Emission and odor reduction using additives

Additives for emission control

The sustainability of products and processes is essential for future societies. Recycled plastics have the potential to contribute toward climate targets and achieving a sustainable circular economy. However, a significant challenge affecting the quality of recycled materials is the presence of emissions and unpleasant odors.

One strategy to tackle emissions and odors in plastics and their recyclates is the use of additives known as emission or odor scavengers. These additives work by reacting with or absorbing emissions or odorous molecules, preventing them from outgassing from the product.

The effectiveness of a scavenger additive depends on the type of polymer as well as on the emission molecule or odorant that needs to be absorbed. The Fraunhofer Institute for Chemical Technology ICT has developed technologies to quickly evaluate suitable additives for emission and odor control and to apply these additives to recycled and natural materials.

Evaluation and application

Additives can be evaluated for suitability using a rapid test stand developed at Fraunhofer ICT. This method allows additives to be tested directly in combination with affected substances, to identify promising combinations. The use of additives for emission control has a broad range of applications. Besides the direct incorporation of the additive into the polymer, a barrier layer made of virgin material containing additives can also be applied.

The use of additives for emission control provides an easy-to-integrate solution for various affected substances, without the need for special equipment during processing.

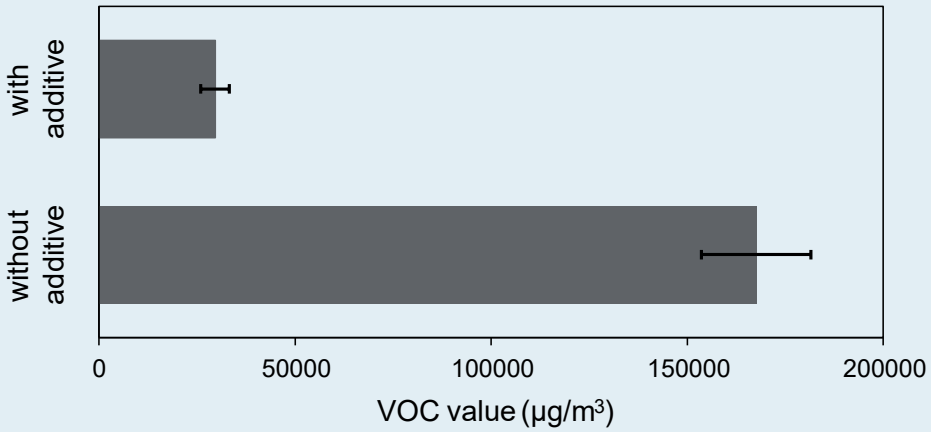
Additive characterization with rapid test stand

To quickly evaluate the suitability of an emission absorber for a specific contaminated substance, we use our so-called rapid test stand. Here we can measure the effectiveness of an additive in absorbing volatile organic compounds (VOCs) released from a contaminated material.

To carry out the test, emissions are collected from a carrier gas stream that flows over a contaminated sample and the additive to be tested. The emissions are absorbed on a porous polymer and then analyzed using thermal desorption gas chromatography/mass spectrometry (TD-GC/MS). For the evaluation, the VOC value is determined, representing the sum of the volatile to semi-volatile substances as a toluene equivalent.

Based on the results, the most promising additives are identified for potential application in plastics, recyclates, and natural materials.

Human sensory analysis of odor-contaminated plastic granulate.



VOC reduction measured with the rapid test stand

Contamination barrier layer

Emission absorbers can be incorporated into the product by applying a so-called contamination barrier layer, developed by researchers from the Fraunhofer Cluster of Excellence Circular Plastics Economy CCPE. This sandwich structure contains the contaminated material as a core, encased in a skin of virgin material that contains the emission absorber additives. The core and skin are made of the same type of plastic, and the components are produced by sandwich injection molding. This concept prevents the migration and outgassing of emissions from the core material.

Advantages of the contamination barrier layer include the low quantity of additives needed, the lack of interactions between additives and the contaminated core materials, and the predictable properties of the virgin material skin, which in turn determines the surface properties of the product.

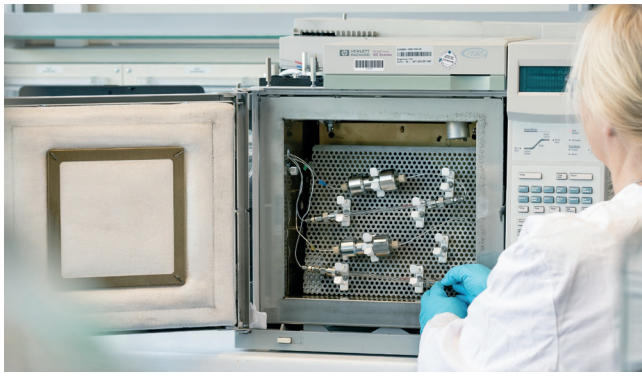
Analytical methods

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 standards, i.e. VDA 277 (automotive, headspace GC) or VDA 278 (automotive, thermal desorption). Both standards measure the concentration of volatile organic compounds.

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 standard a specially trained odor testing panel, working with comparison samples, ensures reproducible results.

Left:
Sandwich test specimen with a contamination barrier layer.

Right:
Sensory analysis of odor-contaminated plastic granulate.



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