Application Report

How absorbent are diapers?

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Drop Shape Analysis System DSA10

How absorbent are diapers?

Diapers, blotting paper, paper towels and toilet papers – these are products which demand a high suction speed and absorbing power. Absorbency examination can be carried out not only tensiometrically with the K12 using the Washburn method, but can now also be realized optically with the Drop Shape Analysis System DSA10. The new High-Speed-Camera now allows quantitative examinations of high-speed absorption processes. The measurement of hydrophobic papers and textiles is also no problem for the DSA10.

The Washburn-method works excellently with absorbent tissues and papers as well as with packed powders or other porous solids. But in two cases this method does not fit: for less absorbent hydrophobic papers and textiles with CA above 90° and for high-speed absorption processes.

In both cases, optical contact angle measurements can provide proper results. It is still not enough to record the absorption process with the usual 25 or 50 pictures a second: a high-speed camera must be used.

By contrast, with the Drop Shape Analyzer DSA10 and the High-Speed-camera option, the measuring can be carried out surprisingly easily. A drop of water is placed on the sample with the help of the Dosing System G140. The DSA1-Software starts the video sequence exactly when the drop contacts the surface. In this case, a film with 240 frames a second is recorded. It can be manually or automatically analyzed picture by picture.

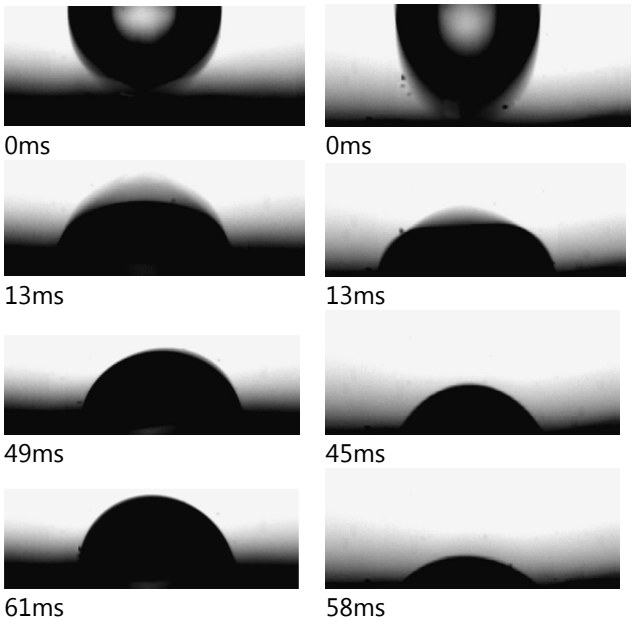

Fig. 1: Selected video images for sample A (left, barely absorbent) and sample B (right, highly absorbent).

Figure 1 shows the result of the experiment in a selection of images of both samples. In both cases one can observe how the drop oscillates in the first 15 milliseconds because of the kinetic energy. At the hydrophobic sample A, the drop stays on the surface afterwards and develops a contact angle of about 85°.

With the high-speed option for the well-established Drop Shape Analyzer DSA10, KRÜSS developed the possibility to select from 60 to 360 frames a second in order to reliably analyze the fastest wetting processes.

In an experiment, examinations of differently absorbent materials are to be carried out. We used two different samples of paper nonwovens for our measurement. The surfaces of both samples had been treated with different surfactants – sample A: hydrophobic; sample B: hydrophilic. The Washburn-absorption-method fails for both samples. For one sample, this is due to lack of absorbency and for the other this is due to the excessive speed of the sorption process.

At the hydrophilic sample B, in contrast, the drop soaks into the material within a few milliseconds. The better absorption characteristics of sample B can be clearly recognized. The drop already has disappeared after 82 milliseconds.

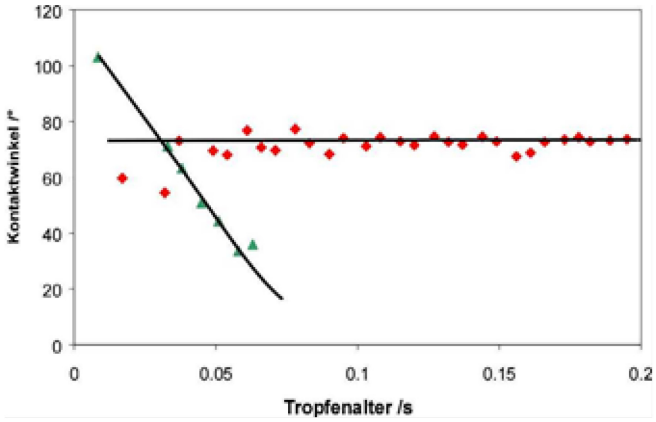

Fig. 2: Contact angle in dependence of drop age. Red squares: sample barely absorbent; green triangles: sample highly absorbent.

Figure 2 graphically displays the contact angles in dependence on the wetting age. Sample A shows a transition to a fixed value, while the contact angle of the drop in sample B quickly decreases and eventually reaches 0°.

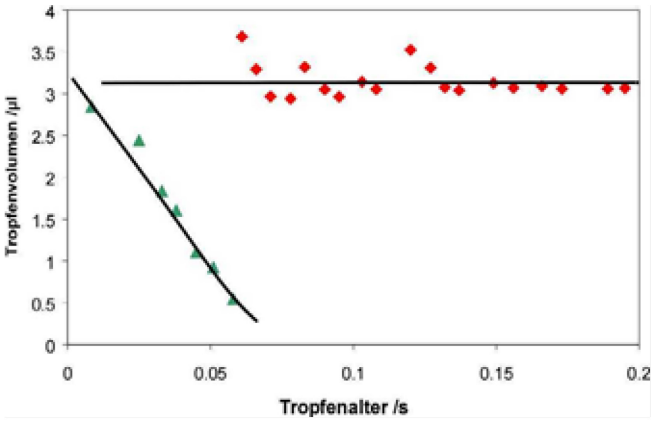

Fig. 3: Drop volume in dependence of drop age. Red squares: sample barely absorbent; green triangles: sample highly absorbent.

The capability of determining the drop's geometrical dimensions and volume by using the KRÜSS DSA1-Software is also interesting. In figure 3 it is clearly visible how fast the volume of the drop in sample B decreases until it is completely absorbed.

Literature

[1] H. Lechner: „Contact Angle Measurement of Spice Oil on Powder Carrier Systems"; Application Note #208, KRÜSS GmbH

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