ACCELERATED SAMPLE CONDITIONING FOR HVI TESTING LABORATORIES

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Abstract

A description of the development of a simple, inexpensive and effective method of rapidly conditioning cotton fibre samples for HVI testing.

Introduction

The use of HVI cotton fibre analysis systems is accepted worldwide as being the most suitable method of cotton grading on a large scale. Not only are these systems being heavily utilised in the developed world, but are now being installed in emerging countries.

The high volume of samples processed each day (this can amount to 1000/HVI line/day) requires the availability of sufficiently large air conditioned areas for storage and fibre conditioning.

The USDA state in their guidelines for HVI testing published in January 1998 that the optimum moisture content of the cotton prior to HVI testing should fall between 6.75% and 8.25%, calculated on a dry weight basis.

The normal time taken to achieve this level, depending on the start point, is of the order of 48 hours. The cost of maintaining suitable atmospheric conditions in such a large environment is prohibitively expensive and very difficult to achieve long term.

Systems have been developed which can greatly accelerate the rate of moisture absorption of the cotton by artificial means. In general they are static, have high power consumptions, and require most of the refrigeration, humidification and control systems already used in the laboratory, resulting in system duplication and higher maintenance costs.

MOISTURE METER READINGS
SAMPLE - 100% COTTON IN BALE FORM

POSITION IN BALE	MOISTURE METER ONE		MOISTURE METER TWO		MOISTURE CONTENT BY REGAIN
	SPRUNG PROBE	SOLID PROBE	SPRUNG PROBE	SOLID PROBE	
Top	5.5	5.5	5.25	5.25	7.3
Middle	5.5	5.5	5.25	5.25	7.3
Bottom	5.5	5.5	5.25	5.25	7.3

Tests Taken on 100g Samples from Rapid Conditioning Cabinet (mean of 10 samples)

MOISTURE METER ONE		MOISTURE METER TWO		MOISTURE CONTENT BY REGAIN TEST
SPRUNG PROBE	SOLID PROBE	SPRUNG PROBE	SOLID PROBE	
5.2	5.2	5.0	5.1	7.5

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We believed it possible to build a system which utilises the actual laboratory atmosphere and circulates it repeatedly through the samples. The benefits of such a system would be:

1. Low capital cost) Using existing
2. Low energy costs) conditioned air
3. Low noise levels
4. Portability
5. Excellent reliability and ease of maintenance due to simplicity of design.

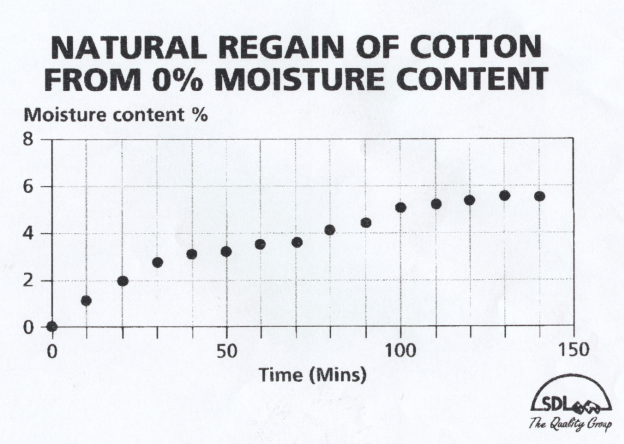
6. The ability to process more samples per operating cycle and to utilise multiple units in a laboratory where required, because of the units compact size.

The result is the SDL Rapid Conditioning System.

Development

In the early stages of development, a number of concepts and system configurations were considered. It had been our intention to assess the performance at each stage of development by the use of hand held moisture meters.

It soon became apparent that this method posed serious problems.



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National Cotton Council, Memphis TN

If we examine this chart, we can see a comparison made between two identical moisture meters fitted with identical probes.

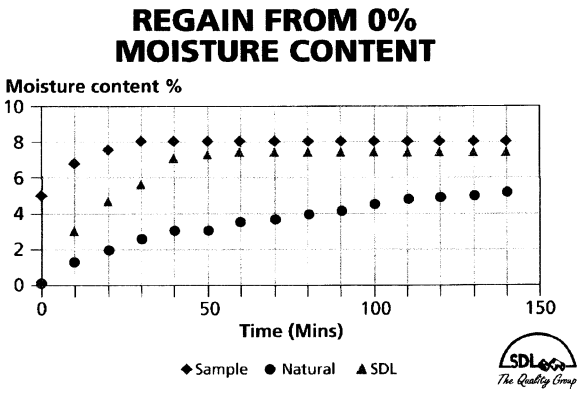
The top table gives readings taken at various points of a bale of cotton.

In comparison are readings taken from similar areas of the bale, the moisture content being determined by the use of a regain oven.

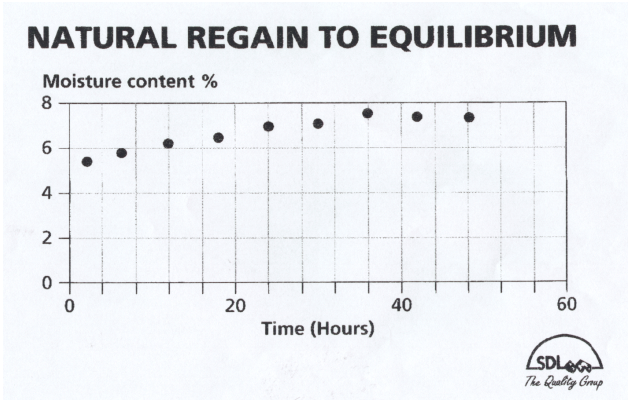
The lower table is a similar exercise carried out on samples of 100g mass taken at random from the production versions of the Rapid Conditioning Cabinet.

It is clear that in every instance, the moisture meter gave significantly lower readings than the actual value obtained by testing to dry weight as recommended by the USDA. Further examination also shows some difference between the two meters, both of which had been calibrated immediately prior to this test.

Based on this evidence, testing by using a moisture meter was not sufficiently accurate for this project and so all further evaluation was made using Rapid Regain techniques, although we are currently using a different moisture meter, calibrated against dry weight curves, for spot checks during further trials. We expect this to give better results although the meter is still very operator influenced.



In order to assess the performance of any system, we first needed some data to show how the cotton regains naturally. As previously discussed this was carried out by drying a representative sample of cotton until the moisture content was zero % and the sample weighed at this condition. The sample was then exposed to standard laboratory conditions (i.e. temperature 20°C ± 2°C or 70°F ± 2°F at a relative humidity of 65% ± 2%) and allowed to condition naturally over a period of time. By weighing the sample at regular intervals it was possible to calculate the quantity of moisture absorbed. The graph shows that after 2 hours in lab air the moisture content has increased from zero to 5.8%.

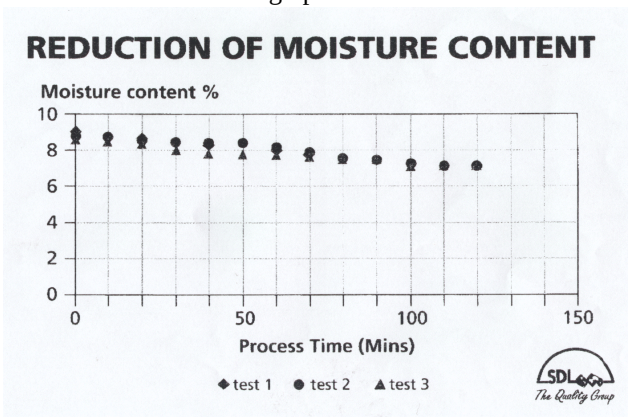


Equilibrium at 7.6% is reached after approximately 40 hours.

As mentioned earlier in this discussion, a wide range of concepts and machine configurations were considered. Complex studies were carried out in order to optimise such factors as airflow direction, flow rate and volume of air flow required through the samples of cotton to obtain maximum regain. A high air turbulence within the system proved to be advantageous, indeed a prerequisite for optimum performance.

At the completion of this work a prototype system containing four trays, each capable of holding 25 x 100g samples (100 samples total) was constructed.

The unit is fitted with a single phase dual fan arrangement which is designed for ease of maintenance, is portable and is controlled by an electronic timer. A summary of the test results are shown on the graph.



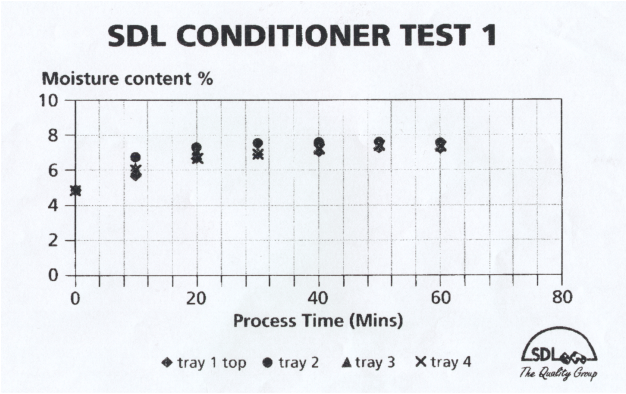
Displayed on the graph are three traces, one trace indicates natural regain from zero % moisture content for comparison purposes.

The second trace represents the regain achieved using the conditioning system from zero % moisture content.

The third trace represents regain achieved on samples of cotton introduced into the conditioning system already containing a moisture content of 5%. This trace is

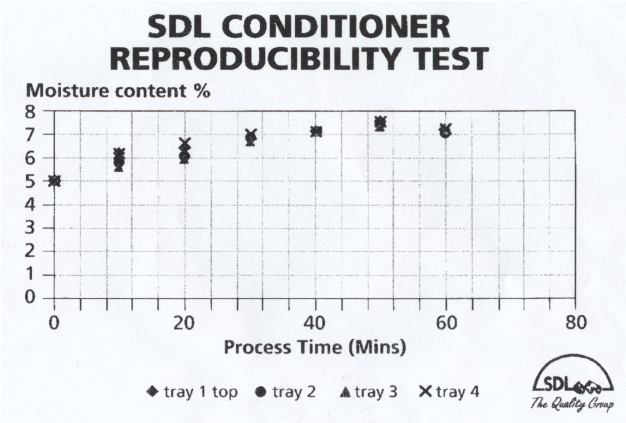
particularly important since we believe it represents what is likely to be a typical sample as presented to the system by an end-user. In both cases, moisture content is raised from 5% to above 7.5% (above the minimum USDA recommended limit of 6.75%) in around 20 minutes.

It should be noted that there is a slight difference in the equilibrium values of the sample conditioned from zero % moisture content and the sample from 5%. This is due to the fact that drying cotton fibre to zero 0% changes the molecular structure of the fibre. This slightly reduces the fibres ability to absorb moisture.



As part of the development programme, the ability of the system to actually reduce the moisture content from high input values was investigated.

Whilst not being as effective as increasing moisture content, levels can actually be reduced but at a much slower rate. To reduce the moisture content from 9% to 8.25% (top of the USDA recommendations) takes around 40 minutes.



At this stage of the programme, we were confident that optimum system performance had been achieved and so the system entered production.

The target specification for the conditioning system we had set ourselves was to obtain a moisture content of between 6.75% and 8.25% within a time scale of 30 minutes, thereby allowing the conditioning of 200 samples per hour, more than enough for a single HVI testing line.

According to the data shown this is clearly being achieved well within the specified time.

The rate of regain can also be seen to be constant throughout the extensive performance trials, showing that results are reproducible and are consistent both between tests and at all points within the system.

Conclusion

The SDL Rapid Conditioning System is effective, portable, inexpensive to purchase and operate and easy to maintain.

It meets the criteria set by our customers by having excess capacity for a single HVI fibre analysis system, and requiring no services other than domestic single phase power.