Applied Digital Optical Microscopic Technology

Application Note: Moisture absorption on Surfaces of bicomponent Spunbond fibers.

In the production of nonwoven textiles made of polypropylene or polyethylene filaments production processes are getting more and more refined. Quality control and characterization of these fibers becomes more and more an analytical challenge.

For example, in a three (bi-component) composition fabric (SMS) a non-woven fabric is manufactured by the combination of spunbound (S) from polypropylene and polyethylene and meltblown (M) from polypropylene. The basic qualities of this type of non-woven fabric include excellent barrier qualities that are used to prevent liquid leakage in combination with the qualities of bi-component non-woven fabric. These products are used mainly as hygienic products such as baby nappies, ladies hygiene products, incontinency nappies and towels. Spunbond (S) part of SMS is manufactured by means of bi-component spunbond technology from polypropylene (core) and polyethylene (sheath). Polyethylene sheath of the individual filaments (continuous filaments) gives the resulting non-woven fabric specific qualities that include the following: softness and very pleasant feel, excellent comfort qualities for contact with the most sensitive parts of human skin, higher elasticity and hence increased comfort for hygienic applications and more over an improved ability to bind other material with the polyethylene sheet in composite fabric products.

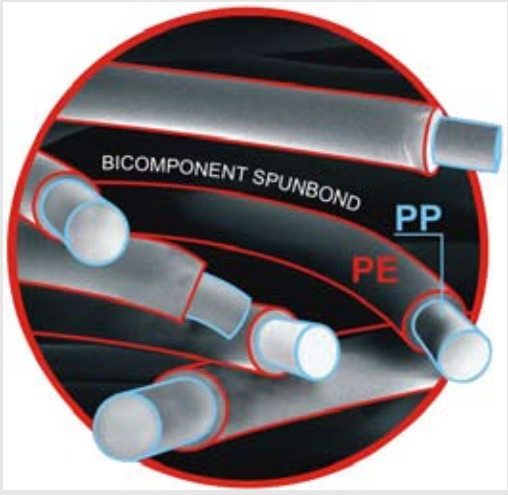

Figure 1

Figure 1. Bicomponent Spunbond fibers.

Production technology for non-woven fabric in all applications where there is a direct contact with sensitive human skin with non-woven fabric. The main applications include baby nappies, ladies hygiene and incontinency nappies and towels.

Figure 2. Microscopic image of a three bi-component composition fabric.
(S= spunbond / M = meltblown / S = spunbond)

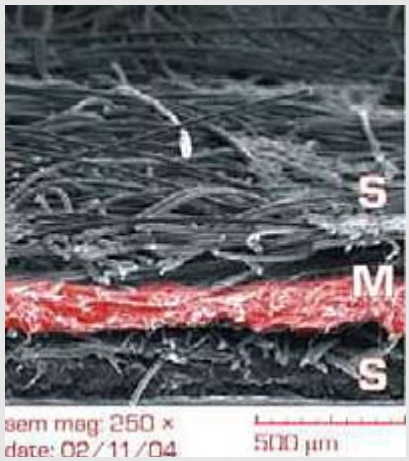

Figure 2

The bicomponent Spun bond fibers have the ability to absorb a considerable amount of moisture. However, some essential features of the bicomponent spun fibers, such as elasticity and modulus can alter when liquid is absorbed on the surface of the fibers. This can lead to undesired properties. In order to improve the physical properties, a characterization technology was needed which gives a better insight in the interaction of liquid with the sheath of the fibers. Obviously microscopy was the technique of choice. Microptik developed a unique 3D digital Optical Microscopic technique to characterize the dispersion of liquid absorbed on the sheath to offer a powerful tool for rapidly scanning many samples. The images and related data analysis where fully automated to enhance throughput and hence enhance efficiency in both quality control and product research. The special optics used allowed dynamic inspection of the non woven material to such an extent that real time images of the fabric can be abstracted with many details not possible with conventional microscopic techniques. In figure 3 a microscopic image is given of a bicomponent PP/PE fiber which clearly shows the dispersion of liquid on the surface of the fiber.

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Microscopic characterizing the dispersion of moisture on fibers has always been a challenge with conventional 2D microscopy where only a part of the fiber can be held in focus. With the Microptik 3D Fiber analyzer, many high quality images can be recorded of one or more fibers and relevant information can be abstracted, useful for quality control or material research. The superb quality of the images allows better insight in the absorption phenomena of the sheathed fibers. During analysis, real time morphometric data is displayed on the computer screen. For example distribution plots of the absorbed droplets (see figure 4). In situ absorption studies can be carried out by using a special environmental chamber in combination with Mikroptik K3000 Digital microscopic analyzer with appropriate lenses. With this experimental set up many moisture absorption studies have been carried out with the purpose to understand the nature of surface interactions of the bicomponent spunbond fibers under real conditions. With calibrated lenses exact dimensions of the liquid particles can be measured as well as the geometries of the fibers. Cross sectional multilayer microscopic studies in addition can reveal Permeability of liquid through the different layers. Microptik has developed various state of the art characterization techniques to study permeability of such multilayer.

Figure 3 Microscopic image of the surface of a bicomponent PP/PE fiber with liquid dispersed on the surface, recorded with Microptik K3000 Digital microscopic analyzer with 10C OL 700 lens. Magn = 700x.

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The Microptik K3000 Digital microscopic analyzer with 10C OL 700 lens can be used to study the unique texture features of the surface of the bicomponent spunbond fiber. Figure 5 reveals an image acquired with a 4200x magnification. The shapes in the picture reveal parts on the surface of the fiber where the polyethylene sheath has become very thin. These sections on the Sheath give the fiber unique absorption properties and for that matter it is important to characterize these shapes in an appropriate manner. Microptik has developed optical accessories with special image analysis software for this application.

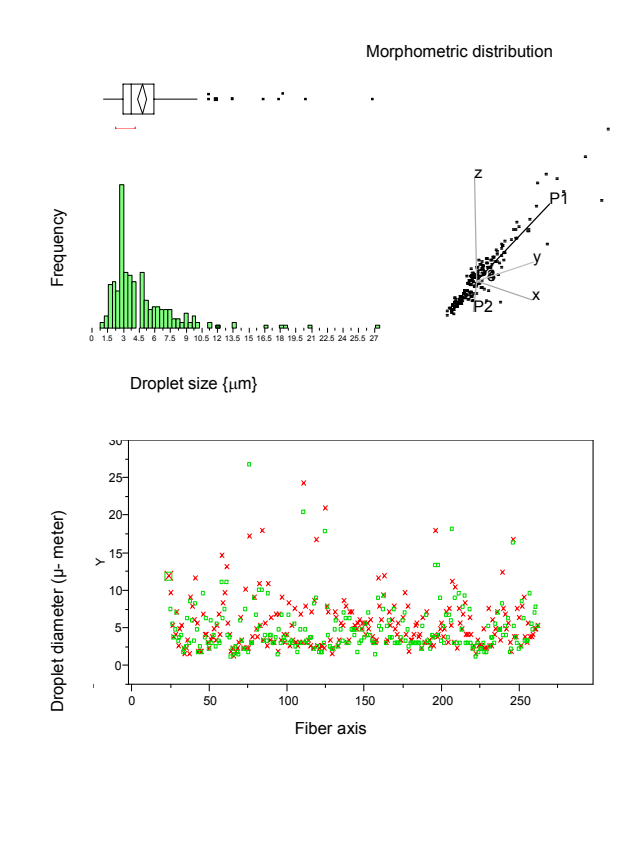

Figure 4. Image analysis characterization features incorporated in the Bicomponent Spunbond fibers Microptik software. Distribution plots as well as time resolved analysis

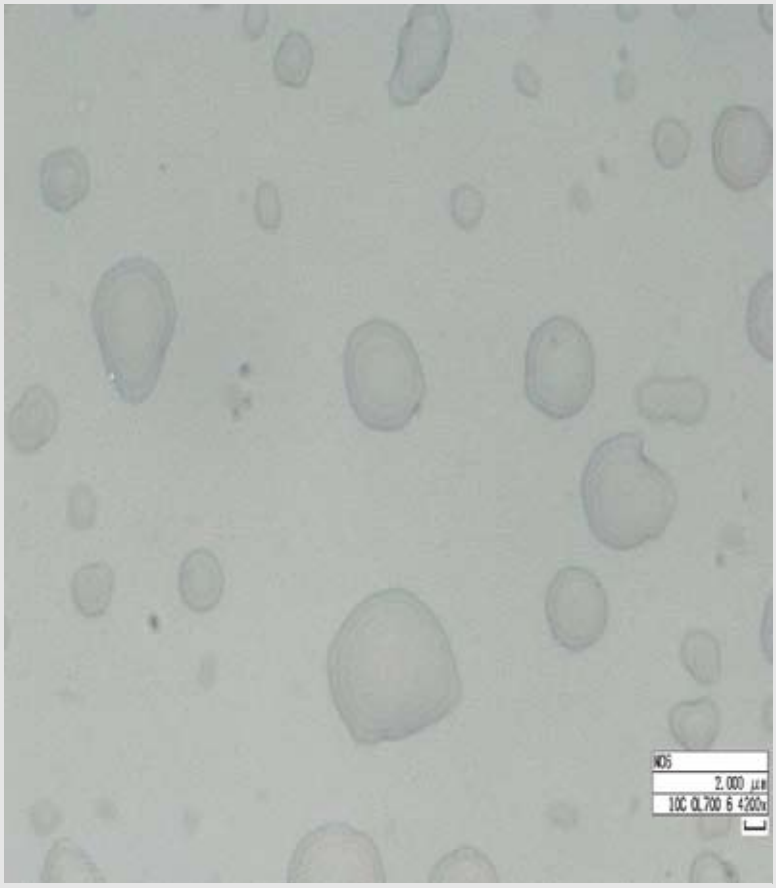

Figure 5. 4200 x magnification of Bicomponent Spunbond fibers acquired with the Microptik K3000 Digital microscopic analyzer with 10C OL 700 lens. The picture reveals the surface texture of the Spunbond fiber.

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