Determination of sinking time of partially scoured cotton fibres

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Efforts have been made to modify the existing standard method IS: 2369 - 1967 which is meant for the determination of sinking time of well-scoured cotton fibres. A fibre container has been prepared to achieve standard dimensions in the fibre mass in cake form at the time of sample preparation and testing. Minute holes are made at the bottom and the lid of the container and the fibre cake is kept inside it to come in contact with water taken in a specially fabricated glass trough. Holes with diameters 0.25, 0.5 and 1.0 mm have been studied to assess their effect on sinking time. It is observed that the fibre container provided with holes having 0.5 mm diameter performs very effectively for the determination of sinking time of partially scoured cotton fibres. This method is also found to be suitable for well scoured cotton fibres. As this method is suitable for the determination of sinking time of cotton fibres scoured to any extent, it may be considered by the standards organizations for introducing it as a standard testing method following the necessary protocols.

Keywords: Cotton fibre, Fibre container, Partially scoured fibre, Scouring, Sinking time, Well scoured fibre

Determination of sinking time, a measure of absorbency, is one of the methods used to find out the efficiency of scouring of cotton materials. Various methods have been prescribed by the standards organizations, namely AATCC, ASTM and IS, for the determination of this parameter for cotton materials. However, with respect to the determination of absorbency of cotton fibres in terms of sinking time, only one method IS: 2369-1967 (ref. 4) is available. In this method, time required to sink the test specimen, which is nothing but a compact mass of fibre in cake form having standard dimensions, completely at the surface of water is represented as sinking time. As this method depends on fibre in cake form which does not undergo change in dimensions during testing, it is suitable only for cotton fibres which can develop very good cohesion at the time of application of load during the sample preparation. In other words, to develop enough cohesion, the fibre has to be necessarily well scoured. It is clear from the above that the method IS: 2369-1967 is not suitable for partially scoured cotton fibres. Hence, an attempt has been made to modify the existing method so as to make it suitable for the determination of sinking time for partially scoured cotton fibres. The modified method can also be used for well scoured fibres.

A 0.5 mm stainless steel sheet (grade 304), conc. HCl, tap water, emery paper (1f: grit 500), polishing soap (P 215) and borosilicate glass (ρ = 2.23 g/cc) were used for the fabrication purpose.

LRA cotton fibre, sodium hydroxide, sodium carbonate, non-ionic detergent, tap water and distilled water were used in scouring. All the chemicals used in the study belong to laboratory reagent grade and were supplied by Qualigens Chemicals Ltd, India.

The fibre cake of required dimensions and the maintenance of the fibre dimensions would be possible when the fibre is kept inside a closed container. Since the fibre has to be placed inside the container, the cohesive property of the fibre becomes immaterial. Hence, such approach can be used both for partially and well scoured cotton fibres. Determination of sinking time requires contact of fibre cake with water. In IS: 2369-1967, it is achieved by placing the fibre cake on a water surface. In the present case, it was achieved by providing holes at the bottom of the container. In order to aid entry of water through these holes, the lid of the fibre container was also provided with holes to make way for entrapped air. To ensure upright standing of the container during its downward movement through water, a water trough with diameter slightly higher (by 2 mm) than the diameter of the lid of the container was used. Such a trough would help in preventing tilting movement and toppling of the container. By keeping the fibre cake, prepared by following the procedure given in IS: 2369-1967, inside the container and placing it on the water taken in the water trough, sinking time of both partially and well scoured cotton fibres can be determined.
fibres was determined. The methodology described above was verified by testing the partially and well scoured fibres.

Fabrication of Fibre Container

The inner dimensions of the stainless steel container were fixed as 30 mm diameter and 25 mm height. It is same as the fibre cake dimensions prescribed in IS: 2369-1967. These are made by using stainless steel sheet metal pressing machine mounted with a suitable die prepared for the purpose using a pressure of 30 tons. A sheet thickness of 0.5 mm was chosen as it was not possible to work in the pressing machine with smaller thickness than this. At this stage the weight of the container was found to be 17.5 g. Then the bottom and the lid were taken for making holes in them. For this purpose, laser drilling technique was chosen as it can produce fine holes with uniformity. Pulsed Nd:YAG Lasers supplied by GSI Group Inc., UK was used for the purpose. Holes with diameters 0.25, 0.5 and 1.0 mm were selected and same number of holes was provided both in the bottom and the lid. It was found that these diameters do not permit the fibres to come out through them when the fibre mass is kept inside the container. Figure 1 shows the details of the bottom and the lid of the fibre container with holes having 0.5 mm diameter. Number of holes made in the bottom and the lid are as follows: 0.25 mm - 856, 0.5 mm - 406, 1.0 mm - 271. After making the holes, the assemblies (containers) were tested for entry of water through the holes after filling them with well scoured cotton fibres. It was observed that water could not enter in the container provided with 0.25 mm diameter holes. Hence, it was discarded. The initial weight of the containers was found to be 17.5 g. As it was on the higher side, efforts were taken to reduce the weight of the container to the maximum extent possible without losing the stability of the container. For weight reduction, the containers were treated with sufficient quantity of conc. HCl at 100ºC for sufficient duration. Then the container was thoroughly washed with running tap water and dried. It was followed by mild abrading with emery sheet and polishing with metal soap.

Fabrication of Water Trough

A water trough with 34 mm diameter and 200 mm height with a proper base (100 mm diameter with 15 mm thickness) was fabricated using borosilicate glass. The volume and weight of the fabricated trough are 181.5 cc and 475 g respectively. A wooden stand with a cavity of 105 mm on the base and a mirror (to avoid parallax error) fixed on its vertical provision was fabricated to place the trough to carry out the tests. Figure 2 shows the details of the above units.

Scouring

The samples were alkali scoured using sodium hydroxide (0.5% w/v), sodium carbonate (0.5% w/v) and non-ionic detergent (0.25% w/v), maintaining liquor-to-material ratio 50:1 at 95ºC for 15, 30, 45,….,180 min (no. of durations - 12). The treated samples were then given a thorough cold wash for 10 min. Finally, they were dried and conditioned in an environmental chamber (Inlab Equipment Private Limited, India) at 65±1% RH and 27ºC ±1ºC.

Testing of Compactness of Fibre Cakes

Fibre cakes were prepared with all the 12 scoured samples following the procedure described in IS: 2369-1967. The cakes were then observed for their susceptibility to undergo dimensional change.

Determination of Sinking Time

Sinking time of fibre cakes formed from scoured samples which have maintained their dimensions were determined following the procedure described in IS: 2369 – 1967.

For all the other fibre cakes of scoured samples, sinking time was determined following the same procedure indicated above with the incorporation of following changes:

Fig. 1—Fibre container having holes with 0.5 mm diameter both in the bottom and lid
After the cake formation it was gently transferred inside the bottom of the container and closed with the lid.

Instead of a rectangular trough, a fabricated cylindrical water trough was used.

Before placing the fibre cake inside the container, care was taken to ensure that the container is free from water.

For each sample, 10 specimens were tested.

After carrying out all the steps involved in the preparation of the fibre container, the weight of the container was found to be 7.8 g. A weight loss of 55.4% on the initial weight of the container has taken place.

Testing of compactness of the fibre cakes, formed with scoured samples reveals that except for the sample scoured for 3 h (180 min), all the other samples undergo change in dimensions. It shows that to achieve compactness in fibre cake, a reasonable amount of scouring has to be carried out. Samples which form compact cake can be considered as well scoured samples and those not forming the compact cake can be considered as partially scoured ones.

Table 1 gives the average sinking time along with its standard deviation and coefficient of variation of partially and well scoured cotton fibres tested with fibre containers having holes with 0.5 mm and 1.0 mm diameter. Very small values of the statistical
parameters indicate that the fabricated fibre containers produce reliable results. It can also be observed that the sinking time of the fibres decreases with increasing scouring time and it is higher when the diameter of the hole is smaller. This kind of sinking behaviour of the fibre container occurs due to the resistance offered by the holes towards the entry of water into it.

Figure 3 shows the plots drawn between sinking time and scouring time for both the containers. It also gives the sinking time for the fibre scoured for 180 min using the compact cake form of the fibre, i.e. sample prepared by following IS: 2369–1967. Equations obtained for the plots show that the slope for sample container with 0.5 mm holes is higher than that with 1.0 mm hole and the sinking time obtained with this container finally approaching the sinking time obtained by following IS: 2369-1967 standard (for fibre cake alone). This finding indicates that by using the sample container with holes having 0.5 mm diameter, not only the sinking time of partially scoured cotton fibres can be determined but also that for well scoured sample, which is found to be comparable to the standard test procedure (IS: 2369–1967) can be determined.

The modification proposed on the existing method IS: 2369-1967 for the determination of sinking time of partially scoured cotton fibres is found to give reliable results. Further, this method can be effectively used for well scoured fibres also. It is suggested that the proposed method may be considered by the standards organizations towards its implementation after following the necessary protocols.

References