L A B M A N U A L

ON

TEXTILE TESTING-I

5th SEMESTER

INSTITUTE OF TEXTILE TECHNOLOGY

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DEPT. OF TEXTILE TECHNOLOGY

EXPERIMENT NO:-1

Aim of the experiment:-

To find out the moisture content and moisture regain percentage of the given sample of cotton fibre by conditioning oven.

Principle:-

The micro sampling on the principle of conditioning oven, 10 samples each of 05gms are dried in a conditioning oven at a temperature of 105^0 C +/-3^0 C and the oven dry weight of each sample is taken to calculate the moisture content and moisture regain percentage of the sample of cotton.

Theory:-

Moisture:-The water vapour present in the atmosphere is known as moisture. The moisture in the atmosphere is expressed in terms of humidity.

Humidity:-Humidity is described as the amount of moisture present in the atmosphere. This can be expressed in terms of either absolute humidity or relative humidity.

Absolute Humidity (AH):-It is the weight of water present in unit volume of moist air. It is the actual density of water vapour in the atmosphere. It can be expressed in terms of grains/cubic feet or gms/$(meter)^3$.

Relative Humidity (RH):-It is the ratio of the actual vapour pressure to the saturated vapour pressure at the same temperature expressed as a percentage.

$$\text{RH\%} = \frac{\text{Actual vapour pressure}}{\text{Saturated vapour pressure}} \times 100$$

Standard humidity maintained in spinning departments:-

Department	Relative humidity%
Blowroom and mixing	– 60% -65%
Carding	– 55% -60%
Drawframe,simplex& Comber	– 50% -55%
Ringframe& Doubling	– 45% -50%
Post spinning(Reeling and winding)	– 65% -70%

Moisture content(M):-

It is defined as the weight of water in a material expressed as a percentage of thetotal weight of the material.

$$\textbf{Moisture content \% (M)} = \frac{\text{Weight of water}}{\text{Total wt. of the material}} \times 100$$

$$= \frac{\text{(Wt.of the sample before heating - oven dry wt. of the sample)}}{\text{Weight of the sample before heating}} \times 100$$

Moisture regain(R):-

It is defined as weight if water in a material expressed as a percentage of the oven dry weight of the sample.

$$\textbf{Moisture regain \% (R)} = \frac{\text{Weight of water}}{\text{Oven dry wt. of the material}} \times 100$$

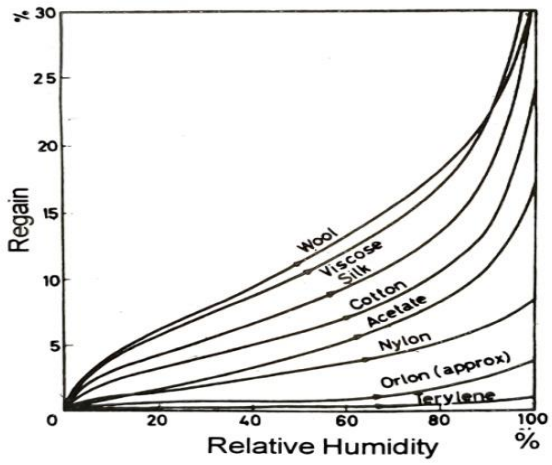
$$= \frac{\text{(Wt.of the sample before heating - oven dry wt. of the sample)}}{\text{Oven dry wt. of the sample}} \times 100$$

Standard testing atmosphere:-

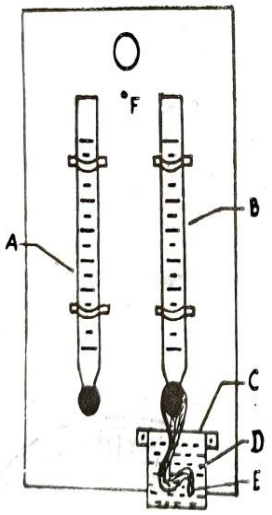
If textile materials are tested at different parts of the world, where RH% differs from place to place according to the climatic condition. So the difference in the RH% affects the test results. So it is mandatory to carry out the testing in a standard testing atmosphere,so that the test result is universally accepted. Hence the standard testing atmosphere is maintained with RH% of 65% +/-2% and temperature is maintained with 20^0 C+/-2^0 C (68^0F +/-4^0F). In tropical and subtropical regions like India temperature of 20^0 C is difficult to maintain. So a higher standard temperature of 27^0C +/-2^0 C is taken.

Standard regain % of different Textile fiber

Raw cotton	—	8.5%	Acetate rayon	—	6%
Cotton yarn	—	7-7.5%	Nylon 6,6.6	—	1%
Silk	—	11%	Orlon	—	1-2%
Wool	—	17%	Terelene/polyester	—	0.4%



ABSORPTION CURVES OF VARIOUS MATERIALS



A-Dry Bulb Thermometer

B-Wet Bulb Thermometer

C-Container

D-Distilled water

E-Muslin cloth

Fig. 1.4

WET AND DRY BULB HYGROMETER

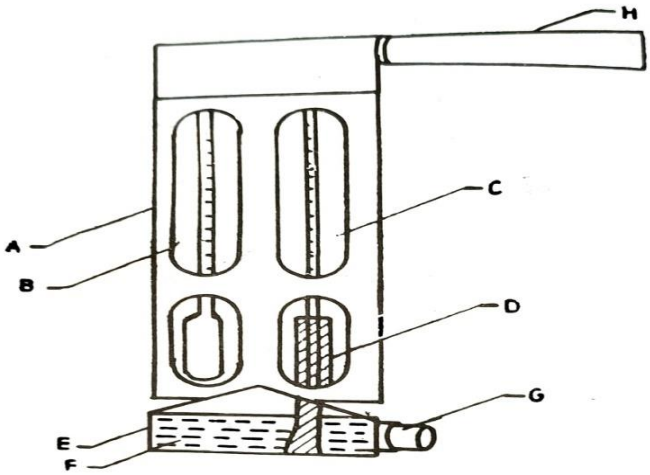


Fig. 1.5 **SLING HYGROMETER**

A - Frame
B - Dry bulb Thermometer
C - Wet bulb Thermometer
D - Wick of muslin cloth
E - Container
F - Distilled water
G - Lid
H - Handle

Apparatus Required:-

1. Conditioning oven.
2. Electronic balance .
3. Porcelain pan.

Procedure:-

10 specimens of clean cotton (free from trash) each of 5 gms are taken and are kept in 10 no. of porcelain pans separately marked with serial numbers 1,2,3,.....,10.The pans with the cotton sample are put in a conditioning oven and allowed to run for 30 mins, till it attains a temperature of 105^0 C +/-3^0 C.The specimens are taken out one by one out of the conditioning oven weighed and put back inside the oven immediately . The weight of the samples arerecorded in a table. The samples are heated again for another 15 mins and the wt. of the samples are taken one by one and put in the table against the corresponding number. It is observed that the weight of the samplesare decreasing in every dry. The procedure isrepeated with 15 mins intervals till 2 consecutive readings for the wt. of the sample is found equal. This means the entire moisture in the samples are expelled out and there is zero moisture in the samples from which moisture content%(M) and moisture regain%(R) are found out.

Let wt. of the samples before heating=W_1 & Oven dry wt. of the sample= W_2

Then moisture content%(M) = $\frac{W_1 - W_2}{W_1} \times 100$ Moisture regain%(R) = $\frac{W_1 - W_2}{W_2} \times 100$

Tabulation:-

No. of obs.	Wt. of the sample before heating (W_1) gms	Wt. of the sample after 30 mins. of heating (W_2) gms	Wt. of the sample after 45 mins. of heating (W_2) gms	Wt. of the, sample after 60 mins. of heating (W_2) gms	Wt. of the sample after 75 mins. of heating (W_2) gms	Mean oven dry wt. of thesample in gms.
01	5.000	4.558	4.554	4.553	4.553	45.686/10 =4.568 gms
02	5.000	4.561	4.554	4.532	4.551	
03	5.000	4.542	4.532	4.530	4.580	
04	5.000	4.577	4.573	4.570	4.570	
06	5.000	4.562	4.560	4.558	4.557	
06	5.000	4.595	4.593	4.585	4.584	
07	5.000	4.569	4.564	4.554	4.554	
08	5.000	4.562	4.560	4.558	4.557	
09	5.000	4.576	4.572	4.570	4.570	
10	5.000	4.584	4.581	4.582	4.580	

Calculation:-

Wt. of the sample before heating (total wt. of the sample) (W_1) =5.000 gms
Mean oven dry wt. of the sample (W_2) =4.568 gms

Moisture content%(M) $= \frac{W_1 - W_2}{W_1} \times 100 = \frac{5.000 - 4.568}{5.000} \times 100$

$= \frac{0.432}{5.000} \times 100 = 8.80\ \%$

Moisture regain% (R) $= \frac{W_1 - W_2}{W_2} \times 100$

$= \frac{0.432}{5.000} \times 100 = 9.64\%$

Conclusion:-

The sample of cotton fibresare dried in the conditioning oven at a temperature of 105^0 C +/- 3^0 C. All the water particles in the sample are expelled and we got a constant wt. of the sample known as oven dry wt. of the sample. After calculation we get the following results:-

Moisture content%(M) = 8.80 %
Moisture regain%(R) = 9.64%

EXPERIMENT:-2

Aim of the experiment:-

To find out the mean length, effective length, modal length, upper quartile length, lower quartile length, percentage(%) of short fibre and dispersion% of the given sample of cotton fibre by using Bare sorter.

Apparatus Required:-

1. Bare sorter.
2. Depresser.
3. Blunt needle.
4. Black velvet pad.
5. Transparent scale.
6. Graph paper.

Theory:-

From bare sorter, a sorter diagram is obtained on a graph paper. After construction and analysing the sorter diagram the following fibre length characteristics/particulars are found out :-

- Mean length.
- Modal length.
- Upper quartile length.
- Lower quartile length.
- % of short fibre.
- Dispersion %.

Principle:-

A numerical sample of fibre is arranged in the form of an array in the decreasing order of length and from tressing this array all the fibre length characteristics are calculated and found out.

The operations involves the following four main steps:-

(i) Preparation of a tuft of fibre with all the fibres are aligned at one end.
(ii) Withdrawal off fibres in the order of decreasing length.
(iii) The preparation of a sorter diagram by laying the fibres on a black velvet pad in decreasingorder of length, the fibres parallel to each other and their lower ends aligned along a horizontal base line.
(iv) Analysis of sorter diagram.

Description:-

The bare sorter is a portable instrument consist of a bed of combs which controls and enable the sample of fibres to be fractionalised into length groups.

The bare sorter has parallel bottom combs with its needles showing upward placed in between a U shaped metalic frame. All the bottom combs are hinged at one end and rested on a rod at the other end extending the width of the frame.

The rod can be moved from its position and when it is drawn the bottom combs drop one by one.In between the bottom combs 03 top combs are placed at one side of the frame with needle pointing downward. The space between to bottom comb is ¼ inch expect the first two bottom combs are separated 3/16 inch appart. Space between a top comb and bottom comb is ⅛ inch.

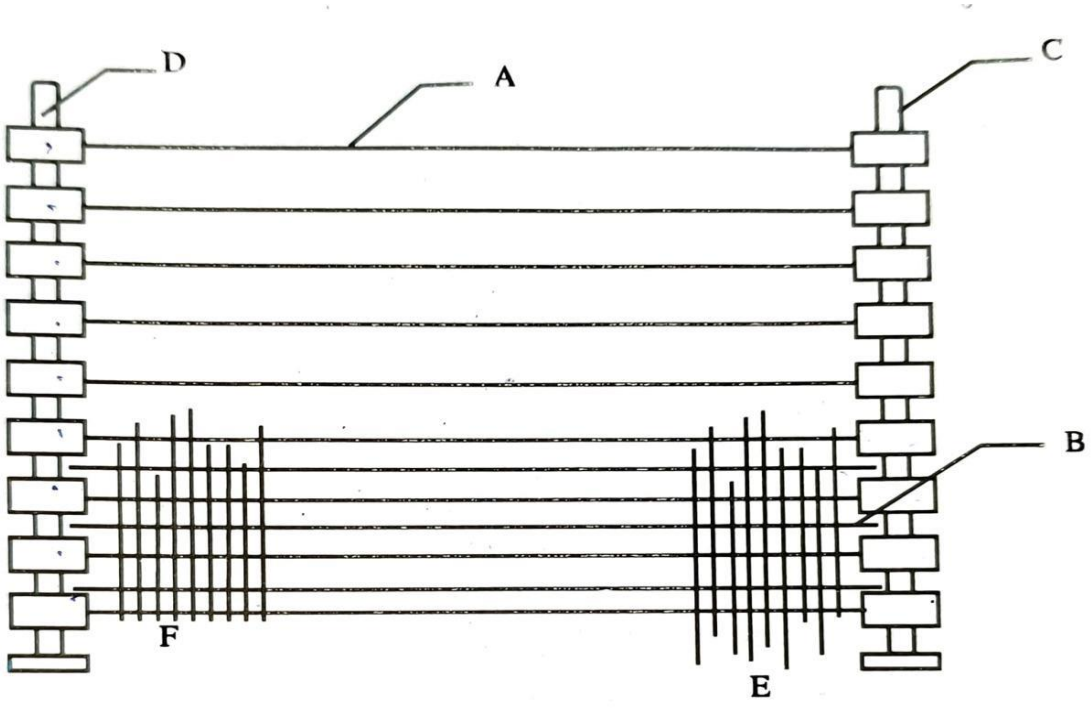
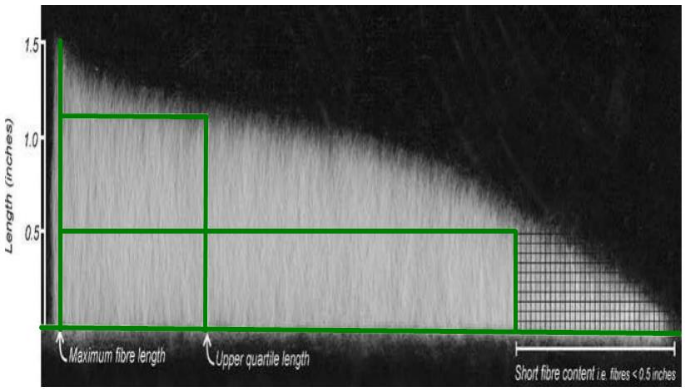


Fig. 2.1 **BAER SORTER TECHNIQUE**

A-Bottom Combs	D-Sliding Pin
B-Position of top combs	E-Fibre fringe
C-Hinged Support	F-Aligned ends of fibres



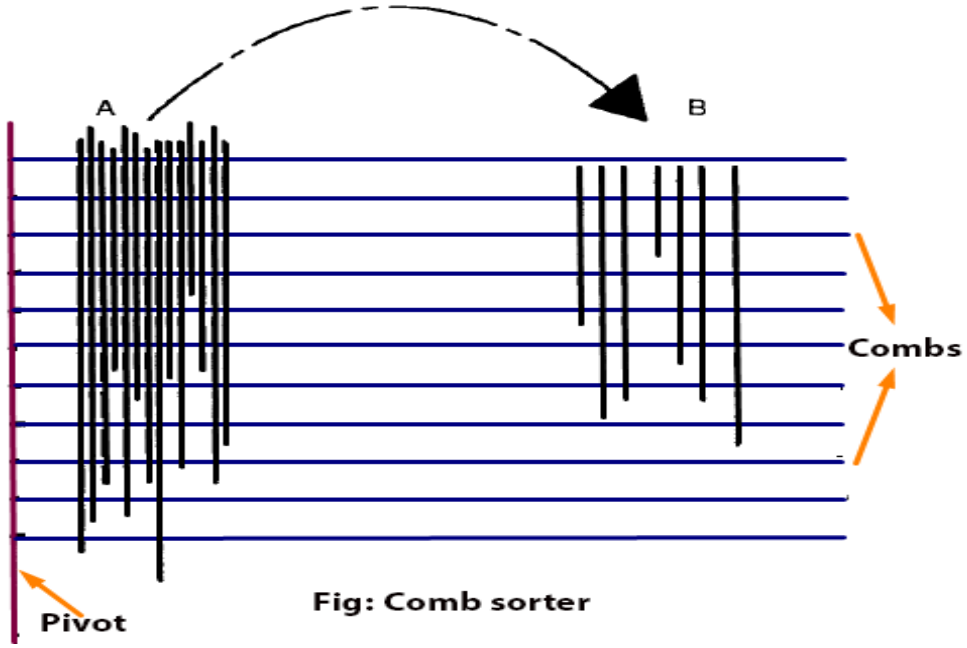


Fig: Comb sorter

Procedure:-

- The sorter is placed with its back side facing the operator. The tuft of cotton sample is slightly twisted by hand and placed on the bottom combs at the RHS of the sorter.
- From the protruding ends all the loose fibres are removed by a tweezer untill the ends are aligned.
- A tuft of fibre is pulled out by the tweezer, combed and transfered to the LHS of the sorter so that the front bottom comb forms a straight line with all the ends of the fibre are aligned to a line.
- The process is repeated till all the fibres on the RHS are combed, transfered to the LHS of the other side.
- The sorter is now turned that the front side face the operator
- The top combs are now inserted in their position to grip and prevent slippage of the fibre.

- The bottom combs are now dropped one by one successively from back side till the tips of the longer fibres are seen.
- The fibres are now pulled by the tweezer,combed, straightened and laid perpendicular to the base line on a black velvet pad.
- The process is continued till the tuft is completely exhusted, transfered, laid down on the black velvet pad and a fibre array is obtained.

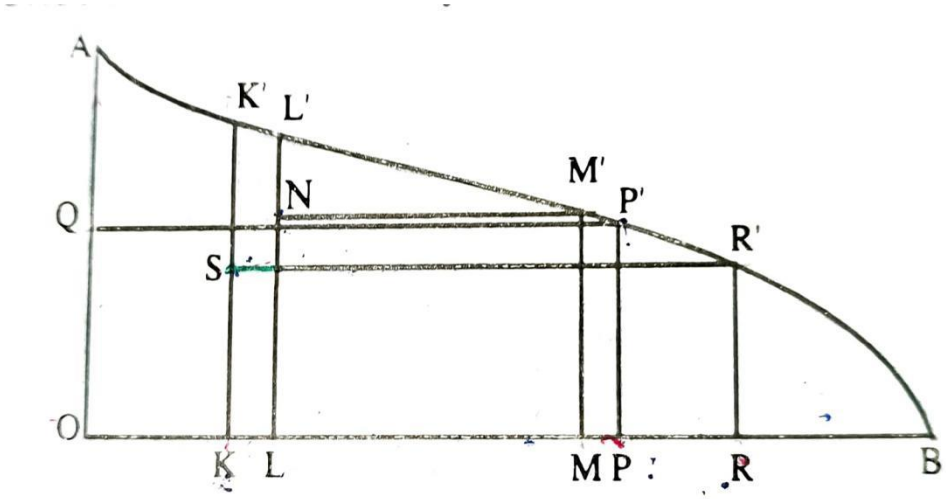


Fig. 2.2 **ANALYSIS OF SORTER DIAGRAM**

- Q is the mid point of OA i.e OQ'=1/2OA.
- From Q, QP' is drawn parallel to OB to cut the curve at P'.
- PP' perpendicular to OB.
- OK is marked on OB so that OK=¼ OP and KK' is perpendicular to OB.
- S is the mid point of KK'.
- From S, SR' is drawn parallel to OB to cut the curve at R'.
- From R', RR' perpendicular to OB is drawn.
- OL is marked on OB. so that OL =¼ OR.
- From L, a perpendicular LL' is drawn to cut the curve at L'.
- OM is marked on OB. So that OM=¾ OR.
- MM' perpendicular to OB is drawn to cut the curve at M'.
- From M', a perpendicular line M'N is drawn on LL'.

Mean length:-

It is the average length of all fibres. In the sample based on weight length, relative length, distribution. It is obtained by dividing the total area under the curve by base line.

$$\text{Mean length} = \frac{\text{Area under the curve OAB}}{\text{OB}}$$

Effective length:- =

It is the length at the main bulk of the longer fibres. It is also the uppre ratio length of the distribution excluding below half of the upper quartile. It is obtained by the geometrical construction on cumulative length frequency.

Upper quartile length:-

It is the length which contains 25% of the longer spinnable fibres, by weight or numbers in the sample.

Lower quartile length:-

It is the length which contains 25% of the smaller/sorter spinnable fibres, by weight or numbers in the sample.

Modal length:-

It is the length of the group of fibres containing 50% of the spinnable fibre where all the fibre have more or less equal length.

Percentage of short fibre:-

The % of short fibre is the % of the length which are equal or less than the half of the effective length.

$$\text{Percentageof short fibre} = \frac{\text{Area of RR'B}}{\text{Area of OAB}} \times 100 = \frac{\text{RB}}{\text{OB}} \times 100$$

Dispersion %:-

It represents the variations in the length of fibre and is the inter quartile range expressed as a percentage of the effective length.

$$\text{Dispersion\%} = \frac{\text{NL'}}{\text{LL'}} \times 100$$

Calculation:-

Maximum length (OA) = 48.5 mm
Effective length (LL') = 40.0mm

$$\text{Mean length} = \frac{\text{Area of OAB}}{\text{OB}}$$

= 800+297+99+77+65+49+22+84+19+27=1530 squares (one small square=2×2 sq.mm)
= 1530 × 4 mm sq.= 6120 mm sq.

$$\text{Mean length} = \frac{6120\text{mm}^2}{194} = 31.54 \text{ mm}$$

Upper quartile length = OAL'L
Lower quartile length = MM'R'R
Modal length = LL'M'M

$$\text{Percentage of short fibre} = \frac{\text{Area of RR'B}}{\text{Area of OAB}} \times 100$$

$$= \frac{\text{RB}}{\text{OB}} \times 100$$

$$= \frac{31\text{mm}}{194\text{mm}} \times 100 = 15.98\%$$

$$\text{Dispersion\%} = \frac{\text{NL'}}{\text{LL'}} \times 100 = \frac{08\text{mm}}{40\text{mm}} \times 100 = 20.0\ \%$$

Conclusion:-

From this experiment we studied how to find out different fibre length characteristics of the given sample of cotton fibre using bare sorter.

Fibre length plays an important role for different setting and gauging in different machinaries of spinning department. An improper setting and fibre length calculation will lead to serious yarn quality problem.

EXPERIMENT NO:- 03

Aim of the experiment:-

Determination of trash content of the given cotton sample by using Shirley trash analyser.

Definition:-

1. Lint content :-

The portion consisting of cotton fibres separated from the specimen and free from trash.

2. Trash content :-

The amount of material other than fibres collected from the specimen in the test.

3. Invisible loss :-

The part of the specimen not accounted for by adding together the lint and trash content.

Principle :-

It operates on the principle of Buyoance separation (air flotation) by the air current.

Sampling :-

The weight of the sample should be 100 grams. The sample should be drawn in such a way randomly from the number of bales which is representative of the entire lot. While preparing the sample care should be taken, so that no trash is lost by handling.

Description & working:-

The is sample is placed on the feed table & presented to the taker-in cylinder which opens up the cotton almost to the single fibre state. Due to the strong centrifugal force produced by the air current on peripheral of the taker-in, trash particles tend to travel tangentially outwards and enters the air stream. This tendency is increased by the action of the steamer plate which is specially shaped to permit the air current set up by the motion of taker-in cylinder. To join the general air stream without forming eddis. The separation of the cotton and the trash takes place as they travel with the air stream through the settling chamber. The heavy trash particles falling straight down to the trash tray due to it's own weight. But the single cotton fibres are carried by the air stream out of the chamber. The lighter trash particles are also taken by the air stream. By correct adjustment the intensity of the air current can be adjusted by the steamer plate. The intensity of the air current can be

reduced so that light trash particle will also be made to the trash tray. Cotton lint and light dust are carried out of the chamber and drawn on to the surface of the cage, the dust and microfibres being sucked through the cage to be collected in an air bag& good fibres travel forward in the direction of rotation and falls into the delivery box by a damper section of the cage.

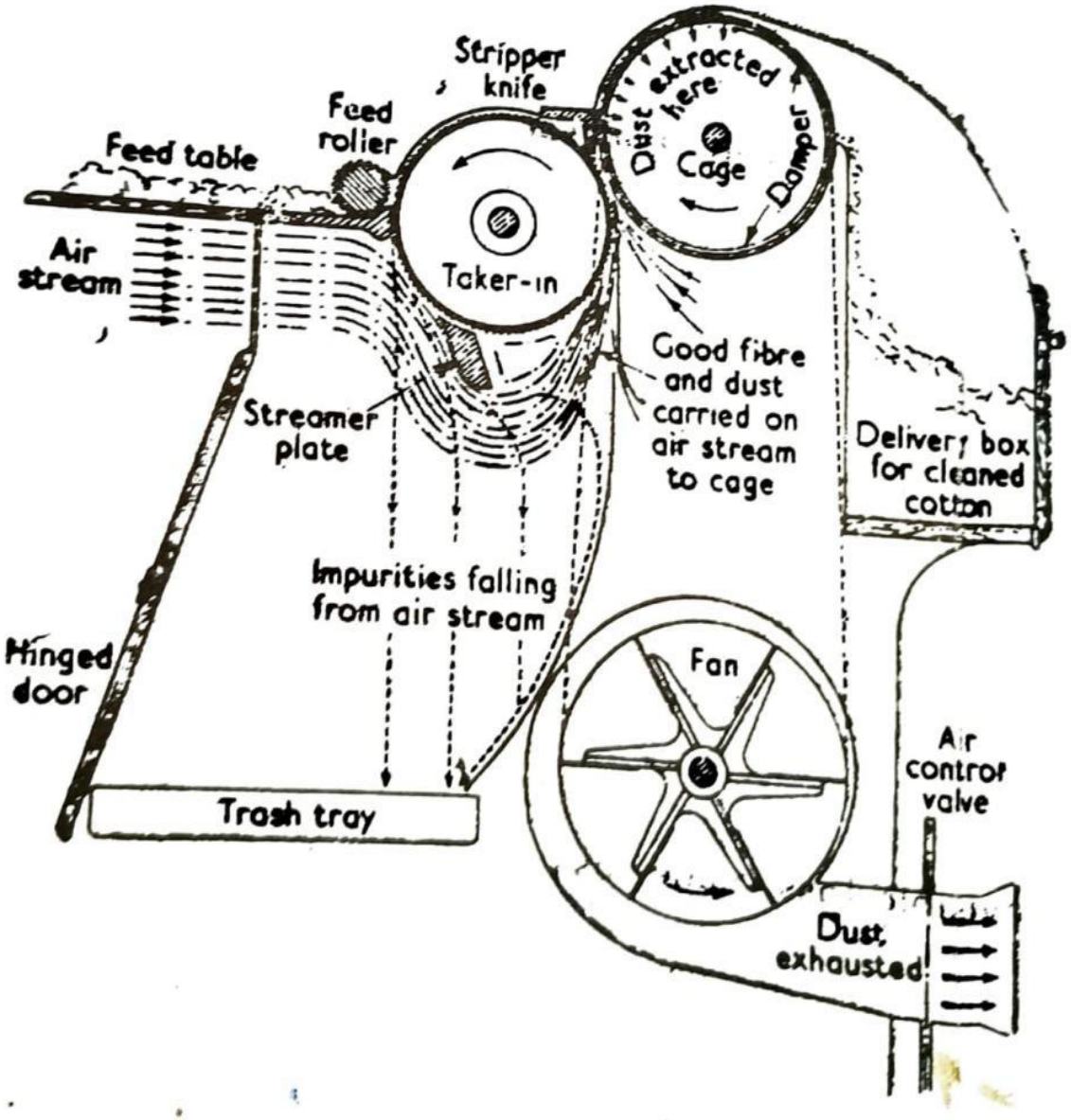


Fig. 2.32 **THE SHIRLEY TRASH ANALYSER**

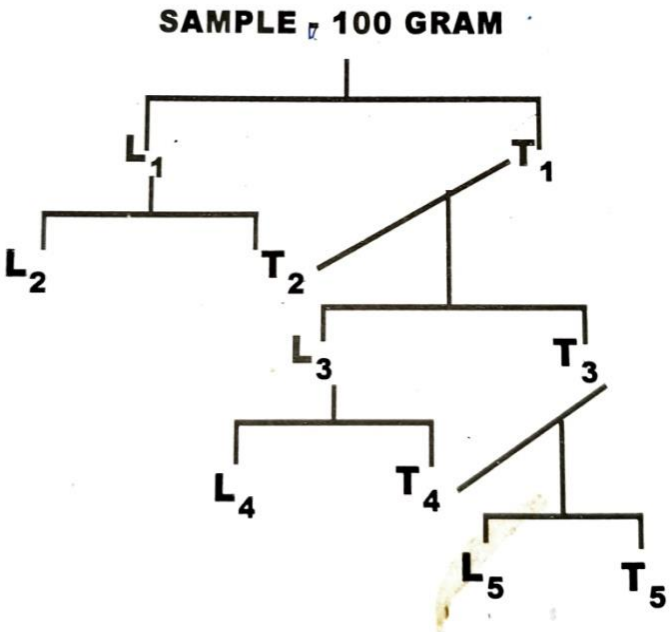


Fig 2.33 COTTON TRASH ANALYSING METHOD

Lint = $L_2 + L_4 + L_5$

Trash = T_5

Procedure:-

- First of all 100 grams of sample of cotton is processed in the trash analyzer.
- The lint L_1 is collected from the delivery box & trash T_1 is collected on the trash tray.
- Again lint L_1 is processed to separate the lint L_2 and the trash T_2. Then the lint L_2 is kept separately.
- The trash $T_1 + T_2$ is processed to collect lint L_3 & trash T_3 on trash tray.
- The lint L_3 is again processed to collect lint L_4 & trash T_4.
- The lint L_4 is added with lint L_2.
- Then trash $T_3 + T_4$ is again processed to separate lint L_5 and trash T_5.
- Then the trash and lint content is weighted separately and expressed as a percentage of the whole sample.

Therefore:-

Lint (L) = $L_2 + L_4 + L_5$ grams

Trash (T) = T_5 grams

Invisible loss (I) = 100 – (L+T) grams

Cleaning efficiency of a beater can be find out with the help of the trash analyzer by the method.

$$\text{Cleaning efficiency \%} = \frac{T_1 - T_2}{T_1}$$

Where, T_1 = % of trash in the material fed.

T_2 = % of trash in the material delivered

Calculation:-

$$\text{Lint percentage in the sample (L)} = \frac{L_2 + L_4 + L_5}{S} \times 100 = 93.73\ \%$$

Trash content in the sample

$$T = \frac{T_5}{S} \times 100$$

Where, S = weight of the sample in grams (100g.)

$$\text{Invisible loss (I)} = \frac{100 - (L + T)}{100} \times 100$$

$$= \frac{100 - (93.73 + 5.07)}{100} \times 100 = 1.20\ \%$$

Uses of the shirley trash analyser:-

1. To give a definite figure of trash content the raw cotton to the purchaser & seller.
2. To asses the beating points to be used in B/R for a particular class of cotton.
3. To find out the cleanliness of the product at any stage of the processing up to ending.
4. To ascertain the quality of spinnable fibres in the waste from any production machine.
5. To determine the loss of good fibre in the sequence of opening & cleaning process.

Conclusion:-

The lint, trash & invisible loss percentage of the given sample of cotton is found to be 93.73 %, 5.07 %, & 1.20 % respectively.