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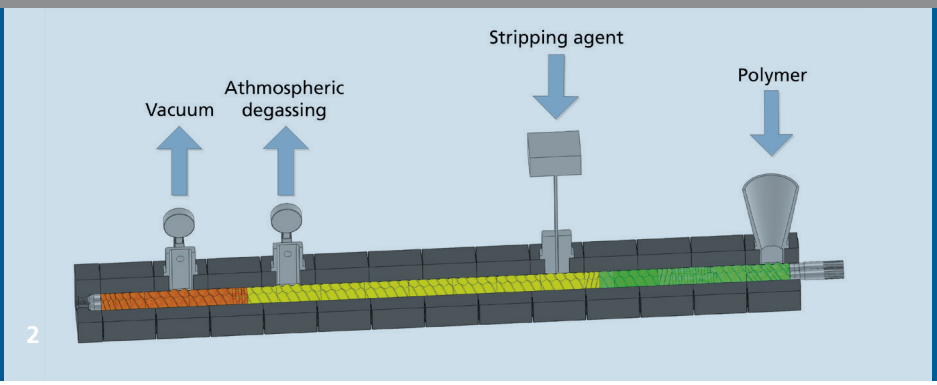

1 *Odor analysis at the Fraunhofer ICT.*
2 *Schematic drawing of the extruder set-up for the stripping process.*

EMISSION AND ODOR REDUCTION DURING COMPOUNDING

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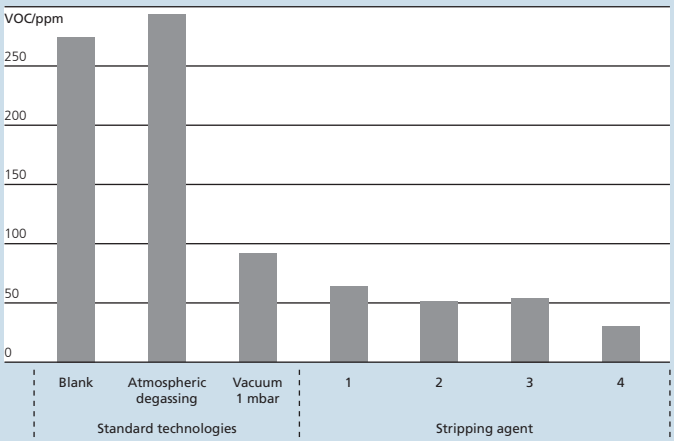
Optimization of product, process, and use of resources

Stricter legal safety requirements, customer demand for higher quality products and the wish to use recycled- or natural-fiber-filled polymers have led to an increased focus on the emission characteristics of polymer compounds, and an increased demand for emission- and odor-optimized materials.

Even in the compounding phase, the application of optimized melt purification technologies can significantly reduce emissions from materials and consequently products. All thermoplastic polymers which are suitable for processing in twin-screw extruders can be purified by this method.

The main fields of application for this technology, which was developed at the Fraunhofer ICT, are the removal of monomer residues from virgin materials, odor-intensive materials from given formulations, and/or the removal of by-products from prior processing. Success was also achieved with recycled polymers: here researchers at the Fraunhofer ICT demonstrated the potential to remove by-products from processing and degradation products from auxiliary materials such as printing inks or coupling agents, as well as other odor-intensive impurities.



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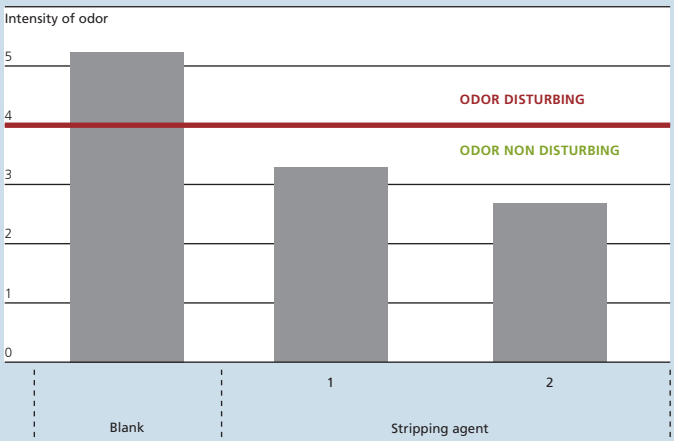

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Application and integration

Technologies to minimize emissions and product odor can easily be integrated into existing compounding lines: The purification is performed continuously in one single extrusion step during compounding. Depending on the requirements for purity, and on technical limitations, a stripping process or an extraction process can be applied. Both processes use fluids during extrusion to enhance the purification performance.

Stripping-agent-assisted degassing

In the stripping process the polymer is fed using the main feed. After the melting zone (2, green section) the selected stripping agent is dosed into the extruder and dispersed in the polymer melt (2, yellow section). In the degassing zone the stripping agent is removed together with the impurities, and the purified polymer exits the extruder at the die (2, orange section).

With optimized process conditions very few additional shear forces need to be applied to the polymer.

It is of course also possible to apply this technology after a side feed dosing, for example in order to reduce the odor of natural-fiber-filled compounds.

With an individually chosen stripping agent (see 3 and 4) and the optimization of machine parameters the performance of this technology in an individual material system can be greatly enhanced.

Extractive extrusion

Contrary to the stripping process the extractive process can be performed with CO_2 alone. In this process CO_2 is utilized in its supercritical state during extraction, and remains as a supercritical fluid when removed from the extruder together with the dissolved contaminants. Subsequent vacuum degassing removes any traces of CO_2 from the polymer system.

During extractive extrusion a considerable amount of shear energy needs to be applied to the material system and more complex equipment is necessary.

Analytical methods

The Fraunhofer ICT uses emission and odor analytics to analyze and optimize the purification processes developed for our customers. Emission analytics is mostly performed according to construction or automotive norms, i.e. VDA 277 (automotive, headspace GC) or VDA 278 (automotive, thermodesorption). Both norms measure the concentration of volatile organic compounds (VOCs).

The quantification of odor reduction can be performed using an odor testing panel, for example according to the odor test VDA 270. Alternatively the new ISO 16000-28 standard can be applied for polymeric compounds (granules). Using this ISO norm a specially-trained odor testing panel, working with comparison samples, ensures reproducible results.

3 *Efficiency of emission reduction.*

4 *Efficiency of odor reduction.*