IMAGE: LUXUS

Increasing the use of recycled resins means tackling the challenge of bad odours. ***Chris Saunders*** *learns about additives and available testing approaches*

Getting on top of bad odour in plastics

As demand for more recycled materials in end products continues to rise, odour reduction has become a critical factor. It is especially relevant in applications such as automotive interiors, where the confined space makes odours more perceptible, and in food packaging, where an unpleasant smell conveys an impression of inferior quality and can instantly put customers off, possibly leading them to form a potentially long-lasting negative association with a brand.

Data from the UK shows the extent of the challenge. Of the 260,000 tonnes of post-consumer polypropylene (PP) waste produced each year less than 1% is recycled into high quality products. One of the main reasons for this is attributed to the polymers retaining odours from previous applications. Meeting today's ambitious sustainability targets means radical improvement, so the search is on to find more effective ways of detecting, managing, or even eradicating odours at source.

UK-based **Luxus**, which claims to be the country's largest independently-owned producer of prime and recycled polymers, initiated its Odour Control Accelerator project with the aims of upscaling validated processing technologies to provide a cost-effective method of identifying odours and deodorising recycled polymers.

The technological concept was developed through a previous project funded by innovation agency Innovate UK, which resulted in the installation of a modified laboratory-scale extrusion line. When trials showed clear evidence of a reduction in odour-causing Volatile Organic Compounds (VOCs), Luxus began working with the Research Centre (TRC), and the University of Lincoln to upscale the technology from laboratory prototype to its compounding facility, where it would allow full scale production.

In April this year, the project was awarded more than £600,000 under Phase 3 of the UK government's Public Sector Decarbonisation Scheme. This funds projects "in which innovative technologies with

Main image: Bad odour in plastic compounds is tough to deal with and the focus of a new project at UK compounder Luxus

Right: Luxus says its Odour Control Accelerator project aims to upscale validated technologies to deodorise recycled polymers

potential to reduce energy consumption, maximise resource efficiency, and cut carbon emissions are developed and demonstrated in industry."

OdorClear is a range of powerful wide spectrum odour-absorbing masterbatches from **Ampacet** designed to neutralise the PCR odours that arise due to the presence of contaminants or residuals. Originally introduced as Odor Scavenger, the newly expanded range is said to minimise odours and enclose them inside the polymer, allowing converters to boost the percentage of recycled content while keeping the odour level down. OdorClear masterbatches have been designed for use with a broad range of recycled polymers and can be specially formulated for injection and blow moulding, film, as well as other extrusion processes.

Last year, **Milliken** launched its latest DeltaFlow Viscosity Modifier grades, which offer lower VOCs and improved organoleptics when used in recycled polypropylene (rPP). The viscosity modifiers are supplied as dust-free solid concentrates and are designed to increase melt flow rate of pre and post-consumer rPP by shortening the material's average molecular chain length.

DeltaFlow-modified rPP resins exhibit improved and more consistent flow, making them suitable for use in a wide range of applications including automotive, industrial packaging, and household storage and garden furniture. Use of the additive also allows processing temperatures to be reduced, which can significantly cut cycle times, boost productivity, and uses less energy overall in the manufacturing process.

The newly-developed DeltaFlow grades use the latest viscosity-modification peroxide chemistry from Nouryon – Trigonox 501-CS40. This results in a lower content of volatiles originating from peroxide decomposition products in the rPP when compared to Trigonox 101 type peroxides, most notably acetone and tert-butanol.

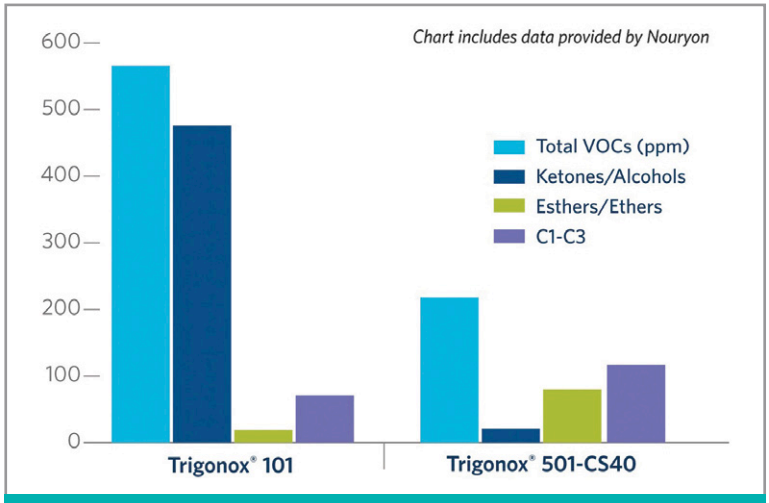

Figure 1: Comparison of VOC generation of Trigonox 101 against the Trigonox 501-CS40 grade used in Milliken's latest DeltaFlow viscosity modifiers
Source: Milliken/Nouryon

IMAGE: LUXUS

Stripping solutions

Odour can also be managed using stripping agents such as **Byk**'s P4200 additive. This is produced by adsorbing an aqueous solution of the agent onto a PP carrier that is then added in the compounding process and is said to carry away odour-causing contaminants and VOCs during vacuum degassing. It is recommended for use at 0.5% to 2.0% addition levels in PP. It can also be used in PE. P4200 is supplied as an easy-to-handle granulate. Byk claims the effectiveness of the product surpasses conventional solutions such as adsorbents.

Researchers at the **Fraunhofer LBF** (Institute for Structural Durability and System Reliability) in Darmstadt, Germany, have been looking into the odour topic for some time and say they have developed a new environmentally-friendly process specifically to remove odours from plastic packaging. Their findings were presented at the Plastics World Expo Europe, organised by *Compounding World*'s parent company AMI, in Essen in Germany in June this year.

The new process is based on pressurised water extraction, which has been shown to remove a tracer limonene fragrance from commercial HDPE packaging with no requirement for organic solvents. In this way, the material quality of processed plastic waste can be significantly increased, according to the researchers. In-process analysis based on infrared spectroscopy and mass spectrometry provided data on the chemical composition of the samples, showing significantly less limonene present after extraction. In addition to the fragrance, other impurities and short-chain HDPE were also removed.

Based on the analysis, the Darmstadt experts

determined the optimal process parameters for pressurised water extraction. Dr Guru Geertz, who oversaw the project, says: "The results demonstrate the benefits of a systemic approach to solving current plastics technology issues with great social relevance."

Developing the process further required gaining detailed insight into the chemical kinetics of the extraction, which was made possible by evaluating data using machine learning methods and is key to optimising extraction parameters in terms of the desired economical process control. At the current stage of development, an application scenario is said to be emerging.

"The extraction process we have developed shows a way to reprocessed single-use plastics with an increased range of applications, and this serves to protect the environment," Geertz summarised. The process is said to be equally suitable for industrialised, emerging, and developing countries, so all market participants manufacturing plastic products can potentially benefit from it.

WEEE innovation

Last year, Spain's plastics technology institute **Aimplas** participated in the EU-funded NonTox project, which is aimed at developing new processes to increase recycling rates. One of the project case studies consisted of recovery of ABS plastic from waste electrical and electronic equipment (WEEE). In the EU, the management of this type of waste is regulated by European directive 2012/19, which is driving implementation of selective collection systems to increase the rate of recovery and recycling to a target of up to 85%.

IMAGE: FRAUNHOFER IVV

Above: Fraunhofer IVV is developing techniques to identify the most odour active compounds in polymer compounds