
5	18.4	14.1	9.20	5.15	153.71
M.R.%	23.8	25	28.2	25	20.48
1	18.5	13.8	9.3	4.16	144.0
2	19.1	13.6	9.20	4.00	138.24
3	19.0	13.7	9.01	3.92	138.8
4	18.1	13.9	9.15	3.76	149.6
5	17.9	13.5	8.99	4.00	144.2
M.R.%	23.4	23.3	21.2	23.46	21.9
1	17.9	13.2	7.6	4.2	144.0
2	19.1	13.8	7.52	4.02	146.88
3	18.7	12.9	7.4	4.25	142
4	18.6	13.2	7.12	4.21	138.2
5	18.5	13.4	7.50	4.16	138.2
M.R.%	33.33	33.33	28.2	30	25
1	18.4	13.4	7.52	4.4	149.76
2	18.3	13.2	7.68	4.20	146.8
3	18.2	13.2	8.0	4.6	138.24
4	19.1	13.5	7.92	4.32	144.00
5	18.8	12.7	7.4	4.4	152.64
M.R.%	26.2	19.2	21.8	21.95	20.48

Table - 4 (Contd.)

1	2	3	4	5	6
1	18.7	12.5	7.36	3.90	138.24
2	18.7	13.1	7.44	3.52	141.12
3	18.6	12.8	7.28	3.68	144.0
4	18.1	13.0	7.12	4.00	138.24
5	19.0	12.9	7.3	3.9	141.12
M.R.%	26.5	19.7	21.9	21.8	20.48
1	18.2	12.5	7.32	3.92	138.24
2	18.2	13.2	7.4	3.52	141.17
3	18.3	12.7	7.28	3.68	144.00
4	18.1	13.1	7.2	4.00	138.24
5	18.8	12.6	7.18	3.92	141.12
M.R.%	26.6	19.06	21.22	20.9[illegible]	20.48
1	19.0	12.2	7.1	3.9	144.0
2	19.2	12.9	7.3	3.4	139.1
3	17.8	12.6	7.2	3.64	142.3
4	18.2	13.0	7.1	4.10	141.2
5	18.8	12.4	7.4	3.8	140.1
M.R.%	26.5	19.2	20.98	20.6	20.6
1	18.6	12.8	7.2	4.46	142.0
2	18.5	12.5	7.36	4.0	138.2
3	19.0	12.8	7.27	3.92	138.2
4	18.4	12.6	7.28	3.76	149.7
5	18.5	12.7	7.4	4.00	144
M.R.%	30	28	27	25	24.2

Appendix - II

Product diversification

1. New improved Australian Woolpacks : The properties are

   a) high density press

   b) reducing bag volume

   c) 550 ton pressure
   20% met by Bangladesh

2. New Zealand Woolpacks:

   100% is met by Bangladesh

3. Japanese rice bag:

4. Lighter carpet backing cloth:

   Weight is reduced from 9-00 to 5.5 oz/sq yrd

5. Jute carpet : Bangladesh is producing 1.55 lac maunds per year

6. Jute reinforced plastics :

   Sofa, auditorium chairs, sliver can, Helmets, are being produced by the Jute plastic plant with the capacity 2000, 5000, 50000 and 500 respectively

7. Housing elements

8. Car bodies

9. House hold goods

10. Furnitures

11. Boats

12. Novotex : 20% - 50% Jeans in weft and rest cotton. Suitings 30 - 50% Novotex and 40% of Jute. Shirtings 30% - 40% Novotex and rest is cotton. Furnishing fabrics 60% Novotex.

13. Juton : 35% jute, 65% cotton

14. Patose : 35% Jute and 65% Viscose

15. Patester : 35% Jute, 65% Polyester

16. Pat wool 4.5 lbs/spy count

17. Jute knitted yarn (blended): 50% jute

18. Light count jute yarn Count is reduced from 7.9 lbs/spy to 21 lbs/spy

19. Jute wall coverings

20. Jute insulator

21. Jute sound absorber

22. Rot proofed jute products

23. Water and Damp proofed jute canvas

24. Intermediate bulk carrier : It is used in 500 - 1000 kg. cargo.

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