

Less fiber breaks with the Micro Scout

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Filament breaks during the spinning process cause waste and loss in production capacity and as a consequence, money. An important cause for breaks is the quality of the raw material, the polymer chips, being used for the spinning process. It is believed that the presence of solid particles, especially those of sizes in the order of one third of the filament diameter, cause filament breaks during high speed spinning and stretching.

To detect and measure these micro-particles, a method based on image analysis has been developed by the R&D department of Acordis Industrial Fibres BV. The method involves dissolving the polymer in a solvent and directing the solution through a flow cell where microscopic images are being taken by a camera in order to have a clear view inside the polymer chips. The actual measurement is based on image analysis, using state-of-the-art computer vision technology. In this development Acordis Industrial Fibres worked closely together with the Dutch computer vision specialist Eagle Vision Systems BV.

The presence of solid particles can be attributed to physical and chemical processes inside the polymer, like catalyst precipitation, degradation of the polymer (for example by overheating), gel formation caused by heavy branching, precipitation of additives, agglomeration of solid additives, but also from the environment like dust and sand.

In order to learn more of the type of particles, the measurement determines the size as well as the number of particles but also the shape and shape distribution, all of which is done using specially designed image analysis software, working at a real time speed of 25 images/s. The polymer solution flows through a cuvet; images are taken with camera and mi-

croscope; particles are measured and classified with special vision software (Fig. 1). The fluid is inspected by a microscope, camera and flash unit with 25 images per second. A solvent is used with a low reflection index, so that the contrast between the dissolved polymers and the pollution is maximal. The images are analyzed immediately. Particles are classified from 1.5 μm up to particles of 22.5 μm . Apart from classifying the particles according to their sizes, it is even more important to classify them for their visual characteristics into 5 classes (Fig. 2): clusters, thread, gel, bubble, user-defined. This particle characterization is done with state-of-the-art developed image vision analysis routines. The images of the particles are automatically captured. Statistical analysis is performed on the number of particles per time period as well as their pollution size and class. The result is a clear correlation between particles $\leq 5 \mu\text{m}$ and filament breaks. Based on the conclusion in this specific case, a different filtering technique was used in production, because of which the number of breaks was significantly reduced.

Fig. 3 shows the correlation between the pollution of 5 μm and the number of breaks. Apart from the above, currently the Micro Scout system is used in diverse situations:

- Analysis of various kinds of raw materials such as glycol, DMT and AH salt. This is especially used to compare the raw materials of various kinds of suppliers.
- Dispersions of carbon black or TiO_2 are measured in both raw material dispersions and polymers.
- All kinds of polymers like PET (flakes and chips), PA 46, PA 66 and PA 6 are analyzed. In case of PET, high viscosity crystalline chips ($IV > 0.8$) are also measured.
- Spun yarns with various spin finishes can be measured, in order to check the pollution after the filtration process.

The Micro Scout system not only predicts filament breaks; it is also used as a tool to facilitate product development and to analyze the behavior of new products in a production environment. More polymers are being re-used, while polymer quality and control of quality is increasingly becoming a key asset of the leaders in the industry.

Other industries might benefit from the experience gained at Acordis. One of this might be the PET bottle industry, where more PET will be recycled. Currently targets off up to 10 % of recycled raw materials have been discussed; controlling the quality of raw materials is thus important for this industry. The use of the Micro Scout in other industries, such as the cable industry as well as the oil and gas industry is also possible.

Acordis has had success with the Micro Scout for over 5 years, which resulted in the business unit Emmtec Services in Emmen/Netherlands rapidly following the trend using the Micro Scout.

Emmtec developed a plan where the Micro Scout was commercialized as a total system to be delivered to the industry. The system not only has its unique features, but its success is in its use and the drawing of the right conclusions, are all based on its statistical analysis of particle content.

Micro Scout = registered trademark

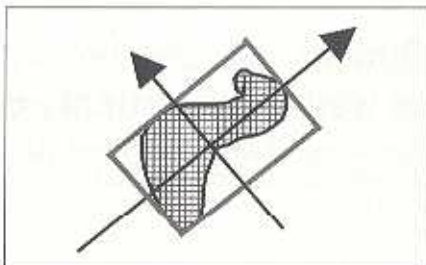


Fig. 2

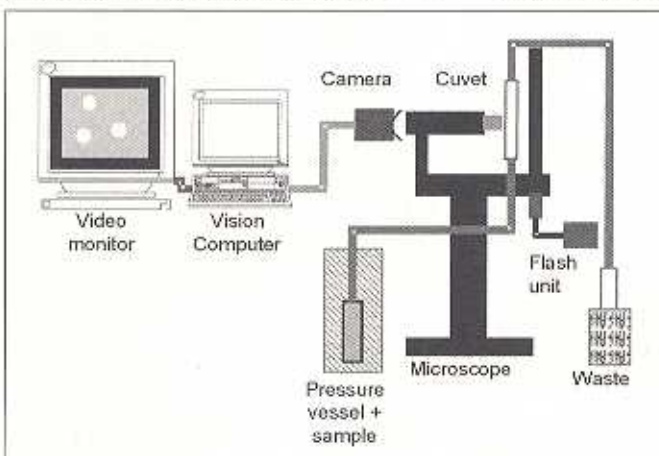


Fig. 1

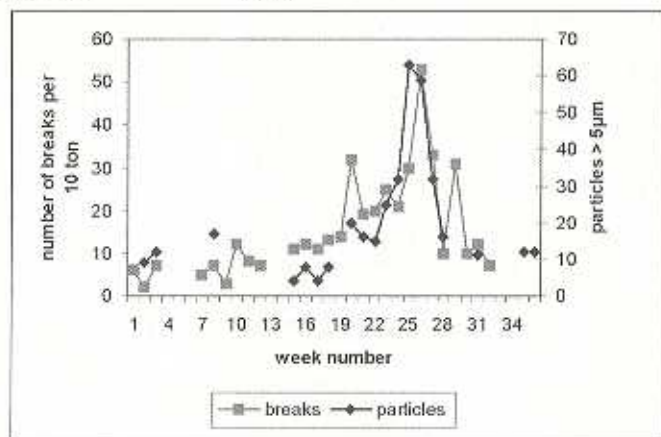


Fig. 3 Correlation between dirt and breaks for a PET product (production 1996)