

Processing PET bottle flakes into nonwovens

with fully-automatic filtration
and online IV monitoring

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1. Introduction

With the increasing consumption of PET resins in the bottle market and the steadily improving collection, as well as selection and recycling technologies, more and more nonwovens are produced with recycled PET or under addition of a certain percentage of recycled PET, e. g. bottle flakes. Substituting virgin material with PET bottle flakes offers major cost benefits.

But even with the most sophisticated recycling technology, when using PET bottle flakes, foreign particles will be found in the recycled PET stream. And as in any other field, price and cleanliness are tightly connected. Therefore, melt filtration is very important if PET bottle flakes are used. On one hand, melt filtration is a tool to consistently remove contamination to lower the dirt load of the spin packs. On the other hand, it is a tool to equalize the level of unavoidable impurities. Pack lifetime as well as the reduction of slubs are decisive with regard to process economy.

Apart from contamination the use of PET bottle flakes usually creates another problem. Compared to polyester melt produced from tailored virgin PET the melt from bottle flakes often shows significant IV variations. Therefore, to use PET bottle flakes successfully in the production of high quality products improved quality control tools are necessary.

2. Filtration in PET bottle flakes processing

The filtration system must remove large quantities of foreign particles from the melt at the highest possible rate. The dirt cake itself can cause degradation of the polymer, leading to quality problems with regard to color and mechanical properties of the sheet. In spunbond manufacturing a constant and reproducible IV is important to guarantee good and reliable processing performance. This requires short residence time of all melt.

Conventional filtration systems have several well known disadvantages:

Depending on the type of filtration system used at least some of the following problems occur. The percentage or the quality of the reclaim material is then limited by the filtration systems.

▪ Pressure drop or pressure surges during filter changes, resulting in temperature and therefore viscosity changes, which can lead to web breaks
▪ Process disadvantages like long residence time of melt and dirt cake
▪ Risk of dead spots and degraded melt
▪ High costs for filter element replacement
▪ Handling of heavy and hot equipment parts during filter changes
▪ Filter changes generate large quantities of polymer waste which need to be recycled or burnt

▪ Handling of caustic chemicals and inflammable liquids
▪ Limitations in filtration fineness
▪ Degraded and cracked particles introduced into the melt during filter changes

3. Fully-Automatic and Process-Constant Melt Filtration

Gneuss invented and developed the Rotary Filtration System RSF*genius* (see fig. 1) as an alternative to conventional melt filtration systems in order to avoid the above mentioned problems and disadvantages.



Fig.1: Filtration system RSF*genius* (patented)

The RSF*genius* is the first fully-automatic, pressure- and process-constant operating filtration equipment which is being introduced step by step in spunbond manufacture as a real alternative to conventional filters. Fig. 2 shows the layout of this filtration system.

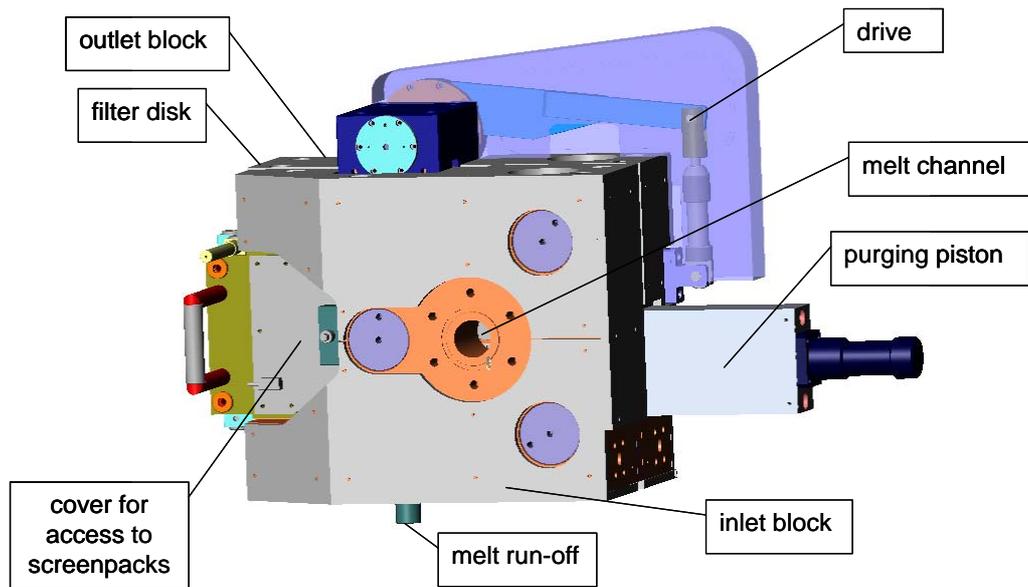


Fig. 2: RSFgenius filtration system

It operates with some unique advantages:

- It operates at constant pressure (even when exchanging filter elements), no process disturbances by pressure variations can occur. Pressure variations do not exceed ± 30 psi, so that the system can be used directly in front of the spin packs without influencing the process.
- Constant pressure means constant temperature and therefore constant viscosity, leading to reduced web breaks.
- The system operates fully-automatic thanks to a highly efficient self-cleaning of the filter elements. Filter element and cleaning costs are reduced to a minimum.
- The exchange of used filter elements can be carried out without any disturbances in the process.
- The system can handle contamination swells and reacts immediately to changes in contamination load. Due to the rotation of the disk a drastically larger amount of clean screen area can be provided in a given time unit while still working economically compared with conventional screen changers.
- The residence time of the material in the Filtration System is extremely short (since the filter medium is exchanged automatically, the active filtration area can be optimized to the throughput rate).

Due to its fully encapsulated design that prevents thermal degradation the RSFgenius is perfectly suitable for thermally-sensitive materials like PET.

Case example	<p><i>Johns Manville, Bobingen/Germany, was using double piston backflushing systems in their PET nonwovens production. With these systems they could not work with recycled material, i. e. bottle flakes, at the desired filtration fineness of 28 microns. The screen changer was exchanging positions nearly continuously and a stable production process could not be achieved. The double piston screen changer was replaced by an RSFgenius 175 Filtration System in order to enable a production with recycled materials. With the RSFgenius it is now possible to use 100 % bottle flakes while maintaining the same high quality.</i></p>
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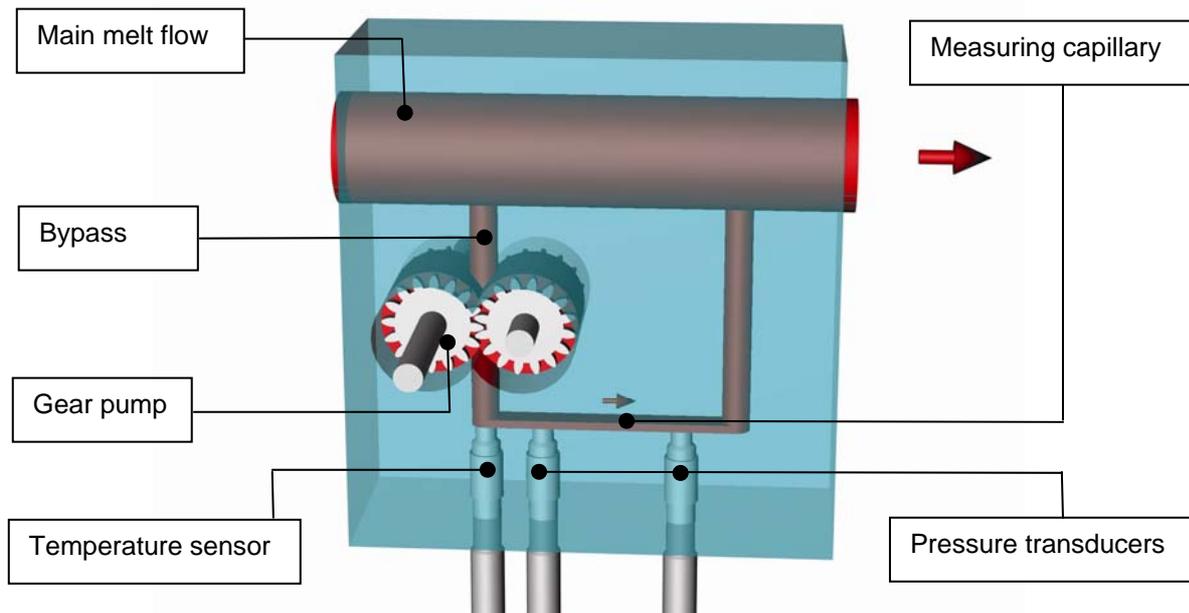
4. Online viscosity measurement

When using PET bottle flakes the melt often shows significant IV variations, certainly in between different lots, but variations are even possible within one delivery lot. In nonwovens manufacturing a constant IV is important to guarantee a good and reliable processing performance. Variations in the input viscosity require changes in material or additive dosing or an adjustment of processing parameters (e. g. vacuum level) is necessary to control the final melt viscosity. For the recording monitoring and control of the melt viscosity a reliable online viscosity measurement system is necessary.

Especially for these production applications Gneuss developed the online viscometer shown in figure 3 and 4.



Fig. 3 + 4: Online viscometer



A small part of polymer melt is diverted from the main melt channel and with a high precision gear pump it is pumped through a precisely manufactured slot capillary. Melt temperature and melt pressure (at two locations) is measured. Based on internal calculations the viscometer monitors the value of the representative shear rate and the corresponding viscosity. Different shear rates can be set and by corresponding corrections the real values for viscosity and shear rate can be derived.

The design is very compact. The viscometer can be fitted between two flange connections. The melt channel can be designed according to customers' specifications between 0.8 and 4,0 inches. The unit includes a pump drive, a pump, pressure transducers, temperature sensors and the control and evaluation electronics. The setting of process parameters, the evaluation and the display is realized via a user friendly touch screen panel or alternatively can be integrated into an existing control system.

This viscometer offers the following advantages:

▪ Short dwell time, no dead spots, no remains in the melt channels
▪ No elastic properties recorded due to measurement in rectangular cross section
▪ Polymer bypass, therefore no melt losses
▪ Minimal temperature variations (< 2 °C) of all parts in contact with melt
▪ Complete cleaning possible without interruption of production process
▪ Very compact design, flexible adaptation to existing melt pipes or extrusion lines

5. Summary

Processing PET bottle flakes into nonwovens poses a couple of challenges, for example the need to remove a significant amount of contamination and the need to monitor and control IV variations.

Thanks to its process-constant operation and its ability to exchange filtration area rapidly, the fully-automatic filtration system RSF*genius* is perfectly suited to PET reclaim applications.

Important aspects are:

▪ Process- and product consistency even when 100% PET post consumer bottle flakes are used.
▪ Filtration finenesses down to 20 microns (635 mesh).
▪ No influence on the consistency of melt viscosity and color by the filtration system.
▪ Very short dwell time of all the melt within the filter.
▪ Fully-automatic melt filtration with controlled consistency of process and product.

Apart from these technical aspects, it is also a big economical advantage to use the automatically operating RSF*genius*, which is flexible in adapting to changing impurity levels. The benefit is keeping the spinning process stable despite changing impurity levels when using recycled PET in the manufacture of nonwovens.

Finally, IV variations can be automatically recorded and monitored with a newly developed online viscosity measurement. A compact design, touch panel controls and easy cleaning make this viscometer very user friendly.

Imprint

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