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Rapidly Conditioning Laboratory Samples of Cotton

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ABSTRACT

A rapid cotton conditioning apparatus that uses a combination of dry air and room air forced through a blended 10 gram laboratory sample is evaluated with 14 cottons. The evaluation indicates that a 6 to 10 minute conditioning cycle is equal to 24 to 48 hours of room conditioning in trays. The use of dry air in the rapid conditioner had little or no effect on hysteresis when compared to samples that were room conditioned in trays.

Conditioning cotton samples for fiber testing, as outlined by ASTM [1], is an involved and time-consuming procedure. To eliminate the effect of hysteresis, the sample should first be preconditioned in an atmosphere in the range of 10 to 25% relative humidity at a temperature below 50°C. To determine when equilibrium at these conditions has been reached, the weight of the sample is measured until the change in weight for a 2 hour period is less than 0.1% of the sample weight. The sample is then conditioned to standard conditions of 65% relative humidity and 21.1°C, with the procedure above being repeated.

In practice, very few laboratories follow this procedure for routine fiber testing. Normally samples are brought into a laboratory that is at standard conditions, placed in open trays, and allowed to condition for at least 4 hours. When large numbers of samples are being tested, it is common for the trays to be stacked on top of each other to save space. This greatly reduces the free flow of air around the samples, thus reducing the probability of all samples coming to equilibrium with the room conditions. For those samples that do, in many cases, it is unknown whether equilibrium was reached from the wet or dry side.

Previous work on rapidly conditioning individual test samples for high volume instrument fiber testing generated interest in the possibility of rapidly conditioning samples for laboratory testing. The potential for savings in time and space for fiber conditioning and for improvement in the reliability of test results is attractive.

Experimental Procedure

The cottons used in these studies were taken from official cotton standards for American upland, length of staple samples. Fourteen cottons were selected, with staple lengths ranging from 20.64 mm to 31.75 mm and Micronaire ranging from 3.7 to 5.2. Ten gram blended samples were used throughout these tests.

METHODS

Rapid Conditioner

An apparatus was designed and constructed for rapidly conditioning 10 g cotton samples (Figure 1). It consists of a vertical 15.24 cm i.d. cylinder, 25.4 cm tall, mounted on a base, and an inside 10.16 cm i.d. cylinder, 15.24 cm long, axially aligned and positioned 1.27 cm below the top of the 15.24 cm cylinder. The 10.16 cm cylinder has a wire mesh screen across its bottom and is supported by a partitioning ring at its lower end, thus forming a suction plenum in the bottom 8.89 cm of the 15.24 cm i.d. cylinder. A suction port is provided for the lower plenum and a compressed dry air port is positioned just above the partitioning ring leading into the space between the two cylinders. A lid for closing the top of the 15.24 cm i.d. cylinder completes the apparatus. In operation, a 10 g blended sample is placed in the 10.16 cm diameter conditioning chamber and the air suction supply is turned on, which

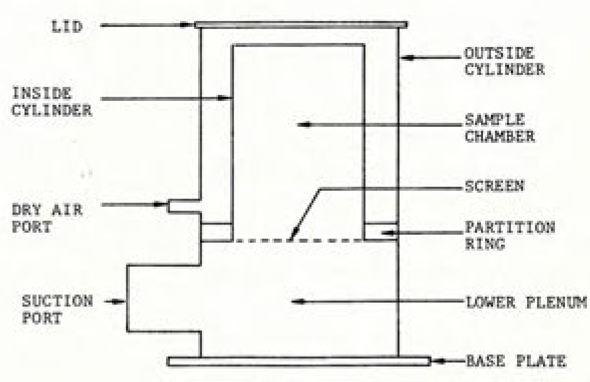

FIGURE 1. Rapid cotton fiber conditioner.

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are lower than expected, but only about half the cottons were lower than indicated by their moisture contents. Comparing the 6 minute rapidly conditioned samples to the 48 hour room conditioned samples, there is only 0.2 grams per tex difference regardless of the original moisture content of the samples. Within each set of samples, however, there is a hysteresis effect of 0.6 grams per tex. This effect was not universal for all 14 cottons: 7 of the 28 pairs of conditioned samples had no evidence of hysteresis, but the 14 cotton average difference is significant at the 5% confidence level. These HVI strength data indicate that *rapidly* drying the samples in the rapid conditioner had little or no effect on hysteresis when compared to 48 hour room conditioned samples. We tested one set of rapidly conditioned samples using the Stelometer and found no hysteresis effect with this instrument. We will investigate this further at a later date.

To show the contribution of the dry air in the rapid conditioning procedure, we conducted a final test wherein the samples were conditioned with room air only for 3 minutes. Figures 7, 8, and 9 compare the rapid conditioning results from a previous test to the results obtained from conditioning with room air only. It is readily apparent in these figures that the dry air significantly improves the conditioning of the 80% RH conditioned samples, while having little or no effect on the 50% RH conditioned samples. Wood reported that in ambient air, cotton fibers give up moisture four times as fast as they absorb it [2]. The data from this test indicate a reversal of this for rapid, forced air flow fiber conditioning. The low moisture content fibers absorbed moisture and reached equilibrium with 3 minutes of room air only, while the high moisture content fibers failed to reach equilibrium in the same time period. Figure 10 shows more graphically how cotton fi-

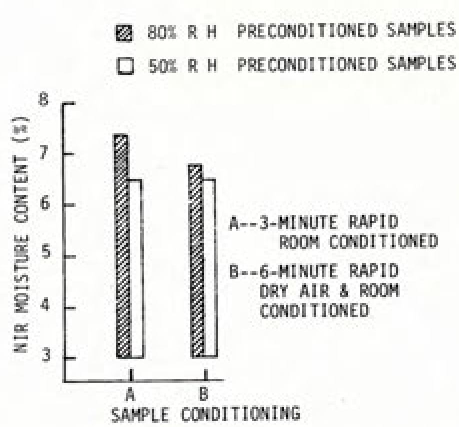

FIGURE 7. Comparison of fiber moisture content when rapid conditioning with room air only.

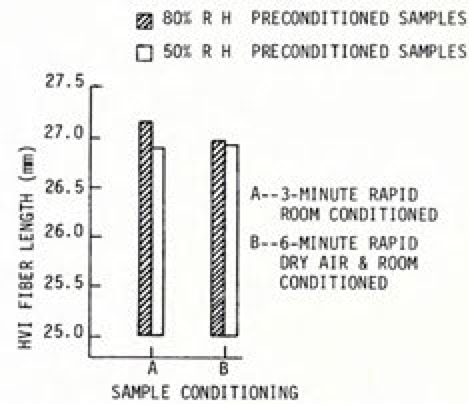

FIGURE 8. Comparison of fiber length when rapid conditioning with room air only.

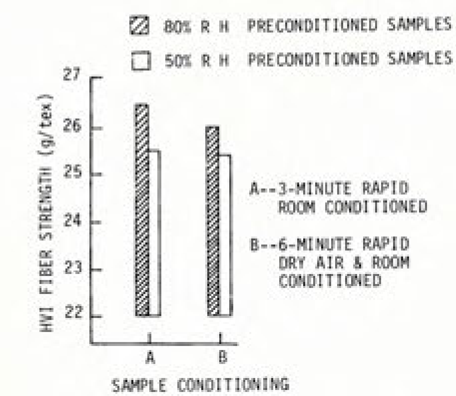

FIGURE 9. Comparison of fiber strength when rapid conditioning with room air only.

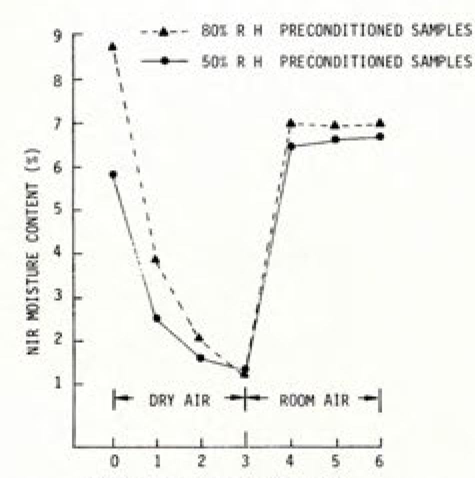

FIGURE 10. Average moisture content within a 6 minute rapid conditioning cycle.

bers react to the forced air flow in the rapid conditioner. They require 3 minutes for desorption and essentially only 1 minute for absorption.

Conclusions

Rapidly conditioning laboratory samples with 0.0118 m^3/s of dry air and room air for 3 to 5 minutes each is equal to room conditioning samples in trays for 24 to 48 hours. The effect of rapid conditioning on hysteresis is negligible for length and strength tests. For routine testing, ignoring hysteresis, the rapid conditioning apparatus allows cotton samples to be brought into the laboratory and tested with no time or space required for preconditioning.

Literature Cited

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2. Wood, Moel H., Moisture Content of Cotton and Fiber Properties, Cotton Economic Research, Research Rep. No. 33, University of Texas, 8, 17, 1955.

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