RESEARCH ARTICLE

Design and Development of Cotton Lint Opener for Preparation of Fibre Quality Test Samples

S. V. GHADGE, S. K. SHUKLA, P. G. PATIL and D. U. PATIL

ICAR-Central Institute for Research on Cotton Technology, Mumbai

Abstract

Cotton lint samples used for fibre quality evaluation must be clean and free from any non-lint content. Generally, lint samples received for testing are drawn from densely packed bales and contain some non-lint portions too. Hence, they require cleaning and opening up to ensure accurate measurement of quality parameters. If lint samples are tested as such without any opening and cleaning, there is every possibility of variations in the readings from the actual values. Presently, the testing laboratories resort to opening cotton lint samples either manually by hand or by using trash analyser. The extent of lint opening in both these methods is not uniform and optimum and also the speed is very slow. Therefore, an attempt was made to design and develop a new mechanical device for opening of lint samples used in fibre quality evaluation. The machine consists of feeder roller, licker-in cylinder and suction assemblies mounted on a frame provided with safety covers. It works on the carding principle where licker-in wires having sharp profile open up lint fibres by scrubbing action. Preliminary test trials of the lint opener have yielded satisfactory performance in terms of the handling capacity (40-50 samples/h) and the specific volume after opening (90-110 cc/g), which was found to be nearly double that of the unopened sample (40-60 cc/g).

Keywords : Cotton, Fibre, Fineness, Lint, Micronaire, Opener, Quality.

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*For correspondence : E-mail: svghadge@gmail.com

Introduction

Fibre quality is important in determining the market value of cotton, especially its grade, which depends upon quality parameters like staple length, strength, fibre fineness or micronaire (Mic), non-lint content, moisture content etc. There is increased interest of farmers, ginners, merchants and spinners in producing and trading better quality cotton varieties. Other factors that affect the fibre quality are location, environment and harvesting conditions. Besides these, mechanical processing machines, non-lint content in the test specimen and sample preparation before testing also affect the values. If cotton lint samples are tested on modern High Volume Instrument (HVI) as such in the condition in which received without any opening and cleaning, possibility of variations in readings from the actual value cannot be denied. However, for increasing the speed of testing, the tendency among machine operators is to use samples as received without any further opening. While opening allows proper air flow and accurate surface area measurement, unopened sample reduces the actual surface exposed to air and offers less resistance to air flow thereby increasing the Mic reading, which further lead to lower tenacity values. Hence, proper opening of samples used for quality evaluation is very important. Otherwise not only erratic Mic but also erratic strength values can result. In the process of opening, fibres are individualised, parallelised and short fibre and non-lint contents are removed, which improves the Mic value.

Presently, opening of lint samples for Mic testing is achieved either manually by hand or by using equipment like trash analyzer and opener blender. The extent of lint opening and the capacity are not uniform and optimum in these methods. In case of hand opening, the desired opening is not achieved and the amount of non-lint content seen is also more as compared to opening by trash analyser. Besides this opening of samples by hand is very tedious and laborious job that leads to a tendency of testing samples without opening. In case of trash analyser, which is used to determine the percentage of lint, trash, dust and microdots in a sample, the more aggressive and excessive opening is achieved by saw band cylinder that may adversely affect the micronaire and other fibre quality parameters. The speed of opening of samples by both these methods is very slow and does not match with the HVI handling capacity.

Therefore, an attempt was made to design and develop a new mechanical device for opening of cotton lint samples used in fibre quality evaluation.

Materials and Method

The design of the cotton lint opener is based on the carding

Table 1: Specifications of the Cotton Lint Opener

Sr. No.	Name of the Assembly/Particulars	Specifications / Details
1	Licker-in Cylinder Assembly	• Cylinder Diameter - 225 mm • Cylinder Length - 300 mm • Shaft Diameter - 30 mm • SS sheet of 3mm thickness underneath the licker-in cylinder for opening of lint by scrubbing action • Licker-in wires of sharp profile • Pillow blocks and Self-lubricating ball bearings for mounting • Feed Roller Diameter - 50 mm
2.	Feeder Roller Assembly	• Feed Cylinder Length - 300 mm • Shaft Diameter - 30 mm • Licker-in wires of blunt profile • Pillow blocks and self-lubricating ball bearings for mounting
3.	Suction Assembly	• High voltage brushless blower - 200 mm WGP, 500 W, 240 V, AC single phase • HDPE piping for suction of opened lint over the perforated chamber
3.	Drives	• Electric Motor - 0.37 kW, 230 V, 50 Hz, 3 phase, 1450 rpm, overload relay for protection - IP 55 • B-Section, V-Belt Pulley of requisite size for power transmission to licker-in cylinder • Chain drive power train mechanism for the feed roller
4.	Other Features	• MS frame for mounting of licker-in, feeder, suction assemblies and drives. • Lint collection chamber for storing about 100g of opened lint • Filter for trapping of short fibres • Observation Window for viewing the operation • Safety covers and mechanism for emergency stop

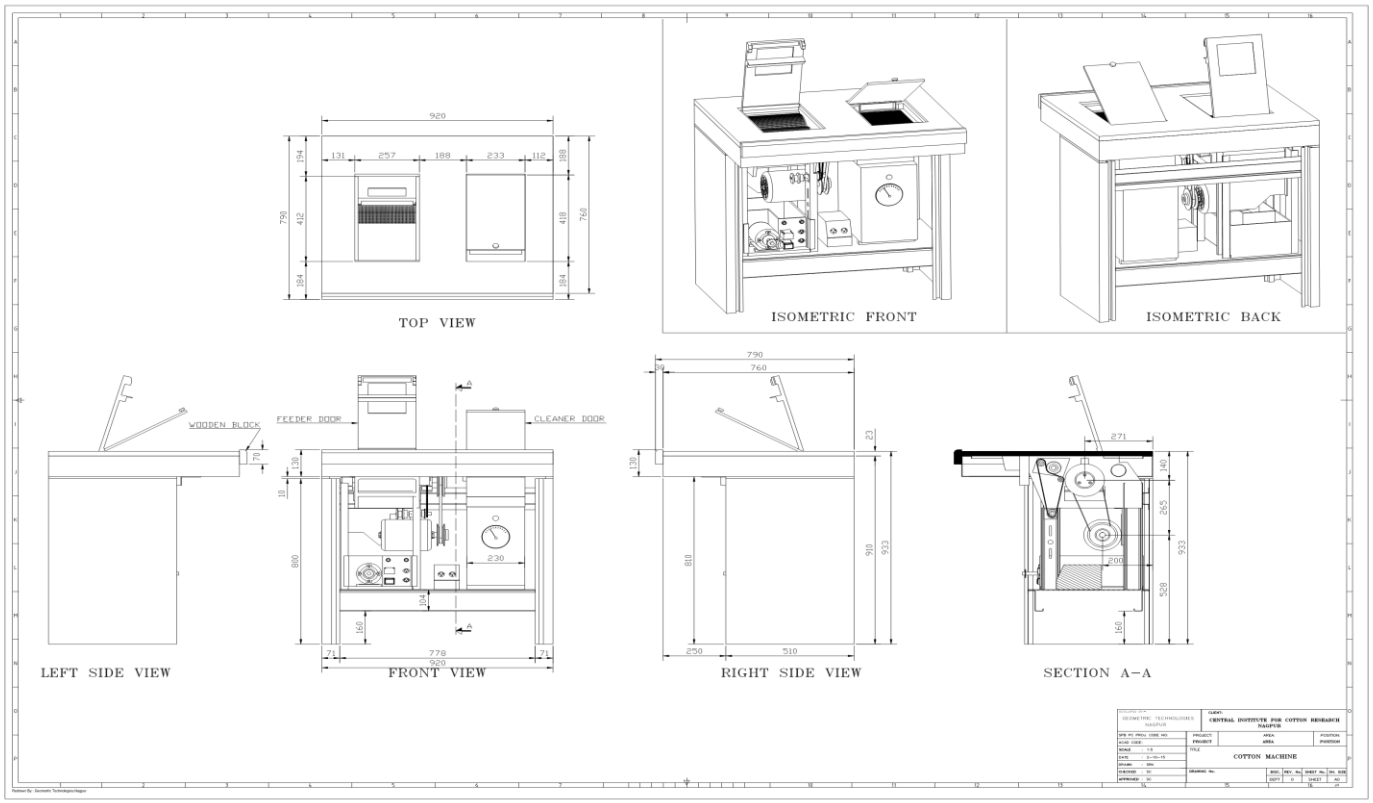

Fig.1: CAD drawing of the cotton lint opener and isometric views

Fig. 2: Cotton Lint Opener

Fig. 3: Specific Volume (cc/g) of the cotton lint samples after opening by different methods (specific volume of unopened sample: 40-60 cc/g)

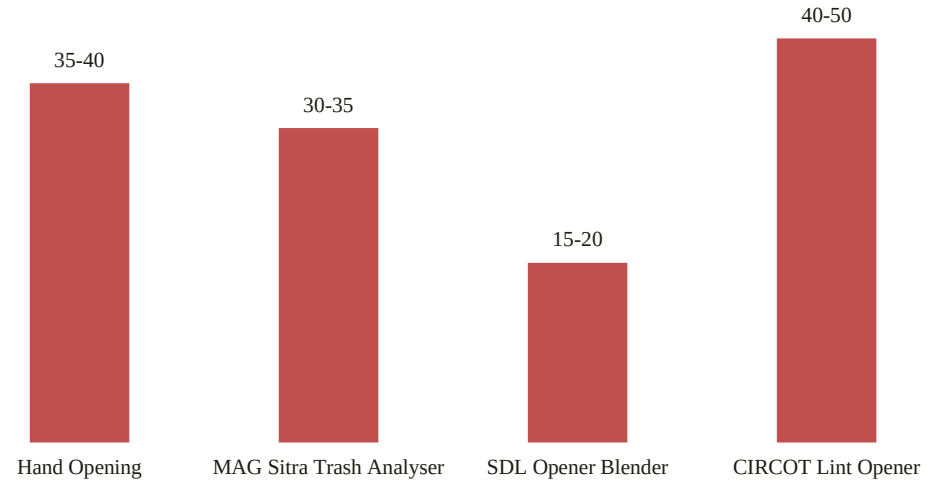

Fig. 4: Capacity (no. of samples/h) of different methods (sample weight: 12-15g)

principle where opening of cotton lint is achieved by scrubbing action of sharp licker-in wires on the lint fibres as they are passed through narrow clearance between licker-in cylinder and the sheet provided underneath the cylinder for the purpose. Licker-in wires are mounted all over on the periphery of the cylinder throughout its width. The licker-in cylinder assembly is the main component of the machine, the other two being feeder roller and suction assemblies for feeding the cotton lint sample and taking out the opened lint, respectively. All the three assemblies along with the electric motor drive are mounted on a frame and provided with safety covers and doors. There is a lint collection chamber for storing about 100g of opened lint. Some of the specification details of the cotton lint opener are given in the Table 1. The engineering drawing and the research prototype are shown in Fig. 1 and Fig. 2 respectively.

The research prototype of the cotton lint opener was fabricated by the ICAR-CIRCOT Mumbai at M/s. Precision Tooling Engineers, Nagpur in partnership collaboration mode. The size of the machine and specifications were arrived at keeping in mind the desired output capacity and the quality considerations of fibre testing. The experiments for performance testing were carried out at Ginning Training Centre, Nagpur, a regional unit of CIRCOT, Mumbai. Cotton lint samples were obtained from the CICR, Nagpur. Women labourers were employed for opening the lint samples by using the developed lint opener. Specific volume (cc/g) of lint samples before and after fibre opening was determined using the beaker method, in which a known weight of lint sample was loosely placed in a beaker and its height measured. The capacity was calculated as number of samples opened per hour by recording the time required for opening cotton samples weighing 12-15g.

Results and Discussion

Proper opening of cotton lint samples for fineness measurement is very important for correct evaluation of the fibre quality. Presently, the HVI testing laboratories generally use trash analyser and opener blender or employ human labour for opening by hands. Opening of cotton lint samples manually by hand is the simplest method of lint opening in which cotton lint bundles are simply pulled apart by hands to separate out the entangled fibres and to remove any non-lint impurities. The performance of all these methods was evaluated for comparison with that of the developed cotton lint opener. The comparative performance results for the quality of opening and the output capacity are shown in Fig. 3 and Fig. 4 respectively.

It can be seen from the figures that the cotton lint opener gave near close performance to that of the trash separator and SDL blender in terms of specific volume after sample opening. The specific volume of the unopened sample (40-60 cc/g) nearly doubled (90-110 cc/g) after opening using the cotton lint opener. Hand opening method could achieve only marginally higher sample opening along with a lot of impurities, which affected the fibre quality testing. The capacity of the lint opener was found to be the highest (40-50 samples/hour) among all the four methods, that could match the handling capacity of the high volume instrument for fibre quality testing.

Thus, the developed cotton lint opener was found to give satisfactory performance for preparing cotton lint samples required for fibre quality testing using the high volume instrument.

Conclusions

Cotton Lint Opener has been designed and developed for preparing cotton lint samples for fibre quality testing. The machine consists of feeder, licker-in and suction assemblies for ensuring proper feeding of cotton lint samples, their opening by scrubbing action of licker-in wires and finally removing the cleaned opened samples, respectively. Adequate provisions have been made in the machine for ensuring operator safety and easy handling. Preliminary test trials of the lint opener have yielded satisfactory performance in terms of the quality of opening and the output capacity matching to the handling capacity of the high volume instrument for fibre quality testing. The cotton lint opener is expected to bridge the gap that long existed in the fibre testing laboratories, which depended upon human labour for preparing the samples.

Acknowledgments

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References

Annonymous (2000) – Technical and Operating Manual of HVI & AFIS, Zellweger Uster, Knoxville, USA

Booth, J. E. (1964) – Principles of Textile Testing - A Heywood Book, Temple Press Books Ltd. London.

Munshi, V. G. and Tamhankar, H. V. (1976) – Final report of the project on fabrication of lint opener – CIRCOT, Mumbai

Sundaram, V., Basu, A., Iyer, K. K. R., Narayanan. S. S. and Rajendran, T. P. (1999) – Handbook of Cotton in India. Published by Indian Society of Cotton Improvement, Mumbai.

Sundaram, V. (1979) – Handbook of Methods of Tests for Fibres, Yarns and Fabrics – CIRCOT, Mumbai.