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Anowar's Handbook on Textile Testing and Quality Control (Part-1)

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Key note of handwritten book

This preprint book is helpful for production engineers, textile engineers, students, quality control in textile industries, researchers, professors and professionals in the field of textile engineering and quality control in textile production. This handbook is written from author's notebook for exam preparation in Bachelor of Science in Textile Engineering.

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Tex-301. Textile testing and quality control

MD. Rokonuzzaman. 01712777737

*** Write down the definition of textile testing.

Definition of Textile Testing: By applying engineering knowledge and science —

to detect the criteria and properties of any textile product (such as fibre, yarn and fabric) is called textile testing.

*** Write down the objects or importance of textile testing.

Ans: The following mentioned points are the objects or importance of textile testing:

(1) Research (a) Fiber is the raw material of spinner so, to discover and test the acceptable values of fibre properties such as length, colour, fineness etc.

(b) Yarn is the raw material of weaver so, to discover and test the acceptable values of yarn properties such as count, strength, twist etc.

(c) Fabric is the raw material of finisher so, to discover and test the acceptable values of fabric properties such as: thread/inch, fault, shrinkage etc.

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(2) Selection of Raw material :

(a) Length, colour, fineness etc will be carefully considered for selection of raw material in spinning department.

(b) Yarn count, strength, twist etc will be carefully considered for selection of raw material in weaving department.

(c) Similarly, Fabric thread/inch, fabric fault, shrinkage etc will be carefully considered for selection of raw material in dyeing and finishing department.

For smooth running process, the raw material will be tested before going production. Raw material will be accepted or rejected as per maintain standard level.

(3) Product/Process control : If process is out of control at that time wastage will increase, production cost will increase so, to reduce wastage and production cost there should be maintained standard level to reduce end breakage (yarn cutting) rate.

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(4) Product testing: After making product, it must be tested it is called product testing. We can know by product testing, was proper raw material used or has the process control maintained properly.

(5) Product development: It is one kind of research example to produce a sample by changing machine setting (By increasing m/c speed)

(6) Specification test: To follow up the production as per specification and to observe it by testing.

Ex: Buyer gave a sample to the producer and the buyer told the producer that the bulk production will be produce as per sample. It is called specification test.

*** Count variation means (thick + thin) view
*** Twist increase – strength increase
*** Twist decrease – strength decrease
*** Micronia- means microgram per inch.
*** Identification of fabric fault is selected according to nape per gauge/kg.

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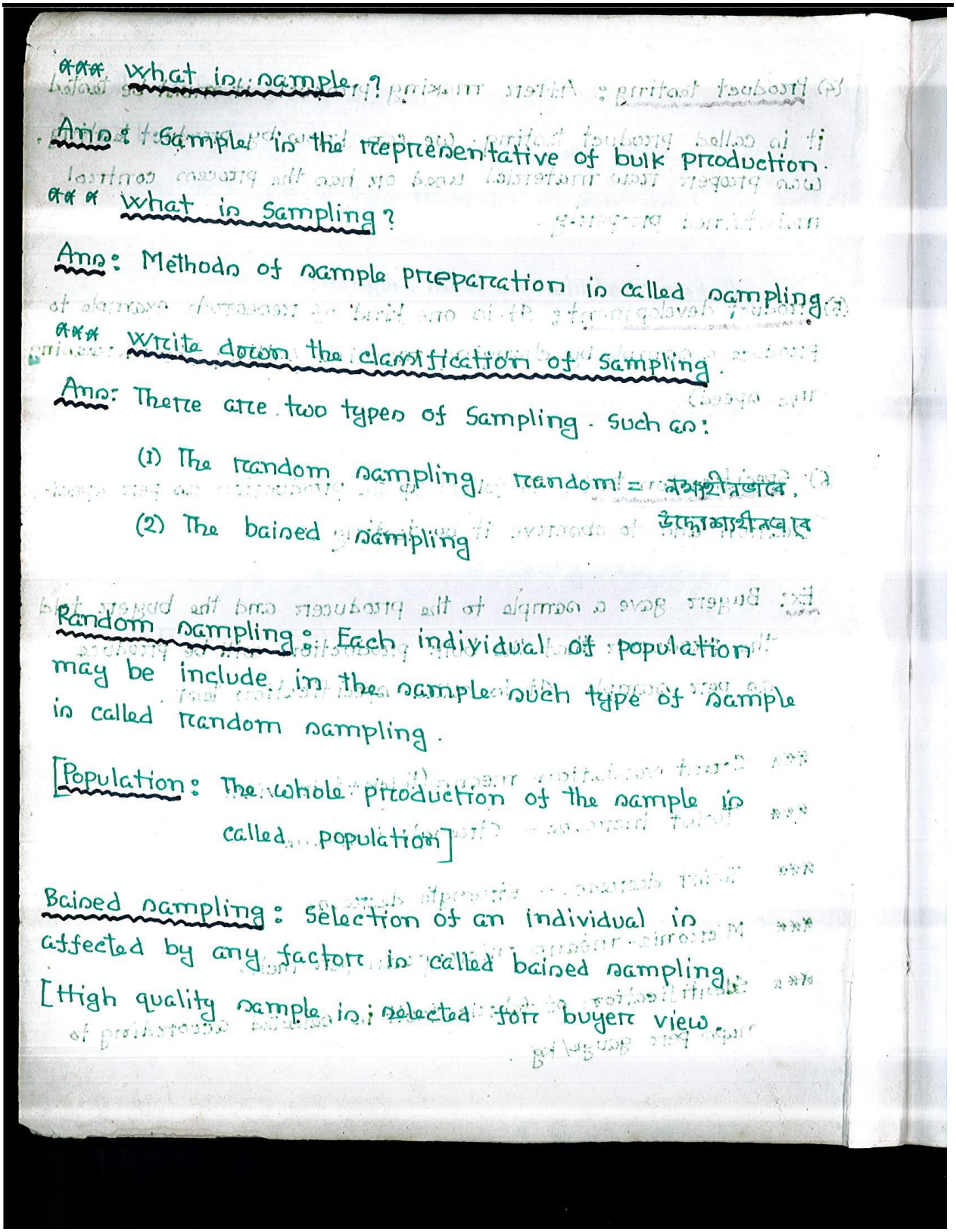

*** What is sample?

Ans: Sample is the representative of bulk production.

*** What is Sampling?

Ans: Methods of sample preparation is called sampling.

*** Write down the classification of sampling.

Ans: There are two types of Sampling. Such as:

(1) The random sampling. random = যাদৃচ্ছীভাবে.

(2) The baised sampling উদ্দেশ্যপ্রণোদিতভাবে

Random sampling: Each individual of population may be include in the sample such type of sample is called random sampling.

[Population: The whole production of the sample is called population]

Baised sampling: selection of an individual is affected by any factor is called baised sampling.

[High quality sample is selected for buyer view.

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*** State the factors which are influence the selection of samples for testing.

Ans:

1. The form of material (Fibre/ Yarn/ Fabric)
2. Amount of the material available.
3. Nature of test.
4. Types of Testing instrument.
5. Information required.
6. Degree of accuracy required.

*** Write down the sampling method for fibre?

Ans: There are various types of sampling method for determination of fibre property:-

1. Length and extent technique.
2. The squaring technique.
3. The cut squaring technique.
4. Zoning technique.
5. Tong sampling technique.
6. Dye sampling technique.
7. Core sampling technique.

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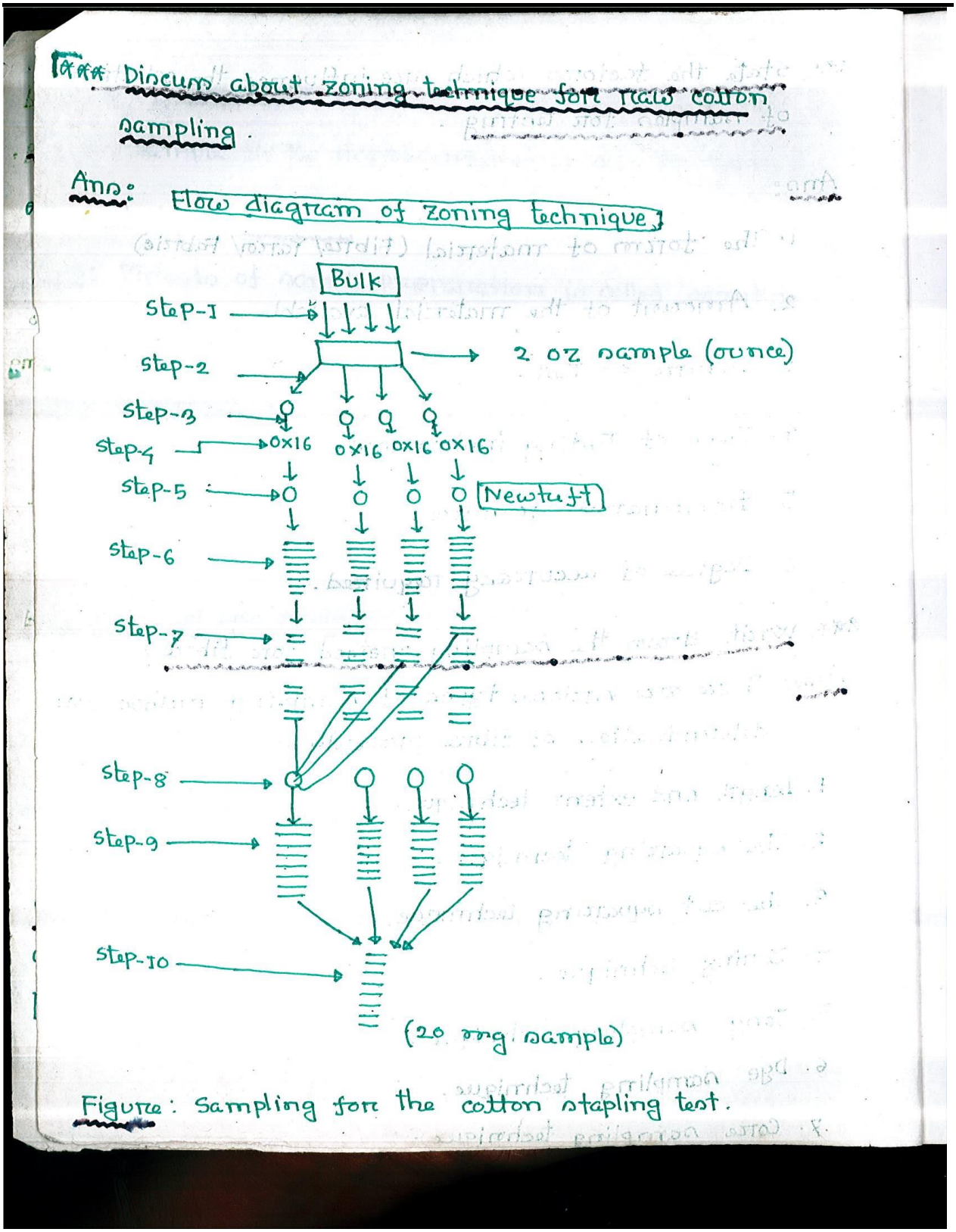

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Step-1 : From the bulk or sample of about 2-oz is prepared by selecting about eight large tuft chosen. From each tuft, small amount of cotton is taken to make a proper mixture.

Step-02 : Divided this sample into four quarters

step-03 : Taken sixteen small tuft at random each quarters. Size approximately 20 mg.

Step-04 : Each tuft is halved four times, Four times discarded alternately with right and left hand.

Step-05 : Each set of wisps is combined into a new tuft.
(আটি)

Step-06 : Each tuft is mixed in turn by doubling and drawing between the fingers.

Step-07 : Each tuft is divided into four parts.
(সমান)

Step-08 : Four new tuft is obtained by combination or part of each of the former tuft.

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Step-09: Each new tuft is mixed again by doubling and drawing.

Step-10: A quantity is taken from each tuft to make the final sample.

Q. Write down the sampling procedure for cotton fibre.

Tag → সনাক্ত করিবার জন্য সংলগ্ন টিকিট

Assign → ভাগ করিয়া দেওয়া, নির্দিষ্ট করা

Ans:

(I) Identification tag (label) is assigned to the bale.

(II) Bale cover is cut on each side of the bale with a sharp knife.

(III) A sample is cut of each side of the bale.

(IV) Identification tag is assigned to the sample.

(V) Finally, the sample is tested.

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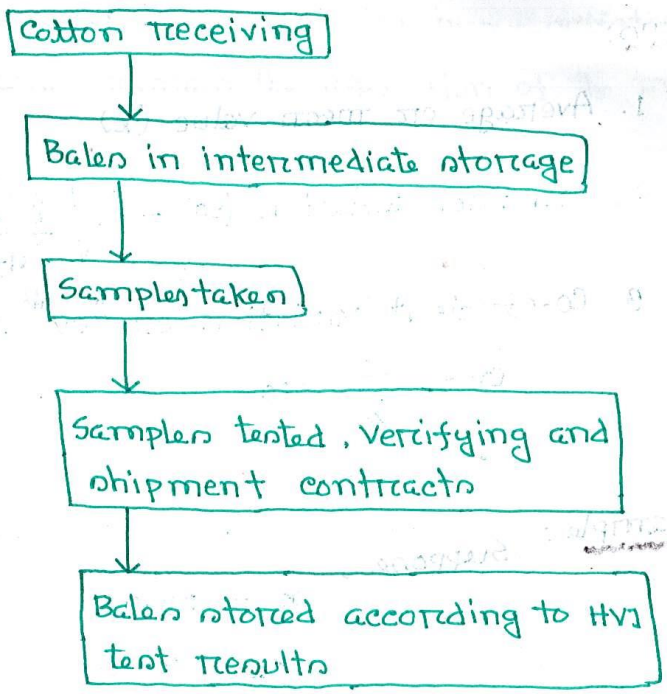
*** Discuss about modern cotton purchasing organization

Ans: Modern cotton purchasing and receiving :



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Q**** Write down three terms used most often for analyzing test results.

Ans:

1. Average or mean value ($\bar{x}$)
2. Standard deviation (SD) = $\sqrt{\frac{\Sigma (x_i - \bar{x})^2}{n-1}}$
3. Co-efficient variation or "CV" value

$$CV = \frac{SD}{\bar{x}} \times 100$$

Example: Suppose,

$x_1 = 29.9$

$x_2 = 30.0$

$x_3 = 29.8$

$x_4 = 29.7$

$x_5 = 29.2$

$x_i = x_1, x_2 \cdots x_n$

$$\bar{x} = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{5}$$

$$= \frac{29.9 + 30.0 + 29.8 + 29.7 + 29.2}{5}$$

$$= 29.7$$

$$SD = \frac{29.9 - 29.7}{5 - 1} = 0.05$$

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*** Why do we test textiles?

Ans: Testing is required at every stage of manufacture so that the finished article will prove satisfactory to the buyer, will maintain the reputation of the manufacturer.

*** Write down the definition of quality?

Ans: Quality consists of those product features which meet the need of customers and thereby provide produc satisfaction.

*** Write down the sampling method for yarn.

Ans: Sampling for determination yarn count:

(1) Sixteen ring cops is taken from ring spinning machine

(2) The skeins (120 gauge) should be wound from the top portion of eight ring cops and from about the half way the remaining eight ring cops.

(3) Then the sixteen skeins should be weighted by electronic balance

(4) Finally, Yarn count is calculated.

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(5) In case of large package such as cones or cheeses, Eight packages are taken and wrapped (টেনে বের করা/সরানো) two skeins from each.

(6). It is preferable to take one skein from the outer portion and one from the middle.

*** Discuss about count of yarn, removed from fabric.

Ans:

1. Count from the fabric at least two rectangular strips (স্ট্রিপ) containing different warp ends for determination the count of warp yarns.

2. At least five rectangular strips representing different weft ends for determination the count of weft yarns.

3. All the strips should preferably 20 inches long

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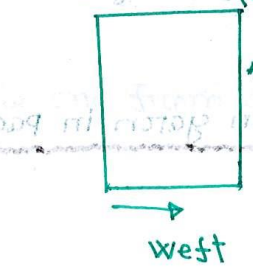
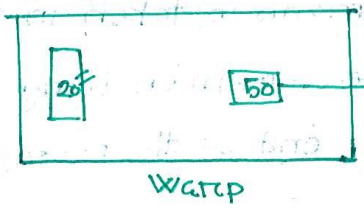
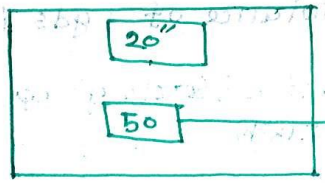
4. Width of strips should be such as to contain at least fifty threads of either warp or weft yarn. (দৈর্ঘ্যের অথবা প্রস্থকাটি)





[Minimum 2 sample]



[Minimum 5 sample]

Calculation:

$50 \times 20'' = 1000'' = \frac{1000}{36} = 27.77$ yds.

Weight of 27.77 yds. = .5 gm

For fabric count $= \frac{L \times \omega}{l \times w}$

$= \frac{27.77 \times 455.6}{840 \times .5}$

$= 31.2 \approx 30^s$

L and ω always fixed, l and w variable

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What is "accuracy" and "precision" ?

Accuracy : The term "accuracy" refers to how well an instrument measures on certain property in relation to its true value. The accuracy of a measurement is often described by "round trials" subsamples of the same . Cotton sample are sent to many different laboratories and tested on the respective instrument . The variation of the results of each laboratory is expressed as " Co-efficient of variation between "laboratories" or CV_b%.

Fibre property	Accuracy
1. Length (inch or mm)	± 0.018
2. Uniformity (%)	± 1.2
3. Strength (gm / tex)	± 1.5
4. Micronaire	± 15
Colour (Rd)	± 1.0
Colour (+b)	± 0.5

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Precision: The term "precision" refers to the ability of an instrument to produce the same measurement result time after time.

It describes how reproduceable a test result is within a series of test. On the same cotton sample and the same instrument in one laboratory. The variation of the test results is expressed as "Co-efficient of variation" within laboratory or CV_w%.

Fibre property ⟷	Precision
1. Length (inch or mm) →	±0.012
2. Uniformity (%) →	±0.8
3. Strength (gm/tex) →	±1.0
4. Micronaire →	±0.1
Colour (Rd) →	±0.7
Colour (+b) →	±0.3

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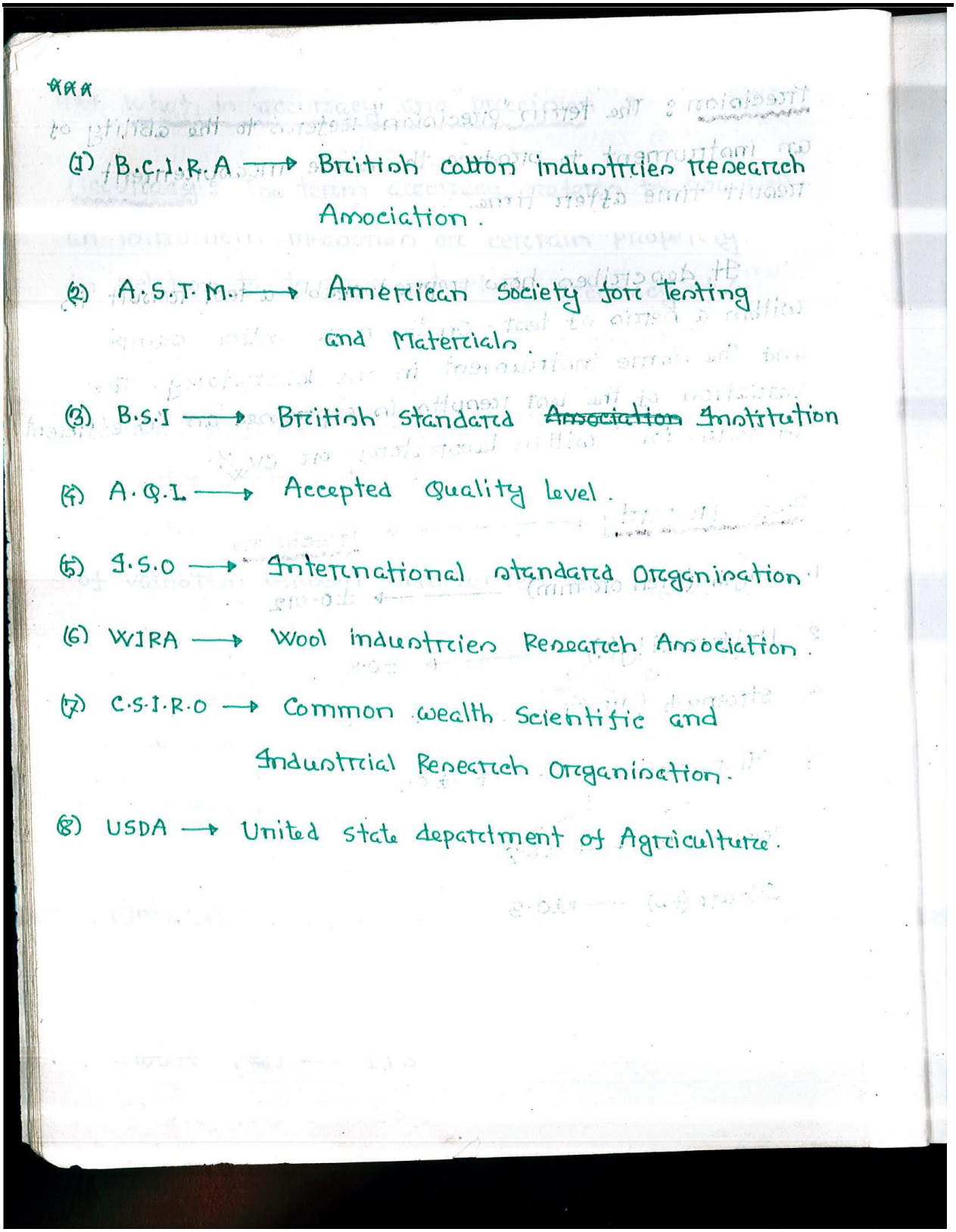

***

(1) B.C.I.R.A ⟶ British cotton industries research Association.

(2) A.S.T.M. ⟶ American Society for Testing and Materials.

(3) B.S.I ⟶ British standard ~~Association~~ Institution

(4) A.Q.L ⟶ Accepted Quality level.

(5) I.S.O ⟶ International standard Organization

(6) WIRA ⟶ Wool industries Research Association.

(7) C.S.I.R.O ⟶ Common wealth Scientific and Industrial Research Organization.

(8) USDA ⟶ United state department of Agriculture.

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*** What is CV_b%.

Ans: Co-efficient of variation between the sample is called CV_b. It is expressed as percentage.

*** What is CV_w%.

Ans: Co-efficient of variation within the sample is called CV_w. It is expressed as percentage.

Moisture regain: The ratio between weight of water to the oven dry weight of the material is called moisture regain. It is expressed as percentage.

If oven dry weight of the material = D

Weight of water = W

Moisture regain = $R = \frac{W}{D} \times 100\%$

Moisture content: The ratio between weight of water to the total weight of the material is called moisture content. It is expressed as percentage.

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If woven dry weight = D

Weight of water = W

Total weight of material = D+W

Moisture content = M

Moisture content, $M = \frac{W}{D+W} \times 100\%$.

Moisture content of cotton = 7.5

Oven dry weight: The weight of the sample at $(105 \pm 3)^{\circ}C$ temperature is called oven dry weight.

***. **What is Relative humidity?**

Ans: The ratio between actual vapour pressure to the saturated vapour pressure at the same temperature is called Relative humidity. It is expressed as percentage.

$$\text{Relative humidity (R.H.)} = \frac{\text{Actual vapour pressure}}{\text{Saturated vapour pressure}} \times 100\%$$

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Q. Discuss about standard atmosphere on testing atmosphere.

Ans: It relative humidity $(65 \pm 2)\%$ and temperature $(20 \pm 2)^{\circ}c$ in atmosphere. It is called standard atmosphere. In tropical and subtropical countries:

Relative humidity : $(65 \pm 2)\%$

Temperature : $(27 \pm 2)^{\circ}c$

Q. Write down the relation between moisture regain and moisture content.

Let,

Oven dry weight = D

Weight of water = W

Moisture regain = R

Total weight of material = D+W

Moisture content = M

We get from the definition of moisture regain and moisture content,

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Moisture regain, $R = \frac{W}{D} \times 100$ ---- (i)

And Moisture content, $M = \frac{W}{D+W} \times 100$ ---- (ii)

We get from equation no-(i)

$$D = \frac{100W}{R}$$

Putting the value of D in equation no: 02

$$M = \frac{W}{\frac{100W}{R} + W} \times 100$$

$$= \frac{100W}{\frac{100W + RW}{R}}$$

$$= \frac{100WR}{100W + RW}$$

$$= \frac{100WR}{100W\left(1 + \frac{R}{100}\right)}$$

$$\therefore M = \frac{R}{1 + \frac{R}{100}}$$

This is the relation between moisture content and moisture regain.

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We get from equation no. (11)

$$D+W = \frac{100W}{M}$$

$$\text{or, } D = \frac{100W}{M} - W$$

Putting the value of D in equation no (1)

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

$$= \frac{100W}{\frac{100W - MW}{M}}$$

$$= \frac{100WM}{100W - MW}$$

$$= \frac{100WM}{100W\left(1 - \frac{M}{100}\right)}$$

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

This is the relation between moisture regain and moisture content

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*** Write down standard moisture regain of different fibre.

Ans:

Fibres	Moisture regain (%)
1. Cotton	8.5%
2. Jute	13.75%
3. Wool	16%
4. Silk	11%
5. Viscose rayon	11%
6. Flax and hemp	12%
7. Polyester	4%
8. Polyamide (Nylon 6 and Nylon 6.6)	4%

*** What is quality control?

Ans: Quality control is the checking, verification and regulation of the degree of excellence of an attribute or property of something.

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*** What is the necessity of correct invoice weight.

Ans: In commercial transactions, where textile materials are paid for by weight, it is clearly necessary to have agreement between buyer and seller on the exact weight to be paid for. The buyer certainly does not wish to pay for excess water at the price per pound of the textile material. A correct invoice weight therefore determined.

$$\text{Correct invoice weight} = C \times \frac{100 + \text{Standard moisture regain}}{100}$$

Here, C = over dry weight
= 200
Standard moisture regain = 8.5%

$$\therefore \text{Correct invoice weight} = 200 \times \frac{100+8.5}{100}$$
$$= 200 \times 1.085$$
$$= 217$$

*** Write down the effect of moisture regain on fibre properties; or importance of moisture regain.

(1) Dimension: Fibre dimension changes for moisture absorption i.e fibre length increases for moisture absorption but fabric length decreases for moisture absorption.

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Mechanical properties: Fibre strength becomes weak for moisture absorption. In case of cotton and flax fibre strength increases for moisture absorption.

Electrical properties: Moisture regain seriously affects electrical resistance of fibre. If moisture gain more static electricity produces which cuts jam in carding m/c.

Thermal effect: When moisture is absorped textile material heat is generated. This heat is stressed as the heat of absorption. Suppose, dry weight of a sample is 1 gm and it is completely wetted, the heat evolved expressed calories per gm of dry material, is termed heat of wetting.

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Example : In passing from a room at 18°c and 45% relative humidity into an outside atmosphere at 5°c and 95% relative humidity, a man's woolen jacked weighting 1kg will produce 100000 Calorie of heat.

*** What are the factors that affected the moisture regain of textile materials.

(1) Relative humidity : If relative humidity more in the air, moisture regain will more in the fibre and if relative humidity less in the air, moisture regain will less in the fibre. Because - If moisture more in the air, fibre will absorb more water.

(2) Time : If a textile material is kept in atmospheric condition; it will take time to reach its equilibrium position. This time is called rate of conditioning. Rate of conditioning depends on sample size, form of material etc.

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Example : Hank of yarn taken 1 hour for conditioning and package of yarn takes 3 hours for conditioning.

(3) Temperature : There is no important effect of temperature on moisture regain. Because, at 10°c temperature moisture regain of cotton changes 0.3%. But it is important at research purpose.

(4) The previous history of the sample : It can effect the equilibrium regain e.g. hysteresis effect processing can also change the regain when oils, waxes and others impurities are removed from textile material, at that time regain changes e.g. moisture regain of scoured wool 16% and moisture regain of unscoured wool 18.5%

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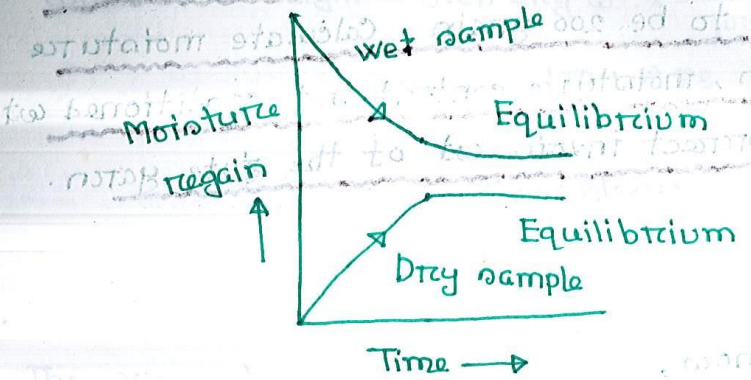
*** What do you understand by Hysteresis effect ?



Suppose two samples of the same material were taken into a given atmosphere. One completely wet and the other dry and at interval of time the regain values for each were determined by plotting the regain against time for both samples two curved would be obtained. The regain changes fairly quickly at first and then more slowly as equilibrium conditions are reached. The sample which was originally wet has a higher regain value than the other, an effect known as hysteresis. So we can say the moisture regain difference of dry sample and wet sample in equilibrium condition is called hysteresis effect.

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The oven dry weight of 220 grains of jute is found to be 200 grain. Calculate moisture regain, moisture content and conditioned wt or correct invoice wt of the jute yarn.

Solution:

We know,

$$\text{Moisture, } R = \frac{\text{Weight of water}}{\text{oven dry weight}} \times 100\%$$

$$= \frac{\text{Original wt} - \text{oven dry wt}}{\text{oven dry wt}} \times 100$$

$$= \frac{220 - 200}{200} \times 100\%$$

$$= 10\%.$$

We know,

$$\text{Moisture content} = \frac{\text{wt. of water}}{\text{original wt}} \times 100\%$$

$$= \frac{\text{Original wt} - \text{oven dry wt}}{\text{Original wt}} \times 100\%$$

$$= \frac{220-200}{220} \times 100\% = 9.09\%.$$

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we know.

Conditional weight = Oven dry wt. $\times \frac{100 + S.M.R}{100}$

$= 200 \times \frac{100 + 13.75}{100}$

$= 227.5$ grain

S.M.R = Standard moisture regain

The woven dry weight of 651 yds of cotton in 40 grain what is the conditioned count of the yarn S.M.R of cotton is 8.5%. Find out the condition weight.

Here,

Length, $L = 651$ yds

length, $l = 840$ yds

Oven dry weight, $W = 40$ grain

$= \frac{40}{7000}$ pound

$= .0062$ pound.

$w = 1$ pound

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$$\text{Condition count} = \frac{L \times \omega}{l \times w}$$

$$= \frac{651 \times 1}{840 \times .0062}$$

$$= 125^{S}$$

$$= \text{Ne } 125$$

$\therefore$ Condition count = Ne 125

$$\text{Condition weight} = \text{oven dry weight} \times \frac{100 + \text{S.M.R of cotton}}{100}$$

$$= 40 \times \frac{100 + 8.5}{100}$$

$$= 40 \times \frac{108.5}{100}$$

$$= 43.4 \text{ grain}$$

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If the oven dry wt of 7200 ydn of jute yarn is 2 pounds. Calculate the conditioned count. S.M.R of jute is 13.75%.

Ans: Condition wt = oven dry wt × $\frac{100 + \text{S.M.R of jute}}{100}$

$= 2 \times \frac{100 + 13.75}{100}$

$= 2.275$

Oven dry weight, W = 2 pounds.

length, L = 7200 yards

$l = 14,400$ yards.

Condition count, $= \frac{W \times l}{L}$

$= \frac{2.275 \times 14400}{7200}$

$= 4.55$ lbs/spyardle

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Determine the standard moisture regain of cotton/ nylon blend (cotton : Nylon = 80 : 20)

Ans:

S.M.R of cotton = 8.5%

S.M.R of Nylon = 4%

Solution:

We know, standard moisture regain.

$$= \left(\frac{P_1}{100} \times R_1\right) + \left(\frac{P_2}{100} \times R_2\right)$$

$$= \left(\frac{80}{100} \times 8.5\right) + \left(\frac{20}{100} \times 4\right)$$

$$= 6.8 + 0.8$$

$$= 7.6$$

S.M.R of cotton / Nylon blend yarn = 7.6

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DDD

Write down the measurement of relative humidity

Ans: There are mainly used three types of hygrometer for measuring relative humidity. Such as:

(1) The wet and dry bulb hygrometer

(2) The hair hygrometer

(3) The electrolytic hygrometer.

Wet and dry bulb hygrometer: There are two thermometer in wet and dry bulb hygrometer. One thermometer is uncovered which is measured room temperature and another thermometer is wrapped by muslin sleeve and kept in distilled water. There is a printed scale between two thermometer reading of relative humidity is taken from this printed table according to the differences of temperature.

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An for example:

Let, Dry bulb temperature = 68°F

Wet bulb temperature = 61°F

Difference between dry and wet bulb temperature = (68-61)°F

= 7°F

Relative humidity from printed scale 67%

Uses: Generally this type of hygrometer is used in mill and industry.

Merits: Relative humidity is measured rapidly by this hygrometer.

Demerits: More accurate result does not get in testing laboratory.

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D.D.P.

Q Write down the method of moisture regain measurement.

Ans:

(1) The WIRA rapid regain tester.

(2) Reynolds and Branson rapid regain tester.

(3) The CSIRO direct reading regain tester (using today)

(4) The WIRA electrical hygrometer.

Q Describe about direct reading regain tester.

Ans: It is suitable for process control of mill very rapidly and accurate result gets by this tester 1.5% to 30% moisture regain measures by this. Its accuracy is ±0.5. It takes only 6 minutes to test moisture regain.

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How to test / measures moisture regain.

Ans:

(1) At first, ~~original weight is taken~~ weight of original sample is taken with container.

(2) Hot air is pressed into the sample for removing moisture from the sample.

(3) Then again, weight of the sample is taken with container.

(4) Moisture regain is measured from the weight of original sample and dry sample.

5. We know,

$$\text{Moisture regain} = \frac{\text{wt of moisture}}{\text{Dry wt of sample}} \times 100\%$$

$$= \frac{W_1 - W_2}{W_2} \times 100\%$$

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$= \left(\frac{W_1}{W_2} - 1\right) \times 100\%$

Where,

W_1 = Undried wt or original sample wt

W_2 = Dried wt.

**** Fibre length: The distance between the ends of fibre when measured under specified condition

**** Staple length: The average length of spinable fibre is called staple length.

**** Mean length: It is the average length of all fibres in the sample.

**** Effective length: It is defined as the length of the main bulk of the longer fibres.

The term effective is used because it is to this length value that many machinary settings are related in particular the distance between the nips of successive pairs of drafting rollers.

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Span length: The length of extended fibre in called span length.

Dispersion: A measure of length variation in cotton fibres in called dispersion.

Percentage short fibre: This is the percentage of fibres less than half the effective length.

*** **Write down the relation between effective length and staple length.**

Ans: For american upland cottons, from about $\frac{3}{4}$" to $1\frac{1}{4}$" staple and clamed on the basis of American staple length standards, a simple conversion formula is American staple length = 0.91 x effective length For Egyption type cottons no staple length standards are in universal use, but on the average it is found that the staple length is equal to the effective.

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In case of staple length $\frac{34''}{32}$ to $\frac{39''}{32}$

Staple length = Effective length $- \frac{3''}{32}$

In case of longer fibre than $\frac{39''}{32}$

Staple length = Effective length $- \frac{1}{8}''$

In case shorter fibre than $\frac{34''}{32}$

Staple length = effective length $- \frac{1}{16}''$

**** What do you understand by Fineness.

Ans: Fibre exhibit a variety of cross-sectional shapes and they also vary in section along their length and vary from fibre to fibre. It is necessary therefore, to derive some index of fineness which can overcome these difficulties.

Mass = Volume x Density

= Cross sectional area x length x density

Since, Mass $\propto$ cross-section

So, linear density i.e weight per unit length is the most useful general way of describing the fineness of textile fibre.

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*** Write down the importance of fibre fineness

Ans:

(i) Average number of fibres in the cross-section: The irregularity in the strand is dependent upon the average number of fibres in a cross-section with a greater number of fibres in the cross-section the irregularity is reduced. The finer the fibre the higher the number of fibre in cross-section and lower the irregularity. The coarser the fibre the lower the number of fibre in cross-section and higher the regularity.

(ii) Surface area for inter fibre contact: If a given count is spun from a fine and a coarse fibre, a more uniform and a stroger yarn will get from the fine fibre. A fine fibre can be spun to finer counts than a coarse fibre.

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So the finer the fibre the greater the total surface area available for interfibre contact and consequently, less twist is required to provide the necessary cohesion.

(iii) Influence on the mechanical properties: The fineness of the fibre also affects several mechanical properties. Two important fibre properties are the torsional rigidity (resistance to twisting) and stiffness (resistance to bending). Finer the fibre, lower the torsional rigidity and stiffness.

From the above discussion, it is proved that fibre fineness is an important characteristic of fibre.

*** What do you understand by Maturity.

Ans: Degree of cell wall thickening is called maturity. The area of the cross section filled with cellulose finally determines the maturity of cotton fibre.

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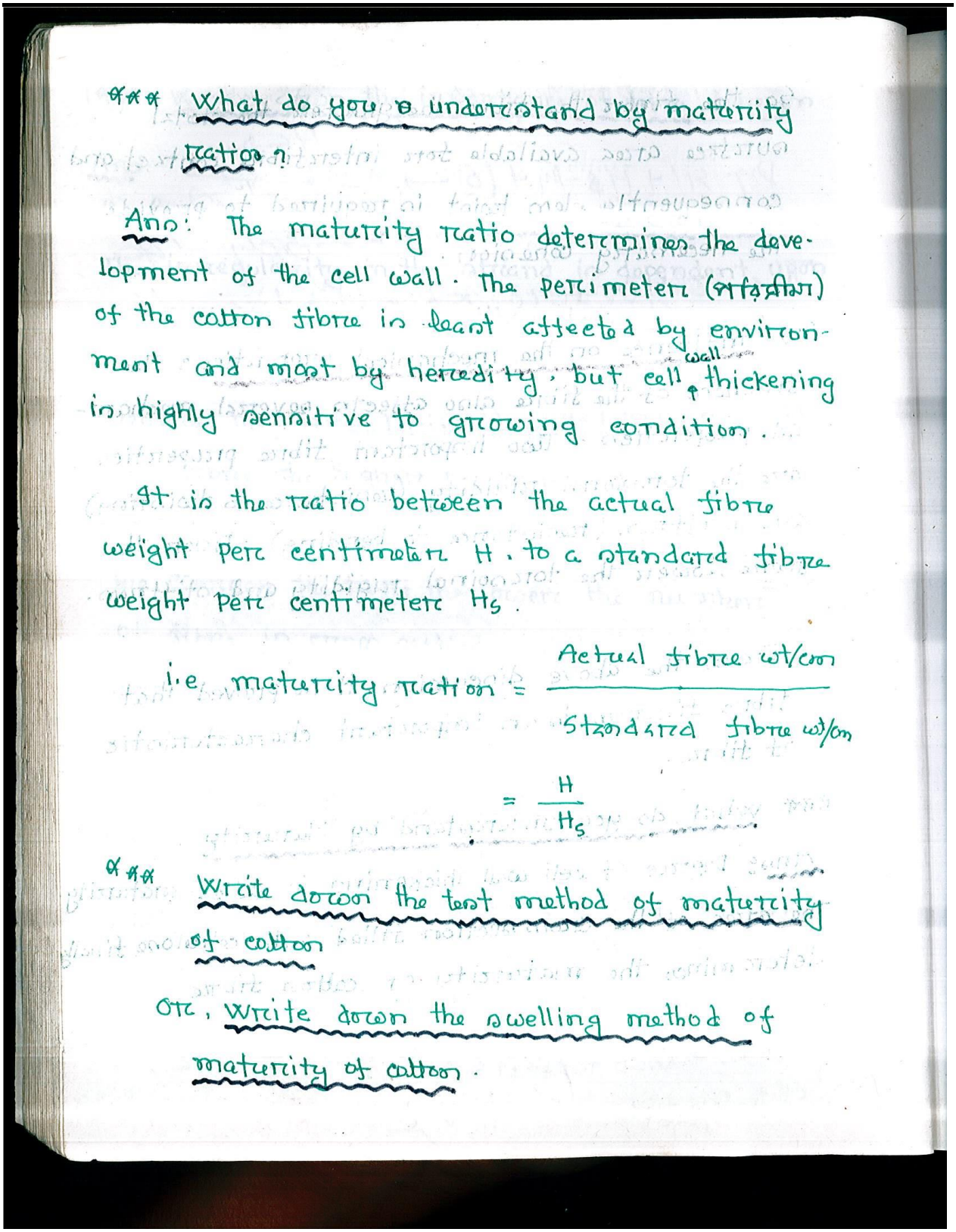

*** What do you understand by maturity ratio?

Ans: The maturity ratio determines the development of the cell wall. The perimeter (পরিধি) of the cotton fibre is least affected by environment and most by heredity, but cell wall thickening is highly sensitive to growing condition.

It is the ratio between the actual fibre weight per centimeter H, to a standard fibre weight per centimeter H_s.

i.e maturity ration = $\frac{\text{Actual fibre wt/cm}}{\text{Standard fibre wt/cm}}$

$= \frac{H}{H_s}$

*** Write down the test method of maturity of cotton

Or, Write down the swelling method of maturity of cotton.

Md. Anowar Hossain, Anowar's Handbook on Textile Testing and Quality Control (Part-1), School of Fashion and Textiles, RMIT University, 25 Dawson Street, Brunswick, Melbourne, VIC 3056, Australia; Department of Textile Engineering, City University, Khagan, Birulia, Savar, Dhaka-1216, Bangladesh; 17 May 2023.

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Ans:

(1) Five tufts of cotton are kept on the velvet pad.

(2) Each tuft is laid on a microscop slide, the fibres are parralled and separated.

(3) The fibres are then irrigated with a small amount of 18% caustic soda solution - which has the effect of swelling them. The presence

(4) The presence or absence of convolutions in then observed, preferably by means of a projection microscope. This enables the fibres to be classified into three groups.

1) Normal fibres

2) Thin-walled fibres

3) Dead fibres (cell wall thickness is less than one-fifth of the total width of fibre.

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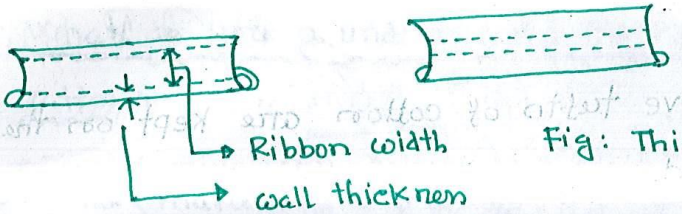

Fig: Thin walled

Fig: Dead fibre

Fig: convolution

Mature fibres with a well developed cell wall and pronounced convolutions in the raw state become rod like, after swelling these rod-like fibres are called as normal fibre. Dead fibres appear ribbon-like even after swelling. Thin walled fibres are those lying between the other two classes. The result of test expres as (N-D).

where,

N = Normal fibre.

D = Dead fibre.

e.g. 64-14 would mean that 64% of the fibres counted were classed as normal

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and 14% classed as dead. therefore by subtraction; 22% would be classed as thin-walled fibre.

i.e $\{100-(64+14)\}\% = 22$

From a sample of 100 fibres it would be abnormal to find that all the fibres could be classified as normal fibres. So a standard was chosen for fully matured cotton.

$$N-D = 67-7 = 60$$

$$\therefore N-D = 60$$

Pronounced → (a) উচ্চারিত, ঘোষিত

Convolution → Twisting.

Swell → ফোলানো/ফাপানো

Projection → নিক্ষেপকরন

Exhibit → প্রদর্শন করা

Span length → এক প্রান্ত হইতে অন্য প্রান্তের দৈর্ঘ্য।

Preferable → অধিকতর উৎকৃষ্ট

Wrap → মোড়ক করা

Sleeve → The part of a garment that covers the arms.

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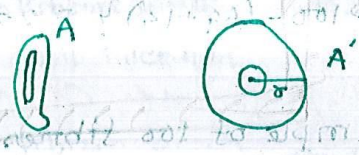
What is degree of cell wall thickening

Ans:



Degree of thickening of a cotton fibre

The degree of cell wall thickening may be expressed as the ratio of the actual cross sectional area of the cell wall to the area of the circle with same perimeter.

The degree of accuracy, $\theta = \frac{A}{A'}$

where,

A = Actual cross sectional area of the cell wall

A' = Area of circle with same perimeter

$$A = \pi r^2 = \frac{4\pi \times \pi r^2}{4\pi} \quad [\text{Multiplying by } 4\pi]$$

$$= \frac{4\pi^2 r^2}{4\pi} = \frac{(2\pi r)^2}{4\pi}$$

$$= \frac{P^2}{4\pi} \quad [P = 2\pi r = \text{Perimeter}]$$

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$$\therefore \theta = \frac{A}{\frac{p^2}{4\pi}}$$

$$= \frac{4\pi A}{p^2}$$

Write down the principle of fineness measurement

or, Write down the working principle of fineness method/ Airflow method.

or. Prove that, $Sx \propto \frac{1}{d}$

Ans: There are forth methods of fineness measurement. Such as:

(1) Gravimetric method
(2) Optical method
(3) Vibroscope method
(4) Air flow method.

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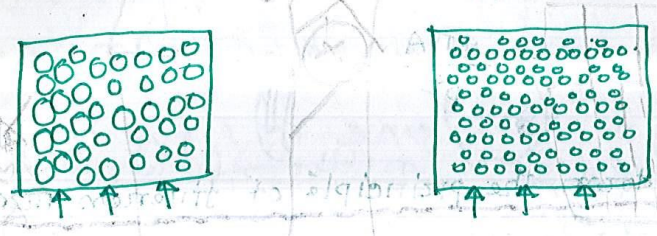
Working principle of Air flow method.



Suppose two cylinders of similar dimensions were filled with (a) a few circular rod of large diameter and (b) many circular rods of small diameter. If air were flown through the two cylinders at the same pressure, it would be found that the rate of air flow through (b) was less than through (a), even through the space through which the air passes in the same for both cylinders. The reason is that the air flowing through (b) has more rod surface to flow past.

So, a difference in the rate of air flow is a measure of the difference in the surface area of the large diameter and small diameter.

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e.g the specific volume of a cylinder

Let, the volume, V = cross sectional area, A x length L

$= \pi r^2 \times L$

$= \pi \left(\frac{d}{2}\right)^2 \times L$

where d = diameter of the cylinder

The surface area (ignoring the ends) $= \pi d L$

Specific surface, $S = \frac{\pi d L}{\pi \left(\frac{d}{2}\right)^2 L}$

$= \frac{4}{d}$

This ratio also equals to the ratio of perimeter of cross-section and area of cross-section

$S = \frac{\text{Perimeter of cross section}}{\text{Area of cross-section}}$

$= \frac{\pi d}{\pi r^2}$

$= \frac{\pi d}{\pi \left(\frac{d}{2}\right)^2} = 4/d$, For $S = 4/d$, or $S \propto \frac{1}{d}$ [4 = constant]

So, it says for fibres of circular cross section, Specific surface is inversely proportional to the fibre diameter.

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*** Show the maturity ratio is proportional to the degree of thickening.

Or, Show that maturity ratio, $M = \frac{N-D}{200} + 0.7$

Ans:

We know maturity ratio,

$$M = \frac{H}{H_S}$$

where, H = Actual fibre wt/cm

H_S = Standard fibre wt/cm

Peirce and Lord found, N-D and H for several pure strains of cotton and within each series only the maturity varied. A linear relationship is found between N-D & H

$$H = 0.937 (N-D) + 135.2$$

$$H_S = 0.937 (67-7) + 135.2$$

$$M = \frac{H}{H_S} = \frac{0.937 (N-D) + 135.2}{0.937 (67-7) + 135.2}$$

$$= 0.0069 (N-D) + 0.706 = \frac{N-D}{200} + 0.7$$

$$\therefore M = \frac{N-D}{200} + 0.7 \text{ (Proved)}$$

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******* What is the relation of fineness between American and British system.

or, How fibre fineness is measured.

Ans: Cotton fibre fineness is measured by two system. Such as:

① British system or British unit

② American system or American unit.

British system: In England the linear density is called either the fibre weight per cm or the hair weight per cm, H. The unit of weight is the milligram $\times 10^{-5}$

Thus, the fibre weight per centimeter for an American upland cotton may be 192. i.e 192 mg $\times 10^{-5}$/ 192 $\times 10^{-5}$ mg/cm.

American system: In America, the weight unit is the microgram (gm $\times 10^{-6}$) and length unit is the inch. The linear density of the American upland cotton would be 4.9 µg/inch. In American system,

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Linear density (μg/inch) is also called micronaire value.

Mathematically, American Linear density

$= \text{Fibre wt in gm} \times 10^{-6} \text{ inch}$

$= A \times 10^{-6} \text{ gm/inch}$

British Linear density $= \text{Fibre wt in mg} \times 10^{-5}/\text{cm}$

$= H \times 10^{-5} \text{ mg/inch cm}$

$= H \times \frac{10^{-5}}{1000} \text{ gm/cm}$

$= H \times 10^{-8} \text{ gm/cm}$

$= H \times 10^{-8} \times 2.54 \text{ gm/inch}$

$A \times 10^{-6} \text{ gm/inch} = H \times 10^{-8} \times 2.54 \text{ gm/inch}$

$A = H \times 2.54 \times 10^{-2}$

This is the relation between American and British fineness measurement system.

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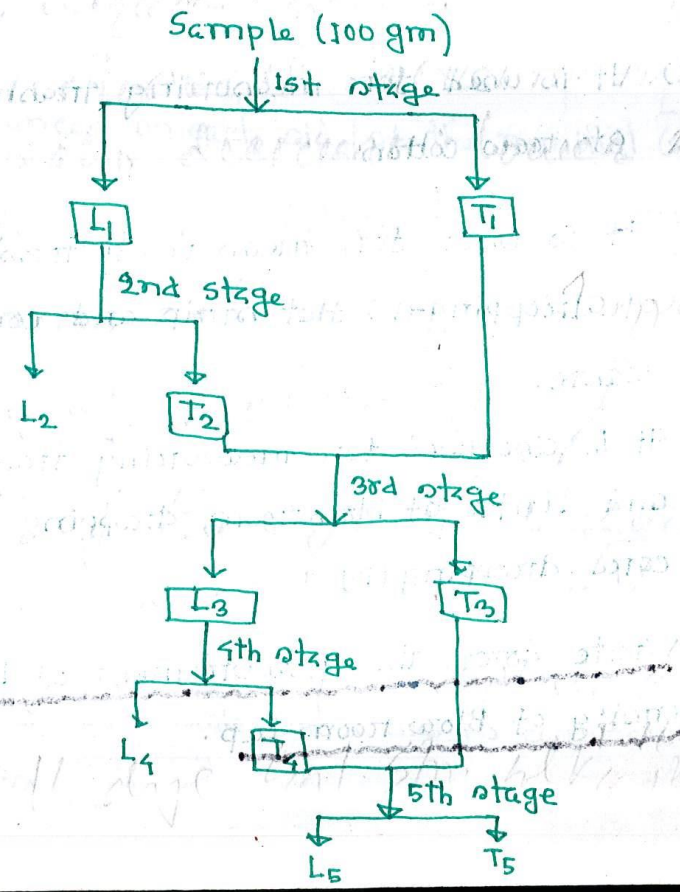
~~***~~ Write down the Measurement of trash content or foreign matter.

Ans: Trash content is accurately measured by the "Shirley Analysis" m/c. For a complete test the time is taken only about is minutes.

Measurement system:



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Calculation :

Total trash, $T = T_3 + T_4$

Trash content $= (T - L_5)\%$

Lint $= (L_2 + L_4 + L_5)\%$

Cage loss $= \{100 - (\text{Lint} + \text{Trash})\}\%$

Uses:

(1) It is used for measuring trash content % of raw cotton

(2) It is used for measuring trash content % of dropping-1, flat strip and comber waste.

(3) It is also used for measuring trash content % and lint % of blow room dropping (D_2) and card dropping (D_1)

D.D.P. **Write down the measurement of Linear density of Blow room Lap.**

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Ans:

(1) First we have to know standard lap weight/yd.

(2) If standard lap weight → 14 oz/yd. When lap weight/yd is taken, weight/yd should be considered 14 ± oz/yd i.e 13 oz/yd to 15 oz/yd.

(3) If a lap length of 14 oz/yd is 40 yds. So total lap weight will be 14×40 = 560oz

(4) Tolerances on each side of the nominal (standard) lap weight. often plus or minus 8 oz are allowed and laps whose weights are out of limits that lap are rejected.

For measuring linear density automatically:

(1) The whittaker lap meter is a comparatively simple m/c which automatically unrolls the lap.

(2) Breaks off a 1 yd length and deposite it into the pan of a scale whose dial is calibrated in ounces.

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(3) ~~Final~~ The weights are recoded and calculated.

(4) Finally, Find out the average weight/yd and CV%.

For measuring linear density of B/R lap manualy:

(I) we have to require a measuring tape ~~and~~ or scale and an electronic balance

(II) Then 1 yd sample from lap will measured by measuring tape by this way 5 samples will be taken and weighted by electronic balance.

(III) Finally, Find out the average weight/yd and CV%

**** Write down the Measurement of linear density of sliver(carding, Drawing, combing)

Ans: For sliver hank or weight/yd test, we have to require wrap block (electrical or manual), Uster autosorter or electronic balance.

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If standard sliver weight – 69·5 grain/yd

If standard sliver Hank – 0·12 ~~grain~~.

Tolerances should be for sliver weight

→ 69·5 ± ·3 (i.e 69·2 - 69·8)

Tolerance should be for sliver hank

→ ·12 ± ·001 (i.e ·119 - ·121)

First we have to measure 6 yds sample by wrap block. By this way, we have to take 5 sample of 6 yds. Then the 5 samples will be weighted on autosorter or electronic balance one by one.

Calculation:

Say, wt of first sample = 27·02 gm/6yd

2nd sample – 26·90 "

3rd " – 27·14 "

4th " – 27·10 "

5th " – 26·95 "

Avg. – 27·02 gm/6yd

– 4·50 gm/yd

~~4·5 × 15·43 gm/yd~~

– 4·5 × 15·43 grain/yd

∵ 1 gm = 15·43 grain

And then find out CV% = 64·49 grain/yd

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For Hank

$$N = \frac{L \times \omega}{1 \times W}$$

$$= \frac{6 \times 4853.6}{840 \times 27.02}$$

$$\doteq 1.19$$

Or,

$$N = \frac{3.24}{\text{Sliver gm/6yd}}$$

Or, $N = \frac{54}{\text{Sliver gm/yd}}$

****** Write down the measurement of Linear density of Roving.**

Ans:

First we have to collect 5 roving bobbin from simplex m/c of standard roving hank - 0.90

Tolerance should be 0.90 ± 0.01 i.e .89-.91

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We have to measure 30 yds roving by wrap block. By this way, we have to take 2 samples of 30 yds from each bobbin.

Total sample — 5×2 = 10

Then the samples will be weighted on autosorter or electronic balance one by one.

Calculation:

Say,

Wt. of 1st sample - 17.95 gms/30 yds $\frac{16.2}{17.95}$ =

Wt. of 2nd sample - 18.12 gms/30 yds $\frac{16.2}{18.12}$ =

Wt. of 3rd sample - 18.03 gms/30 yds $\frac{16.2}{18.03}$ =

Wt. of 4th sample - 17.92 gms/30 yds $\frac{16.2}{17.92}$ =

Wt. of 5th sample - 17.98 gms/30 yds $\frac{16.2}{17.98}$ =

Avg = Avg =

Then calculate: CV%

Here, $Ne = \frac{l \times w}{l \times w} = \frac{30 \times 453.6}{840 \times 18} = .90$

or, $Ne = \frac{16.2}{\text{wt. in gm/30 yds}}$

or, $Ne = \frac{250}{\text{Roving wt. in grain/30 yds.}}$

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Write down the measurement of linear density of yarn.

Ans:

(1) For yarn count test from ring cops or cone we have to require wrap reel and autosorter or electronic balance

(2) We have to collect minimum 5 ring cops or cone and maximum 20 ring cop.

(3) First we have to measure 120 yds (1 lea) from ring cops or cone by wrap reel. By this way, we have to take 5 samples from 5 ring cops or cone. Then the samples will be weighted on autosorter or electronic balance.

Calculation:

Say, $30^s/1$ Karad

Tolerance should be 29.5 to 30

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Wt. of first sample - 2.199 gm/120yd - $\frac{64.8}{2.199}$ =

Wt. of 2nd sample - 2.189 gm/120yd - $\frac{64.8}{2.189}$ =

Wt. of 3rd sample - 2.178 gm/120yd - $\frac{64.8}{2.178}$ =

Wt of 4th sample - 2.175 gm/120yd - $\frac{64.8}{2.175}$ =

Wt of 5th sample - 2.185 gm/120yd - $\frac{64.8}{2.185}$ =

Avg = Avg. =

Then calculate. cv%

Here, $N = \frac{L \times w}{l \times W}$

$= \frac{120 \times 453.6}{840 \times 2.185}$

$= 29.5$

Or, $Ne = \frac{64.8}{\text{Wt in gm/120yds}}$

= Yarn count.

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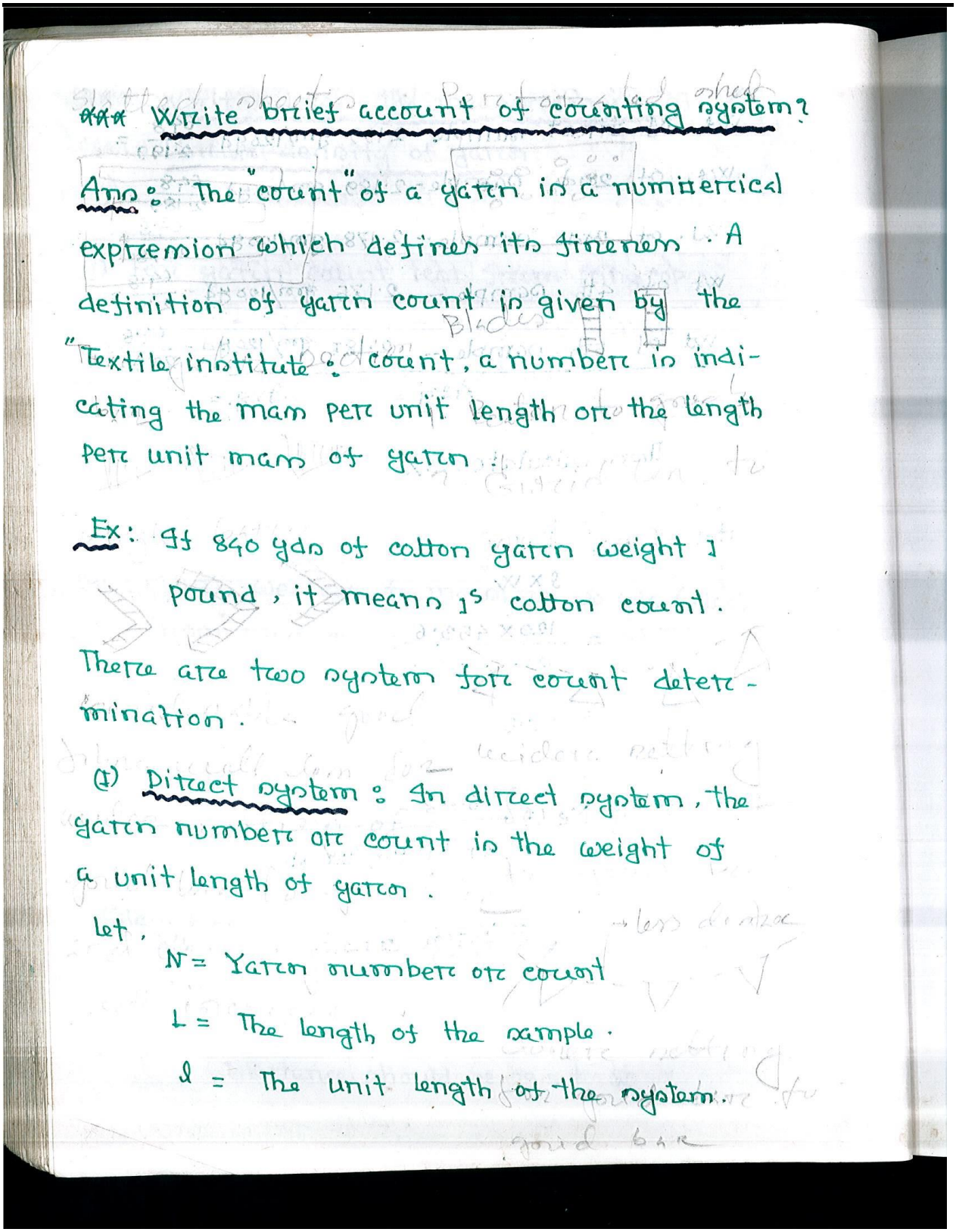

*** Write brief account of counting system?

Ans: The "count" of a yarn is a numerical expression which defines its fineness. A definition of yarn count is given by the "Textile institute": count, a number is indicating the mass per unit length or the length per unit mass of yarn.

Ex: If 840 yds of cotton yarn weight 1 pound, it means 1^s cotton count.

There are two system for count determination.

(I) Direct system: In direct system, the yarn number or count is the weight of a unit length of yarn.

let,

N = Yarn number or count

L = The length of the sample.

l = The unit length of the system.

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Then, $N = \frac{W \times l}{L}$

If the number is bigger, the yarn will thickener or coarse.

Uses: It is used for jute, hemp, silk, linen etc.

Indirect system: In an indirect system, the yarn number or count is the number of 'units of length' per 'unit of weight'

let, N = Yarn number or count.

W = The weight of the sample

ω = The unit of weight of the system.

L = The length of the sample.

l = The unit of length of the system

Then, $N = \frac{L \times \omega}{l \times W}$

If the number is bigger of the yarn count; the yarn will be finer.

It is used for cotton, worsted etc.
(woolen yarn)

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Ne → Number of 840 yards weight in one pound yarn. It in English cotton count.

Nm → Number of kilometres weight in one kilogram of yarn. It in metric count.

Tex: Weight in gms of one kilometer of yarn.

Denier: Weight in gms of 9 kilometers of yarn.

Ne x Tex = 590.5

Given: convert 30 Ne to Tex.

Ans: We know,

$$Ne \times Tex = 590.5$$

$$\Rightarrow 30 \times Tex = 590.5$$

$$\Rightarrow Tex = \frac{590.5}{30}$$

$$\therefore Tex =$$

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Ne x Denier = 5315

Denier = 9 x Tex

Nm = Ne x 1.69

Show the way for determining the conversion factor of cotton to denier and denier to cotton

Ans: Ne to denier:

let,

cotton count = 1

i.e weight of 840 yards yarn = 1 pound

or, Wt. of (840 x .9144) meter yarn = 453.6 gm

Wt. of 9000 meter yarn = $\frac{453.6 \times 9000}{840 \times .9144}$

= 5315 gm.

[∵ 1 yd = .9144 meter
1 pound = 453.6 gm]

∴ Conversion factor,

Ne to Denier = 5315

or, Ne x Denier = 5315

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Denier to Ne:

Let,

Denier = 1

i.e Length of 1 gm yarn = 9000 metre

∴ Length of 453.6 gm yarn = (9000×453.6) ..

Or, length of 1 pound yarn

$$= \frac{9000 \times 453.6}{840 \times .9144} \text{ yds}$$

$$= 5315 \text{ hank}$$

[∵ 1 yd = .9144
1 pound = 453.6 gm]

Convertion factor,

(Denier to Ne) = 5315

Or, Denier × Ne = 5315 (shown)

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******* Write down the conversion factor of Ne to Tex and Tex to Ne.

******* Prove that, Ne x Tex = 590.5

Ans:

Ne to Tex:

let, cotton count = 1

i.e weight of 840 yds yarn = 1 pound

or, Weight of (840 x .9144) metres yarn = 453.6 gm

$\therefore$ Weight of 1000 metres yarn $= \frac{453.6 \times 1000}{840 \times .9144}$ gm

$= 590.5$ gm

[$\because$ 1 yd = .9144 metre]

1 pound = 453.6 gm

$\therefore$ Conversion factor (Ne to Tex) = 590.5

or, Ne to Tex = 590.5

Tex to Ne:

let, Tex = 1

i.e. length of 1 gm yarn = 1000 metre

$\therefore$ length of 453.6 gm yarn = 453.6 x 1000 metre

or, length of 1 pound yarn = 453.6 x 1000 metre

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Due to presence of weak in the

$= \frac{453.6 \times 1000}{.9144}$ yd

Due to presence of weak in the

$= \frac{453.6 \times 1000}{840 \times .9144}$ Hank

Due to presence of

$= 590.5$ Hank

[$\because$ 1 pound = 453.6 gm]

1 yd = .9144 metre.

Due to presence of weak in the

$\therefore$ Conversion factor (Tex to Ne) = 590.5

or, Tex × Ne = 590.5

If a skein of 100 metres of filament viscose yarn weights 1.67 gm. Calculate the its denier, Tex and Ne.

Ans: We know,

$$\text{Denier} = \frac{w \times l}{L}$$

$$= \frac{1.67 \times 9000}{1000}$$

$$= 150.3 \text{ Denier}$$

Here,
w = 1.67 gm
l = 9000 metre
L = 100 meter

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We know,

$$\text{Denier} = 9 \times \text{Tex}$$

or, $150.3 = 9 \times \text{Tex}$

or, $\text{Tex} = \frac{150.3}{9}$ Tex

$= 16.7$ Tex

or,

$$\text{Tex} = \frac{W \times l}{L}$$

$$= \frac{1.67 \times 1000}{100}$$

$= 16.7$ Tex

Here;

$W = 1.67$

$l = 1000$

$L = 100$ metre

We know,

$$\text{Denier} \times Ne = 5315$$

$$\Rightarrow 150.3 \times Ne = 5315$$

$$\Rightarrow Ne = \frac{5315}{150.3} = 35.36 \approx 35^{s}$$

or, $Ne \times \text{Tex} = 590.5$

$\Rightarrow Ne \times 16.7 = 590.5$

$\Rightarrow Ne = \frac{590.5}{16.7}$

$= 35.36 \approx 35^{s}$

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Or, For cotton

$$Ne = \frac{L \times \text{width}}{l \times w}$$

$$= \frac{100 \times 1.09 \times 453.6}{840 \times 1.67}$$

$$= 35.24 \times 35$$

Here,

The L = 100 metre

$= 100 \times 1.09$ yd

w = 1 pound

$= 453.6$ gm

l = 840 yd

w = 1.67 gm

If a skein of 500 metres of filament viscose yarn weights 5 gms. Calculate its Tex, Denier and Ne

We know,

$$Tex = \frac{w \times l}{L}$$

$$= \frac{5 \times 1000}{500}$$

$$= 10 \text{ Tex}.$$

Here,

w = 5 gms

l = 1000 metre

L = 500 metres

We know, Denier $= 9 \times Tex = 9 \times 10 = 90$ Denier

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We know,

$$Ne \times Tex = 590.5$$

$$\Rightarrow Ne = \frac{590.5}{10} = 59.05 \approx 59^s$$

A lea of cotton yarn weights 25 grain. Calculate its count in Ne, Tex and Denier system.

Ans: We know,

$$Ne = \frac{L \times \omega}{l \times w}$$

$$= \frac{120 \times 453.6}{840 \times 1.62}$$

$$= 40^s \text{ Ans.}$$

Here,

$L = 1$ lea
$= 120$ yds

$\omega = 1$ pound
$= 453.6$ gm

$l = 840$ yds

$w = 25$ grain
$= \frac{25}{15.43}$ gm
$= 1.62$ gm

[$\because 1$ gm $= 15.43$ grain]

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Another way,

$L = 1\text{ Lea} = 120$ yds

$\omega = 1$ pound

$l = 840$ yds

$W = 250$ grain

$= \frac{250}{7000}$ pound

[$\because$ 1 pound = 7000 grain]

$Ne = \frac{L \times \omega}{l \times W}$

$Ne = \frac{120 \times 7000}{840 \times 25}$

$= 40^s$ Ans.

Calculate the weight of 500 yds of 30^s yarn

We know,

$Ne = \frac{L \times \omega}{l \times W}$

$\Rightarrow 30 = \frac{500 \times 1}{840 \times W}$

$\Rightarrow 30 \times 840 \times W = 500$

Here,

$Ne = 30^s$

$L = 500$ yds

$\omega = 1$ pound

$W = ?$

$l = 840$ yds

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$\Rightarrow W = \frac{500}{30 \times 840}$

$\therefore W = .019$ pound

Another way,

840 × 30 yds contain 1 pound

$\therefore 1$ " " $\frac{1}{840 \times 30}$ "

$\therefore 500$ " " $\frac{500}{840 \times 30}$ "

$= .019$ pound

Calculate the length of 50 gm of 30^s Ne

We know,

$$Ne = \frac{L \times w}{l \times W}$$

Or, $30 = \frac{L \times 453.6}{840 \times 50}$

Or, $L \times 453.6 = 30 \times 840 \times 50$

$\therefore L = \frac{30 \times 840 \times 50}{453.6}$

$= 2777.77$ yd.

Here,

$Ne = 30^s$

$w = 1$ pound

$= 453.6$ gm

$l = 840$ yds

$W = 50$ gm

$L = ?$

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Another way,

1 pound yarn contains 840×30 yds

or, 453.6 gm " " $\frac{840\times30}{453.6}$ "

∴ 50 " " " $\frac{840\times30\times50}{453.6}$

$= 2777.77$ yds

*** Calculate the length of 50 gm of 30 Tex yarn.

We know,

$$Tex = \frac{W \times l}{L}$$

$$\Rightarrow 30 = \frac{50\times1000}{L}$$

$$\Rightarrow L = \frac{50\times1000}{30}$$

$= 1666.66$ metres.

$Tex = 30$
$W = 50$ gm
$l = 1000$ m
$L = ?$

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Another way,

30 gm yarn contain 1000 metres

∴ 1 " " " = $\frac{1000}{30}$ "

∴ 50 " " = $\frac{1000 \times 50}{30}$ "

= 1666.66 metres.

*** Calculate the weight of 500 metres of 30 tex yarn.

We know,

$$Tex = \frac{W \times l}{L}$$

or, $30 = \frac{W \times 1000}{500}$

or, $W \times 1000 = 30 \times 500$

or, $W = \frac{30 \times 500}{1000} = 15$ gm

Tex = 30
W = ?
l = 1000 metre
L = 500 metre.

Another way,

1000 meter yarn contain = 30 gms.

∴ 1 " " " = $\frac{30}{1000}$ "

∴ 500 " " " = $\frac{30 \times 500}{1000}$ "

= 15 gms.

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*** Calculate the wt. of 500 metres of 30 Denier yarn.

We know,

$$\text{Denier} = \frac{W \times 9}{L}$$

$$\Rightarrow 30 = \frac{W \times 9000}{500}$$

$$\Rightarrow W \times 9000 = 15000$$

$$\Rightarrow W = \frac{15000}{9000}$$

$\therefore W = 1.60$ gm.

Here,

$l = 9000$ metres

$L = 30$ metres

Denier $= 30$

$W = ?$

*** Write down the different method of measurement of yarn count.

Ans: (1) Wrap reel and electronic balance.

(2) Wrap reel and ~~count~~ Lister automatic

(3) Wrap reel and knowles balance

(4) Wrap reel and quadrant balance

(5) Beesly balance.

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*** Discuss about measurement of twist

or, Prove that, $TPI = k\sqrt{count}$

or, Twist per inch = Twist multiplier $\sqrt{count}$

or, $TPI = TM \times \sqrt{count}$

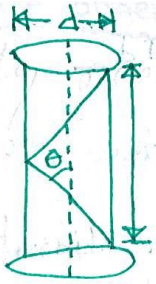
Ans:

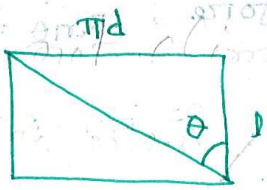
We know,

$$\text{Twist amount} = \frac{n}{l}$$

where, n = number of turns

l = length of yarn





The following mentioned figure represents an idealised element of a yarn, showing one fibre on the yarn surface, following a helical path and making one turn round the yarn axis. The twist angle θ is the angle between a tangent to the helix formed by the fibre and the yarn axis by unrolling

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the surface lay we see that the fibre becomes the hypotenuse of a right angle triangle.

Let, the yarn diameter be d inches and l be the length of yarn occupied by one complete turn of twist.

Then, $\tan\theta = \frac{\pi d}{l}$ ----- (i)

where, θ = Twist angle

and turns per inch = $\frac{1}{l}$ ---- (ii)

Therefore, $\tan\theta = \frac{1}{l} \times \pi d$

$= \tan\theta \times d \times$ turns per inch ---- (iii)

In an indirect system, the yarn diameter is inversely proportional to the square root of the count.

Thus $d \propto \frac{1}{\sqrt{\text{count}}}$ ---- (iv)

From equn (iii) and (iv) we get,

$\tan\theta \propto \frac{\text{turns per inch}}{\sqrt{\text{count}}}$

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2. Elimination of impurities and ...

Etc, Turns per inch = $\tan\theta \times \sqrt{\text{count}}$

Elimination of ...

or, Turns per inch = $K\sqrt{\text{count}}$

The constant K is termed the twist factor or twist multiplier is directly proportional to the tangent of the twist angle.

3. $\therefore TPI = Tm\sqrt{\text{count}}$

*** Write down the different method of tensile force observation.

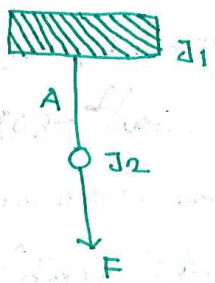
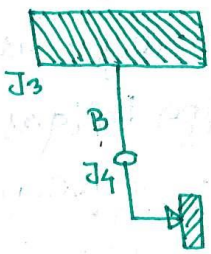


Fig: C.R.L (constant Rate of Loading)



C.R.E (constant rate of extension)

Consider two identical specimens A and B. Speciman A is gripped in a fixed top jaw J1 and

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in a bottom top jaw J_2 which is removeable. A force F, initially zero but increasing at constant rate, is applied to the specimen in a direct shown. The effect of applying this force is to extend the speciment untill it eventually breaks. The loading has thus caused the elongation. Here, we have C.R.L conditions. Speciman B is gripped in the fixed top jaw J_3 and in the bottom jaw J_4 which can be moved downwards at a constant velocity by means of a screw mechanism. Initially, the tension in B is zero but when the bottom jaw J_4 moves downward the speciman is extended and an increasing tension is developed untill the speciment finally breaks. The extension has thus caused the loading. Here, we have C.R.E conditions.

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*** What do you understand by single fibre and fibre bundle test.

Ans: The most common methods of testing fibre strength:

(1) Stelometer.
(2) High volume instrument (HVI)

* Stelometer: The stelometer applies a constant rate of loading principle for fibre strength testing.

HVI: The Latest HVI instruments use the constant rate of extension principle for fibre strength testing.

Measurement: Single Fibre strength is measured by stelometer and HVI and results are given in grams per tex (GPT)

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Fibre bundles strength is also measured by pressly instrument and the value is given in thousands of pounds per square inch (1000 psi)

$$PSI = 17.5 \times \sqrt{GPT} \times 1000$$

This is the relation of PSI and GPT.

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