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FABRIC ANALYSIS.

Testing Yarns and Fabrics for Moisture.

Conditioning.

(Continued from January issue.)

The above percentages must be added to the chemically dry weight, obtained by drying at 212 deg. *F.*, for several hours.

For example: Suppose a quantity of cotton yarn weighs 1,000 grains, and after thoroughly drying is found to weigh only 880 grains, the amount of excess moisture is found by adding 8½ per cent of 880, and deducting the sum from 1,000, the percentage being then obtained in the usual way.

880 + 8½% = 954·8 grains.
1,000 — 954·8 = 45·2 grains excess.
1,000 : 45·2 : : 100 : 4·52%.

Accurate weighing is a great *desideratum* in all moisture tests, and to obtain this a chemical balance is almost essential. Next there is the condition of the yarn after being dried. If it is allowed to cool in the ordinary atmosphere it will quickly absorb a certain quantity of moisture, the amount depending upon the state of the atmosphere, and this would reduce the value of the test. To guard against this, the material should be placed in some receptacle from which the atmosphere is excluded, and all weighed together, and having deducted the weight of the bottle, proceed to ascertain the moisture in the manner indicated above.

CONDITIONING OVEN.

To carry out such a test as this, the material may be dried in a copper drying oven, having a cavity all round, containing the water to be kept at boiling point for from 2 to 5 hours, by means of a Bunsen burner.

In addition to this plan there are many others, some being a combination of a drying chamber and a balance; such a one is shown at Fig. 85. *A* is the outer casing of the apparatus; *B* shows the cavity in which the water is contained and kept heated by gas admitted through the pipe *D; E* is a thermometer, and near it is shown a pipe which acts as an outlet for evaporated moisture; *C* is the outlet for steam and the inlet for water. The cage shown in dotted lines contains the material to be tested, and is suitably suspended from one end of the balance *F*, the other end or pan containing the weights. The reduction in weight is carefully watched until there is no further loss, when the percentage is obtained in the manner stated. One of the faults of this and similar machines is that some portion of the condensed steam settles upon the wire, which must extend into the drying chamber, and to this extent the weighing is incorrect.

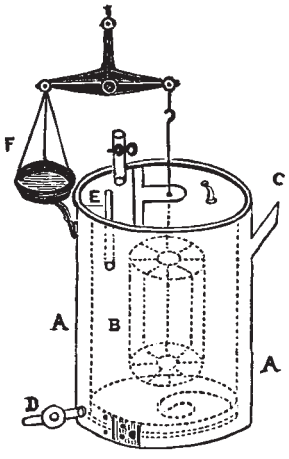

Fig. 85

For testing silk much more elaborate machines are employed; but for cotton, wool, and linen the one shown is sufficiently accurate for all practical purposes.

The apparatus used by testing houses, as well as large silk, etc., mills, who make conditioning an object of their routine work for obtaining absolute dryness, consists of an oven of cylindrical shape constructed with an inner and outer case, about 40 inches high and 30 inches in diameter (outside measurement). A space of 1½ inches is allowed between the two cases to permit the heated air to circulate freely around the inner hot-air chamber. A pair of scales, sensitive to 0.1 gram, is firmly fixed to the oven in such a position that a reel or cage suspended from one arm is directly in the centre of the oven. Both reel and cage are of equal weight, the former being employed for tops or yarns and the latter for loose materials or in the form of cops, and each one corresponds in weight with the pan and chains at the other end of the beam. The heat is obtained from a Bunsen gas burner, the lighted jets being arranged in a circle underneath the inner oven. A thermometer ranging from 40 to 120 deg. *C.* or higher, is placed so that the bulb reaches half way down the oven, to register the temperature within.

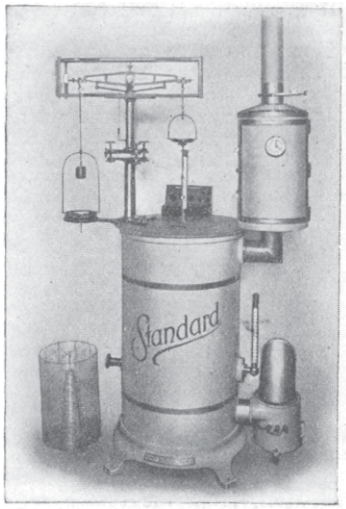

Fig. 86

Conditioning Ovens are also built to be heated by electricity instead of by gas. In this instance two (sometimes three) electric heaters are employed. Each heater is controlled from a separate switch, so as to facilitate the regulation of the temperature. This system is less liable to fire, and as there are no fumes discharged it is less injurious to the person in charge.

Fig. 86 shows the Baer "Standard Conditioning Oven" heated by electricity, equipped with a Fore-heater attachment by which the waste of hot air is made to partly dry out another sample while one test is made, *i. e.*, to build an apparatus in which the material to be dried out could be thoroughly dried in as short a time as possible, at the right temperature and without chances of overheating or scorching the material.

In the old type oven it was relied upon that the warm air being lighter than the cold, would travel of its own accord up through the material and in this way it took a long time before the warm air really penetrated through the material.

In the new Conditioning Oven, the heating-coils are therefore built somewhat stronger and very compact, providing at the same time a fan, driven by an electric motor, which, drawing the air from the outside through a fine wire screen, forces it through the heating unit and from there through the material to be dried. In its passing through the heating

coil the air is heated up to 235 to 284 degrees *F.*, according to the material to be dried; for silk 284 degrees *F.*, is the average temperature used.

In order to insure an even drying of the material, the baskets are provided with a conical mesh wire funnel into which the air passes on its reaching the drying chamber. Not being able to scatter all around the baskets, it is forced to go through the material to be dried.

From the drying chamber the air enters into the pre-drying chamber, in which the waste air is used to partially dry a second sample; in this way making the Oven more economical and effective.

It has been found that the first sample which is placed into the drying chamber (cold) takes about 45 minutes to completely dry out, while a second sample which was subjected to the waste warm air while the first sample was being dried out, requires only 25 minutes additional time to completely dry out when placed in the drying chamber.

By means of a Thermostat and Reostat the temperature of the air, as it leaves the heating unit, is automatically controlled, and registered by an angle thermometer. A second thermometer indicates the heat in the drying chamber, which is always 10 to 15 degrees lower than the temperature indicated by the angle thermometer, on account of the expansion of the warm air in the drying chamber.

This "Standard Conditioning Oven" is handled in the U. S. by Alfred Suter, Textile Engineer, 200 Fifth Ave. New York.

In the silk trade there are recognized Conditioning Houses to which all purchases are sent to be tested, and upon the results of these tests the material is bought. This, of course is a very necessary precaution with such a valuable fibre as silk, but in cotton and some other fibres it is considered sufficient to test samples from any doubtful delivery of raw material or yarn, and it is this class of testing which will be dealt with here.

Conditioning Process.

The material to be conditioned is first weighed in the bulk; then, in order to secure a fair average sample, three equal portions are taken — one from the top, one from the centre, and the third from the bottom of the bale; or one portion may be taken from the centre and two from the sides.

The sample is immediately weighed, great care being taken that it is evenly balanced, and is then suspended from the apparatus by means of the cage or reel, a weight corresponding with the weight of the material being placed in the pan at the other end of the beam. The oven is heated up to 230 deg. *F.* for wool, 220 deg. *F.* for cotton, and up to 248 deg. *F.* for silk, any higher degree being liable to scorch and discolor the sample, while anything lower than 212 deg. *F.* will not abstract all the moisture.

As the moisture is driven off, the change in the weight of the sample is compensated for by the addition of small weights, which are placed in a cup above the rod of the reel or cage, the original weight of the sample being left at the opposite end of the scale. The sample is subjected to heat until it ceases to lose weight, a further period of five or six minutes being allowed, during which the needle of the scale remains stationary, the material being then considered absolutely dry.

The percentage of moisture present is obtained by comparing the weight in the cup with the original weight in the pan, and for clean material the true invoice weight = (gross weight — percentage of moisture) + standard regain per cent.

Testing Scoured Wool.

For example, assume that a bale of scoured, *i. e.*, clean loose wool weighs 200 lbs.

The original weight of the sample = 16 oz., or 100%
The weight in the cup = 3 oz., or 18¾% direct loss.

There is left ..... 13 oz., or 81¼% dry wool.

The temperature used with wool is 230 deg. *F.*

The dry weight of the 200 lb. bale is:

16 oz. : 13 oz. :: 200 lbs. : 162½ lbs. of dry wool;
or, 100% : 81¼% :: 200 lbs. : 162½ lbs. of dry wool.

To this must be added the percentage of regain, which for loose scoured wool is 16 per cent, giving an invoice weight of:

100 : 116 :: 162½ : 188⅔ lbs.

To find the excess of moisture expressed in % present:

100 : 116 :: 81¼% of dry wool : 94¼%.
100 — 94¼ = 5¾% excess, *Ans.*

Testing Raw Cotton.

To make a test, samples are collected from different parts of the bulk, and placed as loosely as possible within the oven and then weighed. Next the heat is turned on; and 10 to 15 minutes after a temperature of 220 deg. *F.* has been attained, weights are placed in the small pan attached to the cage wire, to restore equilibrium. The material is then shaken and turned top to bottom, and again submitted to the heat, and weighed at intervals of 5 to 8 minutes until a constant weight, indicating absolute dryness, is obtained. The weights in the cage pan represent loss or moisture, and the same subtracted from the original weight (which has remained undisturbed throughout the operation) gives the dry weight. The addition of the percentage regain to the latter then gives the correct weight, or weight in the correct condition.

Example: Suppose 2 lbs. of cotton are taken from a 500 lb. bale of cotton, and they are to lose 4 oz. in drying.

The dry weight of these 2 lbs. of cotton is thus 1 lb. 12 oz., or 28 oz.

Adding 8½ per cent of permissible moisture to the latter (*i. e.*, 2.38 oz.) we obtain (28 + 2.38 =) 30.38 oz. as the correct weight.

From this we obtain the invoice weight of the bale of cotton thus:

$$\frac{30.38 \times 500}{32} = 474.68 \text{ lbs.}$$

Excess moisture in the bale of cotton under consideration thus is:

500 — 474.68 = 25.32 lbs.

Another Example: From a lot of cotton yarn weighing 260 lbs. net, 1½ lbs. of cops are taken for testing.

When absolutely dry, they weigh 1 lb. 5¼ oz.

Question: Can any claim be made for excess moisture, and if so to what amount, assuming the yarn to cost 22 cents per lb.

Dry weight (1 lb. 5¼ oz. =)	21.25000 oz.
Add 8½ per cent	1.80625 oz.
Correct weight	23.05625 oz.
Original weight (1½ lbs. =)	24.00000 oz.
Correct weight	23.05625 oz.
Excess moisture	0.94375 oz.

$$\text{Total excess moisture} = \frac{0.94375 \times 260}{1\frac{1}{2} \times 16} = 10.22 \text{ lbs.}$$

Answer: Claim to be made is 10.22 lbs. @ 22c = $2.25.

Testing Yarns for Moisture.

For testing yarn in the hank a number of hanks are selected and placed upon the reel. Provided the yarn to be tested is upon spools, tubes or bobbins it must be wound into hanks, whereas if warp yarn is ball shape, a convenient number of ends are split off.

When dealing with the testing of loose material, for convenience of simplifying calculations, as a rule a fixed quantity is used, whereas this is not the case when dealing with yarns and when the sample is weighed intact, and the calculation worked out as previously explained, the difference being that we may have to use additional fractions in the calculation.

Testing Fabrics for Moisture.

The percentage of moisture present in fabrics can be largely increased above the normal amount by storing the goods in damp cellars, or by loading the material with certain hygroscopic substances which have a natural affinity for moisture. In former days, and when conditioning was unknown, loading of woolen goods by moisture was then the means of producing by Government contracts some of the old time millionaire textile manufacturers in this country, and when storing goods rejected on account of "below weight" were stored for some time in damp cellars, to be in turn found "up to weight" later on by the government. The basements of mills on the Schuylkill of the "Falls" furnishing excellent specimens for this work.

To determine the percentage of moisture at present, a given quantity of fabric is weighed and dried in a conditioning oven as previously explained.

Whether dealing with fabric, yarn or raw materials, provided only small samples are tested, a most delicate balance must be used, one weighing up to the ten-thousandths part of a grain or even finer; the *"Troemner Balance"* being the Standard Balance used by the Government.