Application example: Foam-laid Forming

Motivation

In foam-laid forming the properties of the foam are crucial for optimal process performance and yield. Compared to traditional forming in paper and board production, foam-laid forming can save significant amounts of raw materials, water and energy. The key parameters of the process are foam density and bubble size distribution. To improve web properties, such as formation, the bubble size of the foam should be in a certain range compared to fiber size. Other important factors in the forming process are foam homogeneity and stability. The results shown in this application note have been presented in PaperCon 2017*.

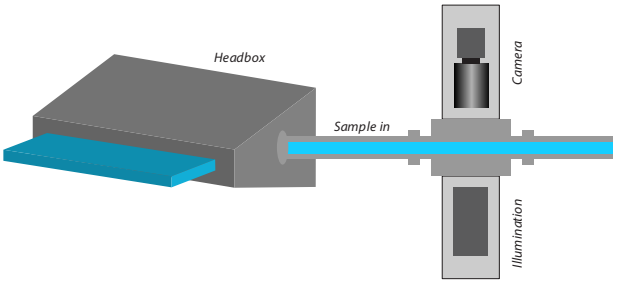

Figure 1. PFM installation in the process

Measurements

A Pixact Foam Monitoring (PFM) system was installed on a sample line connected to a headbox to measure foam properties in a foam-laid forming process (Fig. 1). The imaging of the foam was carried out in a Pixcell flow-through cuvette. The size range of the bubbles was 0.02–1 mm and the air content of the foam was above 30%. The system was used to continuously measure bubble size distribution, bubble density and foam light transmission. Besides a live view of the foam, the operator could follow trends plotted for mean values, standard deviations and percentiles of cumulative distribution (D10, D50 and D90).

Results

Figure 2 shows how the visual characteristics of the foam and the size distribution of the bubbles change after the surfactant feed has been started. The mean bubble size decreases and the distribution becomes narrower. When the illumination power is kept constant, a decrease in bubble size and an increase in bubble density result in darker images. Small bubbles scatter the light whereas big bubbles let the light pass through. The illumination power can be controlled automatically, and a value can be calculated to describe foam light transmittance. By measuring mean bubble size, density and light transmittance it is easy to control the key parameters of the process to achieve and maintain optimal foam properties.

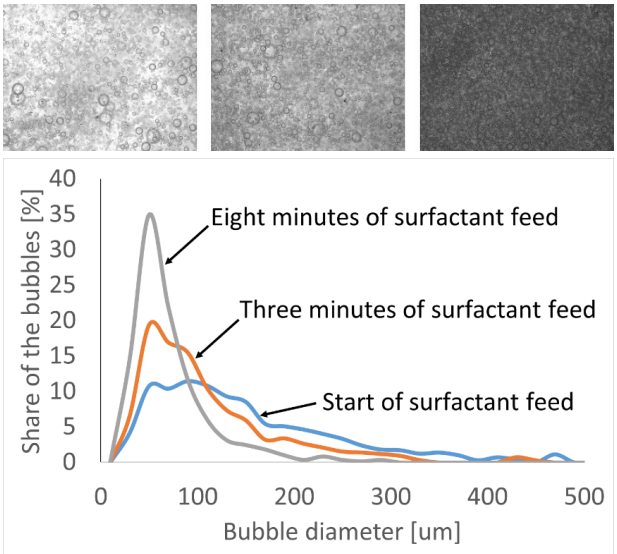

Figure 2. Above from left to right: bubbles at the start of, 3 min into and 8 min into the surfactant feed. Below: corresponding Sauter size distributions.

The foam forming process was quantified by measuring e.g. the optical formation and tensile strength of the produced paper sheets. The Sauter mean size of the foam and optical formation were measured at several basis weight levels (60 to 130 g/m^2) and consistencies (0.6–2.7%). The results are presented in Figure 3. There is a clear correlation between bubble size and the optical formation of the sheet.

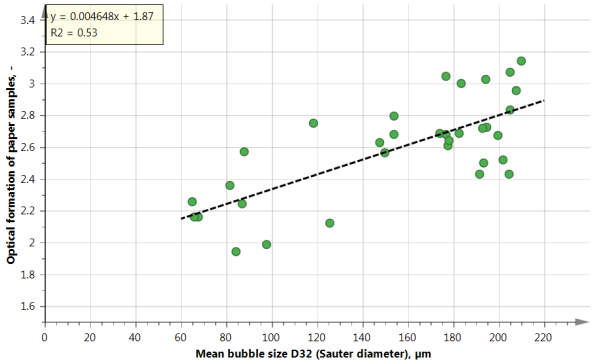

Figure 3. Sauter mean bubble size vs. optical formation of paper

Benefits

With PFM, the customer can optimize the properties of the foam to reduce variation and improve end product quality. Mean bubble size and bubble density can be used as control signals for surfactant dosage and other process parameters, such as mixing speed and air flow. A stable and small enough bubble size was achieved with the help of PFM.

*Eloranta et al. Real-time monitoring of bubble size distribution in a foam forming process. PaperCon 2017.

Technical implementation

The installation consists of field and control room components as shown in Figure 4. Figure 5 displays the Pixcell flow-through cuvette that was installed on the sample line. In this case the sample flow line was 10 mm in diamater, but other dimensions are also available. A summary of the specifications of the measurement system is presented in the table below.

Setup	Pixcell DN10 flow-through cuvette
Material	Stainless steel AISI316L
Light	Pixstrobe illumination unit
Protection	IP67
Bubble measurement range	20 µm … 1 mm

More information on the Pixact Foam Monitoring system and configuration options can be found in the Pixact Bubble Monitoring brochure.

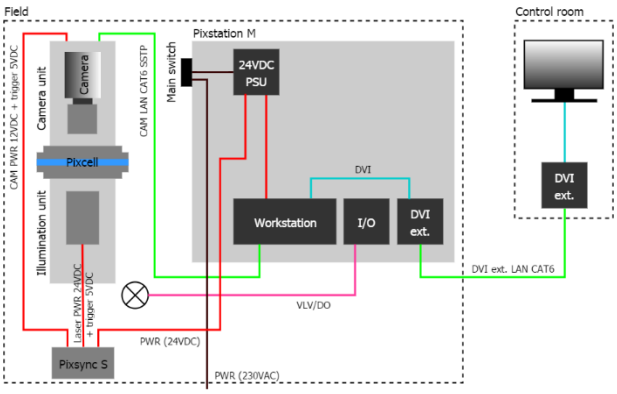

Figure 4. Connection diagram

Figure 5. Pixcell flow-through cuvette with the illumination and camera units

Acknowledgement

Pixact would like to thank VTT for collecting and analyzing the measurement data used in this application note.

*Eloranta et al. Real-time monitoring of bubble size distribution in a foam forming process. PaperCon 2017.