

# **ACCURATE TRASH MEASUREMENT AND ITS SIGNIFICANCE IN COTTON CHAIN**

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Trash content in cotton has significant impact on all phases of cotton chain. In the initial stage of this process, this measurement plays an important role in fair valuation of grower's cotton thru services provided by classing operation. In the gins, it assists with optimization of the ginning process. In spinning, it influences major quality and cost factors in yarn production. The current practices in measurement of this important cotton quality range from human judgment calls to inherently slow and often inaccurate mechanical instruments which are influenced greatly by the operator.

This paper reviews the application and value of accurate trash measurement and introduces Uster Technologies new HVIGT1000 Trashmeter.

## **VALUE OF AN ACCURATE TRASH MEASUREMENT IN COTTON CHAIN PROCESSING**

### **Classing:**

Today, more than 60% of the world's cotton is tested by instruments, a number which grows each year. The reasons for rapid change from manual to instrument classing are a greater number of properties with much higher degree of accuracy, and higher testing throughput. Yet, with the exception of US, in the rest of the world trash content of cotton is either performed by a classer or excluded from classing services. An accurate and fast instrument for this application should fill this void.

### **Ginning:**

A typical ginning practice in removing trash from lint can result in over drying of cotton. This practice can cause fiber damage and excess loss of good fiber.

Timely knowledge of accurate trash content will assist in optimization of pre-cleaning and lint cleaning operations resulting in efficient removal of trash while minimizing fiber damage.

### **Spinning and weaving:**

The knowledge of an accurate measurement of trash content in cotton is of high importance for these operations since it impacts removal in the blow-room, carding and combing. This in turn affects the raw material cost either through loss of fiber in these removal processes, or through the ability to negotiate a price which is a function of this parameter. An additional impact on spinning is in the form of quality and performance cost. Trash in spinning influences end breaks affecting yarn quality due to piecing and defects. Additionally, higher end breaks which result in lower spinning efficiencies, affect productivity and financial performance.

## **Today's Status:**

The ASTM reference method for trash measurement is based on separating and direct weighing of the trash content. The currently used instruments are generally based on antiquated technologies. The cycle time is slow and resultant data are influenced by the operator.

Other instruments, which use indirect methods for trash measurement have not universally found their ways in the trade

## **Uster GT1000 TECHNICAL DEVELOPMENTS:**

In development of Uster GT1000 the current shortcomings were addressed using three design objectives:

- Trash measurement must be gravimetric based. This direct method of quantifying trash content is the most widely used and accepted practice in trade and mill applications.
- This measurement must be more accurate than existing instruments on the market.
- This instrument must have a fast cycle time to make its application HVI compatible for use in classing or applications where multiple testing is required.

## **Technical Performance:**

The functional diagram for GT1000 and a picture of the instrument are shown in Figure #1 and # 2 with the following performance specifications:

- Ability to test a wide range of menu selectable materials such as saw ginned, roller ginned, card mat, card sliver, gin waste and spinning process waste
- High degree of accuracy utilizing patented technologies for efficient separation mechanism, air flow design, and imaging algorithms
- High separation efficiency of greater than 90% for a single pass as shown in figures # 3 thru #8.
- High degree of automation with auto weighing trash and no intervention by operator
- High speed testing with a cycle time of 60-90 seconds for a 30 gram sample
- High precision with a CV% of 6.9% as shown in figure #9 for repeatability and reproducibility among three instruments over a 90 day trial period
- Lack of operator dependence on test data is shown in Figure #10 with the high correlation coefficient of 0.98 using three operators

Figure #1 technical components and their associated functions in GT1000.

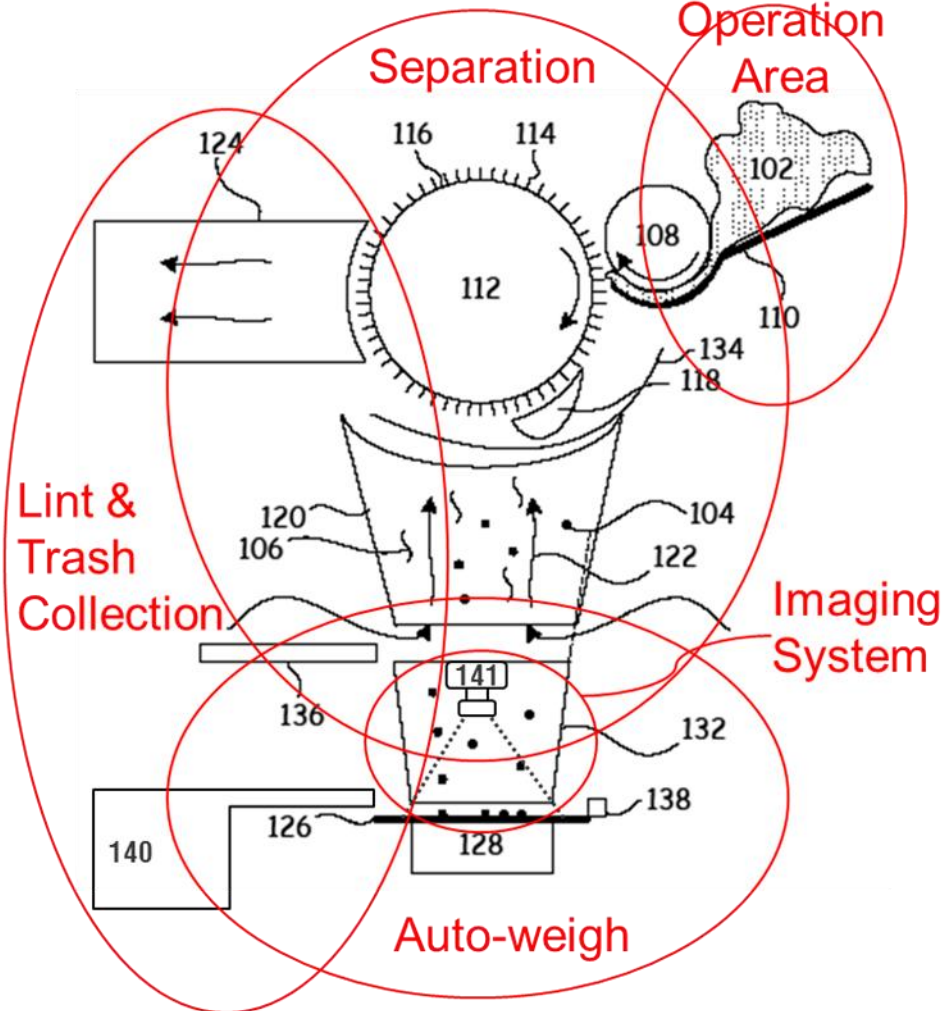
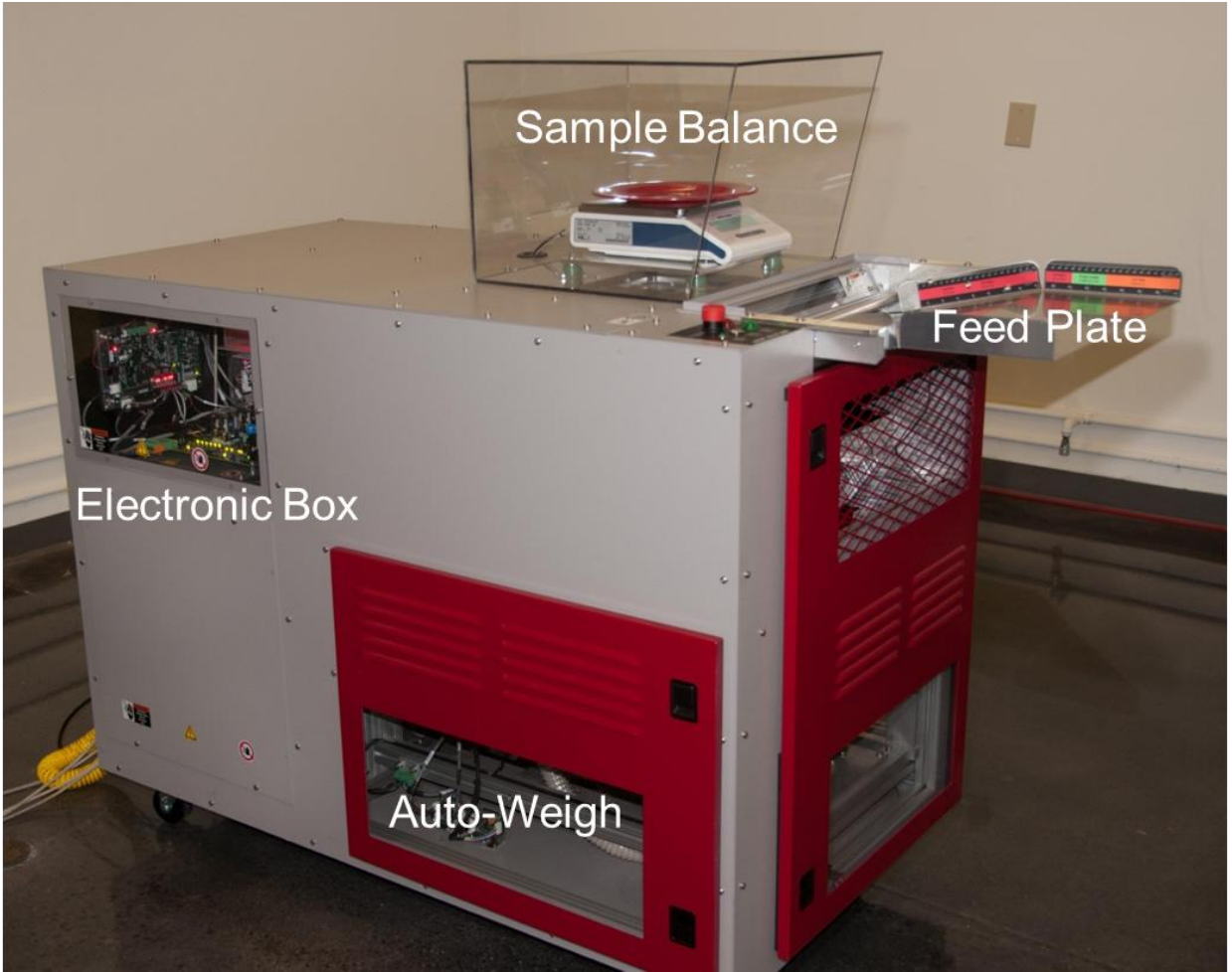


Figure #1. GT1000 Functional Diagram



**Figure # 2.** GT1000

Figures number 3 and 4 are pictures of a sample with 3% trash content before and after trash removal. Figure # 5 is the picture of removed trash from this sample.



**Figure # 3.** Cotton sample with 3% trash content

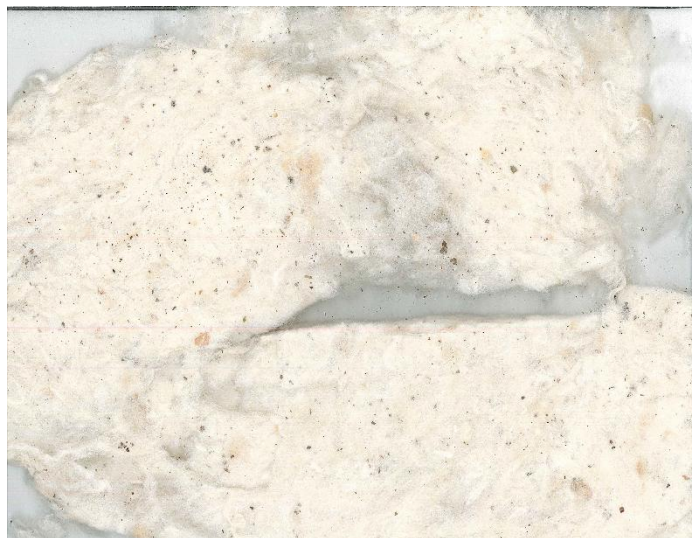


**Figure # 4.** clean lint



**Figure # 5.** Separated trash

Figures number 6 and 7 show pictures of a sample with 4.5% trash content before and after trash removal. Figure # 8 is picture of removed trash from this sample.



**Figure # 6.** Sample with 4.5% trash content



**Figure # 7.** Clean lint



**Figure # 8.** Separated trash

Figure # 9 represents the performance of three GT1000 for repeatability, reproducibility, cycle time and cleaning efficiency tested over a three months period.

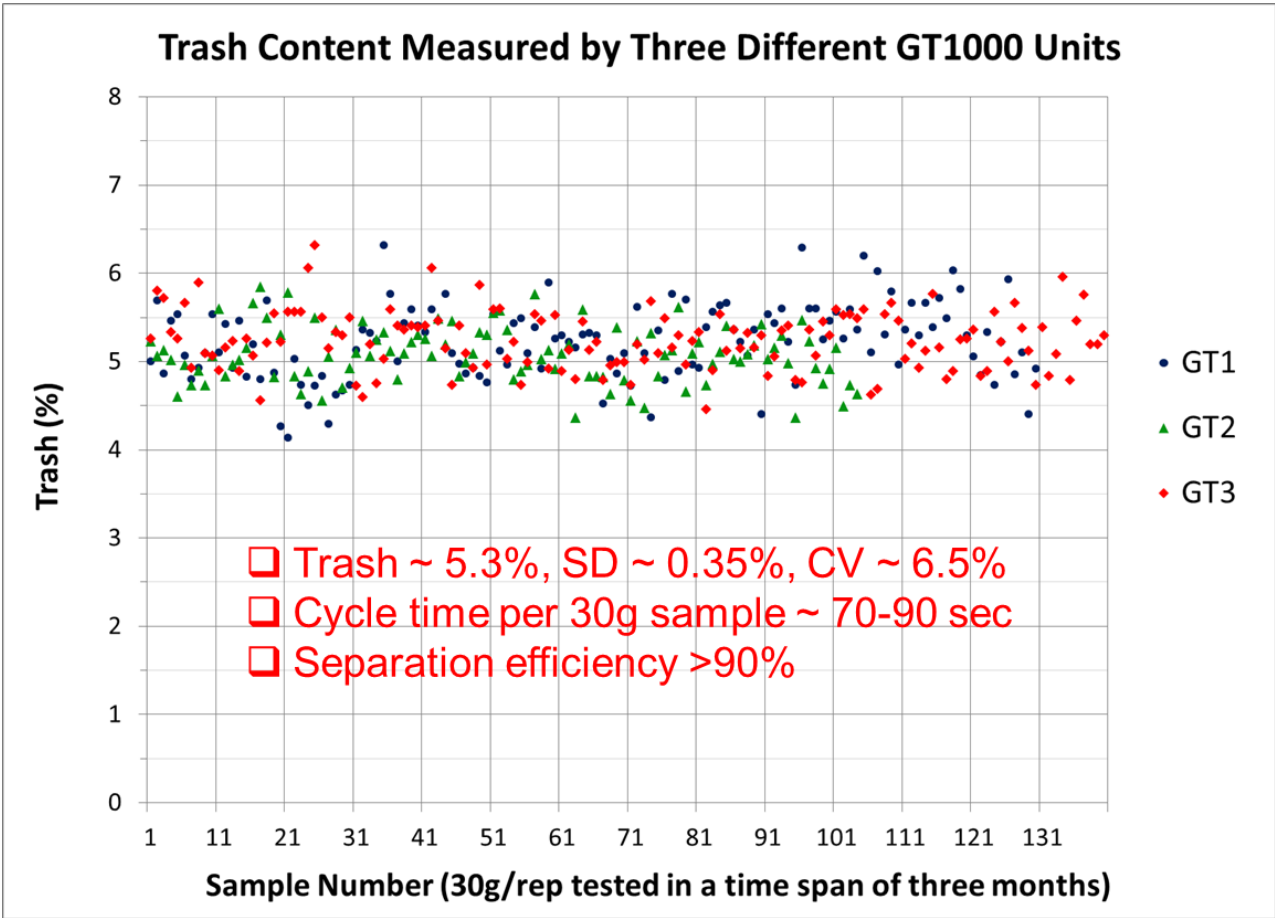
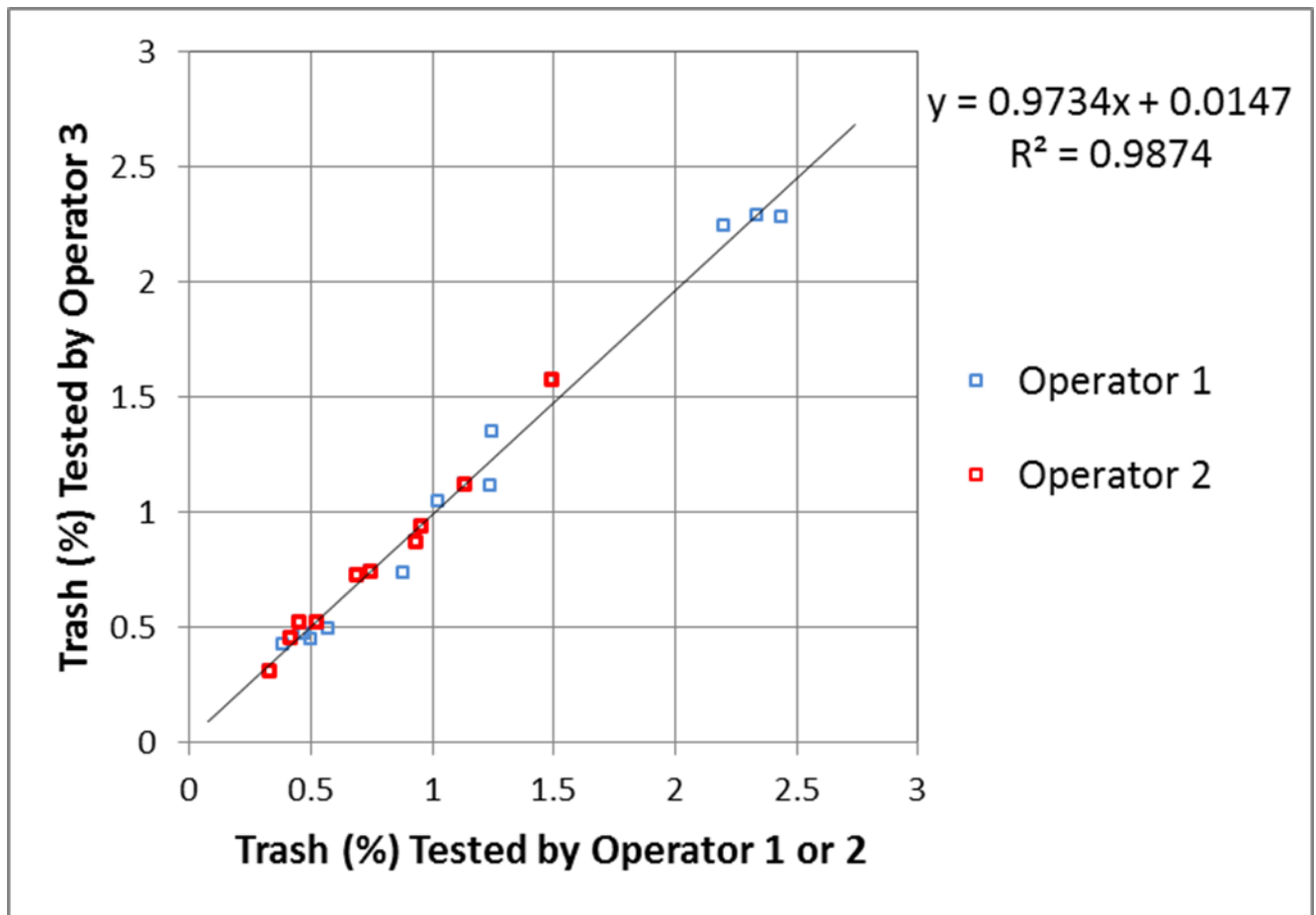


Figure # 9. Performance of three GT1000 over a 90 day trial

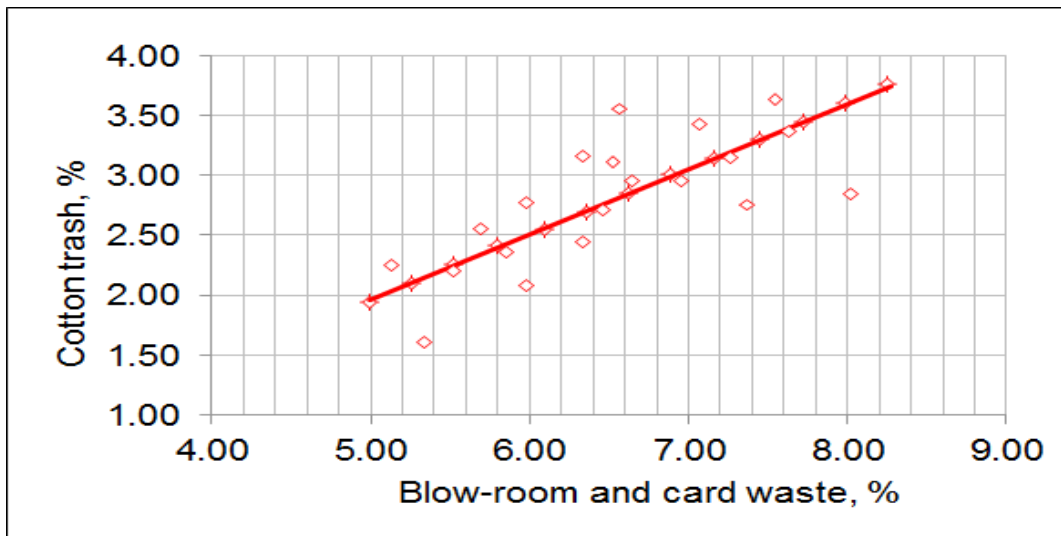




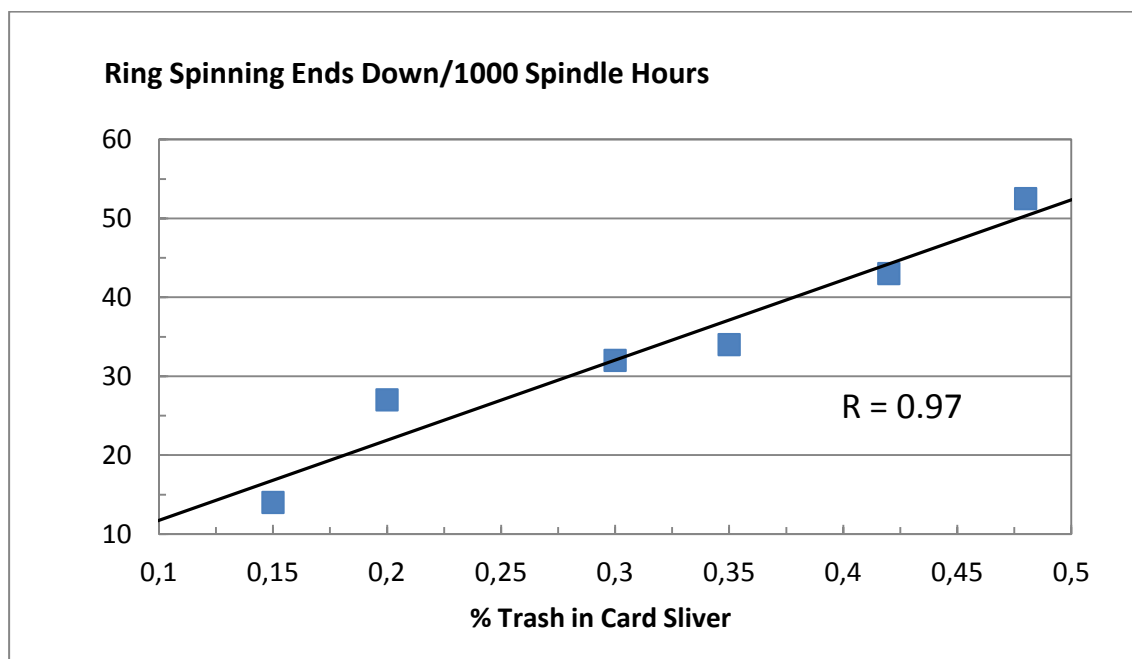
**Figure # 10.** GT1000 data showing lack of operator's influence on results

**Applications of GT1000:**

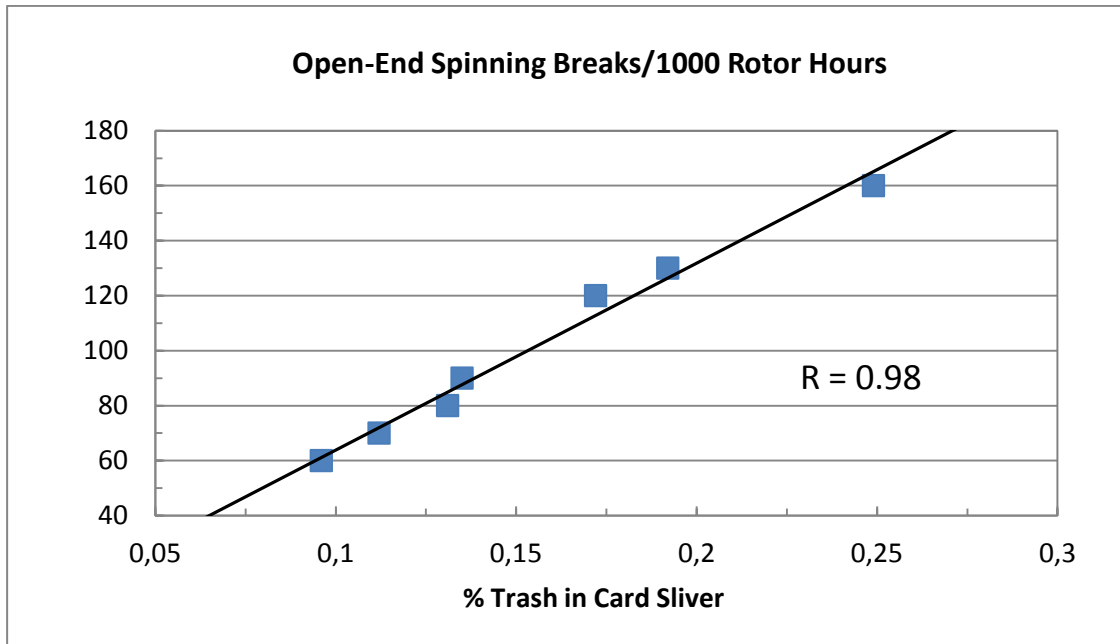
**Known information about impact of trash on spinning and weaving performance:**



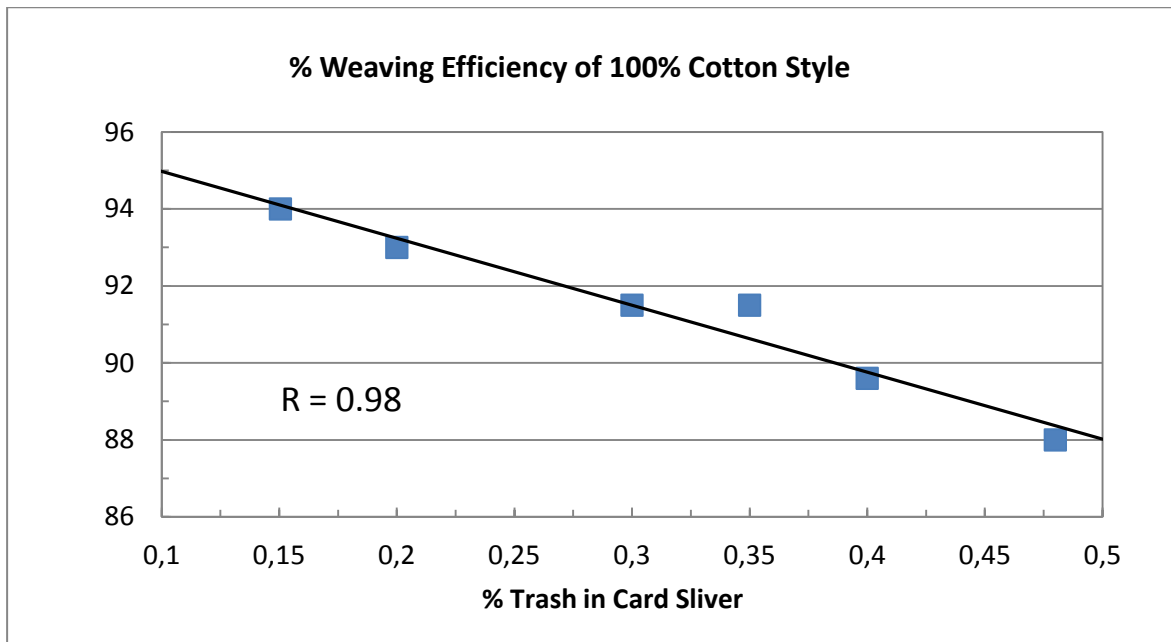
**Figure # 11.** Effect of % cotton trash on amount of blow room and card waste removed.



**Figure # 12.** The relationship between percent trash in card sliver and the number of ends down at ring spinning (From book "Short Staple Yarn Manufacturing" McCreight, Feil, Booterbaugh, & Backe, Carolina Academic Press, p.99.)



**Figure # 13.** The relationship between percent trash in card sliver and the number of spinning breaks per 1000 rotor hours. Note: From “Trash Content of Card Slivers Related to the Frequency of Broken Ends in Rotor Spinning.” by Artzt, Azarschab, & Maidel, *Texil-praxis International*, 45(11), p.1146.



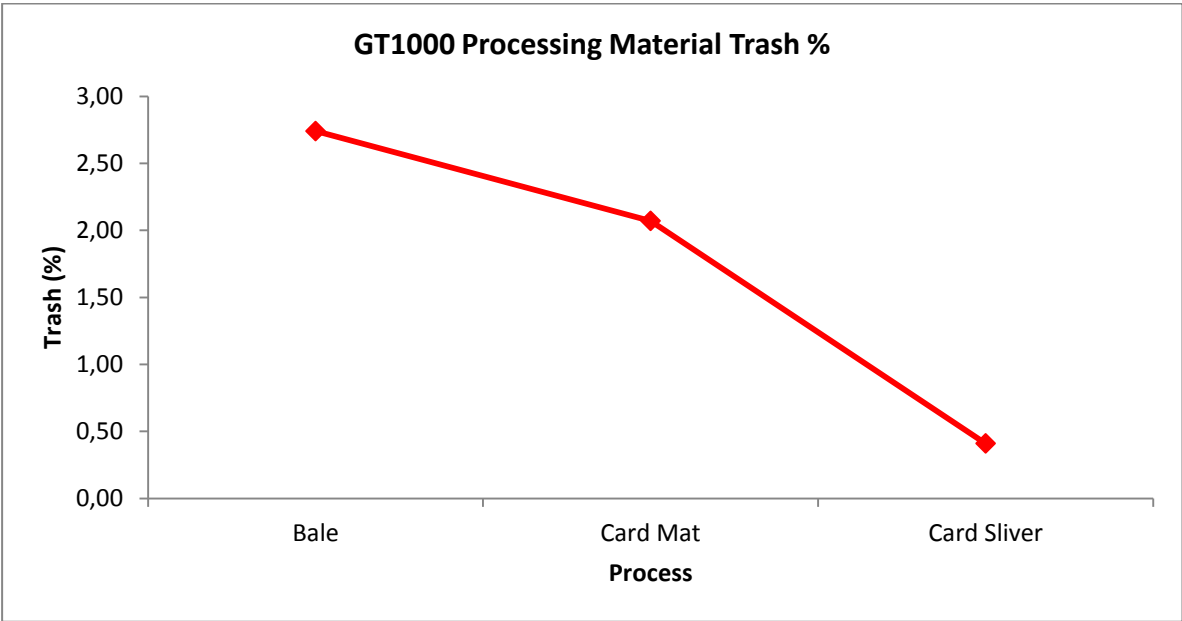
**Figure # 14.** The relationship between percent trash in card sliver and yarn performance at weaving (From book “Short Staple Yarn Manufacturing” McCreight, Feil, Booterbaugh, & Backe, Carolina Academic Press, p.100.)

This information indicate that trash’s impact in a spinning mill is considerable and carries through to fabric forming, making the cost of defects an accumulative factor further down-stream in the process.

**Performance of GT1000 in Classing and Spinning trials:**

GT1000 was evaluated by a classing operation for accuracy and cycle time. It was also used in a spinning mill for a period of 2 months. In the interim tests were performed on three instruments in a research laboratory. The reports indicated achieving the objectives that were set for this instrument at the design process.. The data presented in this paper is from these three sources

This instrument is capable of processing raw cotton from bale, card mat, and sliver as well as reclaimed waste. Figure #15 the measurement of process material from bale, card mat, and card sliver yield expected results with decreasing amounts of trash at each subsequent process.



**Figure # 15.** GT1000 measurement of Trash % in spinning mill processing material.

Each material was tested by same operator on same instrument using 30 gram per repetition, 3 repetition test protocol for each process material. The results of these tests in Figure # 16 demonstrate a CV's at below 10%.

<u>Bale Sample</u>					<u>Card Mat</u>				<u>Card Sliver</u>					
Bale ID:	100%	Cotton			Bale ID:	100%	Cotton	Card		Bale ID:	100%	Cotton	(Card	
Comment:	Plant 5	(Bale)			Comment:	Plant 5	(Mat)			Comment:	Plant 5	(Sliver)		
Rep	Sample	Trash	Trash		Rep	Sample	Trash	Trash		Rep	Sample	Trash	Trash	
	[g]	[g]	[%]			[g]	[g]	[%]			[g]	[g]	[%]	
===	=====	=====	=====		===	=====	=====	=====		===	=====	=====	=====	
	1	30.74	0.78	2.54		1	30.31	0.61	2.03		1	30.55	0.13	0.44
	2	29.88	0.79	2.64		2	30.25	0.57	1.88		2	30.53	0.12	0.39
	3	30.45	0.92	3.03		3	29.7	0.68	2.29		3	30.97	0.12	0.39
===	=====	=====	=====		===	=====	=====	=====		===	=====	=====	=====	
Avg		30.36	0.83	2.74	Avg		30.09	0.62	2.07	Avg		30.68	0.12	0.41
SD		0.44	0.08	0.26	SD		0.34	0.06	0.21	SD		0.25	0.01	0.03
CV		1.44	9.54	9.43	CV		1.12	8.91	9.95	CV		0.81	6.48	6.9

**Figure# 16.** GT1000 test results for each process material tested.

**Conclusions and remarks:**

The need and value for the cotton trade, classing operations, and textile mills for an accurate and fast measurement of trash content has been stated in multiple international conferences and forums. GT1000 was developed as a response to these requests. These published data are the result of GT1000's evaluation by a classing operation, an in-mill study, and a research laboratory. As part of an overall assessment of this instrument, it has also successfully completed the requirements for CE certification.

In the coming months, GT1000 will officially be introduced to the market.