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recycling

Adding value with additives

As one of the world's leading suppliers of additives for the plastics industry, Baerlocher knows a thing or two about what happens when a polyolefin is recycled. **Andreas Holzner**, the Global Head of the Special Additives business unit sees these materials as having the 'highest potential' with regard to upcycling.



Although perhaps best known for its focus on, and expertise in, additives for PVC, Baerlocher also has extensive experience with other polymers, which is the area of expertise of its Special Additives Division. As Andreas Holzner, the Global Head of the Special Additives business unit explained: "We are focussed on all non-PVC applications with our polymer additives and when we talk about recycling, I'd say to a large extent that we are talking about polyolefins."

While PVC recycling is a well-established activity in Eu-

rope, it is differently organised from other polymers, with completely different collection systems. As it is often used in construction, PVC waste tends to be generated during renovation projects – the installation of new pipes or new windows for example, where contractors and other professionals handle the materials and are responsible for getting them into the recycling stream.

Polyolefins, said Holzner, are most commonly used for short-life applications. "As such, they show up at the recyclers more often. At the same time they have the highest potential with regard to upcycling."

Not designed for recycling

Recycled polyolefins – PP and PE – are typically derived from less well-defined streams of post-industrial or post-consumer waste. In the case of post-consumer waste, such as packaging films and bottles, this is collected, sorted, washed, shredded and regranulated into pellets, for converters to reprocess into new products.

"However, virgin polyolefins are typically stabilised for one-time use," said Holzner. Polymer producers add additives to stabilise these materials to ensure

they meet customer expectations – "No stress cracking, no discoloration of films, or brittleness of the films – this kind of thing," he clarified. "But polymer producers – who have been optimising their costs structures for decades – only add the minimal dosage of additive to their polymers in order to save costs. So these polymers are typically not designed for recycling."

As a result, post-stabilisation of the polymer is needed, in order to be able to produce recycle with the quality needed for long-lasting products

"Without additives, problems

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may occur, such as products exhibiting poor surface quality or big variations in melt viscosity," Holzner said. "Converters using recycled materials tend to mix this with virgin material. By restabilising the recycle, the percentage of recycle that can be used can be increased, which contributes to the sustainability of the polymer in its application and widens the range of products for which the recycles can be considered."

Preferably, the stabilisers are added prior to regranulation. As Holzner explained: "It's because of the damage done to the polymer during recycling: first it's melted, then typically, in order to purify the material, this is followed by a melt filtration, which means the waste is passed through fine filters to eliminate the impurities. But to achieve the low viscosity needed to pass it through the filters, the processing temperature must be increased."

He added: "And if the stabilisation package is added up-front, a stabilisation effect will occur already at this stage, and the recycle production process will not de-

teriorate your material. Once the material is harmed, this cannot be compensated for by using additives.

Adding the stabiliser as early in the process also avoids the polymer balancing on the edge of being under stabilized, with for example flowability variations as a result. Stabilisation ensures a more uniform product."

How does it work?

A typical stabilising package for polyolefins consists of three components. The first is an antioxidant, which destroys all catalyst residues and protects the other additives. In the recycling process it takes care of acidic species that may have contaminated the material during product life. However, in the recycling process the second component is more important. This is a process stabiliser, or a secondary

antioxidant, which protects the polymer chains from decomposing. Adding the third component - a primary antioxidant to the system - then provides to the polymer the stability needed for long-term use.

"It is about avoiding degradation of the polymer during the regranulation process and adding to the long-term stability of the product," said Holzner.



Polyolefins have the highest potential with regard to upcycling."

Andreas Holzner
Baerlocher

It is, however, relatively sophisticated chemistry and recycling is an extremely price-sensitive market. As a result, many recyclers prefer to avoid adding costs to their system. And as long as the recycled resins are destined for 'low profile' applications, this is not a problem.

However, as Holzner pointed out, Europe's circular economy ambitions and the Green Deal - the roadmap for making the EU's economy sustainable - involve commitments from society and the plastics industry regarding the use of recycle.

"More recyclers need to learn how to offer a more consistently performing recycle. If we really want to be able to use recycle in applications which are exclusively or mainly served with virgin polymer today, then we need to protect the polymer during the recycling process. And today, more and more re-

cycling companies realise this. Plus there are a lot of brand owners working with them, communicating their expectations and their specifications to them. At that point, the recycling companies realise that they have to act."

A sustainable technology

Baerlocher has developed a resin stabiliser technology which is sold as a formulated product to the recycling market under the Baeropol brand name. Dust-free, easy to handle and reliably free flowing, the technology is tailored to the environment of a recycling facility, offering the efficiency of the additive package with high workplace hygiene. The products, both for post-industrial and post-consumer waste, are selling well.

"Even now, despite the fact that currently mineral oil prices are down and virgin polymers are cheaper than they used to be, our sales are good. With brand owners following a clear philosophy of increasing the recycle content of their packaging materials, the demand is there," said Holzner. Although, he added, in recent weeks, the feedback from the market is that demand for recycles is finally starting to slacken due to 'less demand in various industry segments and lower pricing of virgin polymers'.

Yet, with the increasing popularity of online shopping - especially in these times of COVID-19 - more and more packaged products are being purchased, which means more and more packaging films to be recycled.

"And using the right stabilizer technology means that you can actually engage in upcycling," said Holzner. While regulatory aspects still prevent the use of this recycle in most food packaging and the packaging of pharmaceutical products, other high-value applications are certainly possible.

Such as?

"For me, a high-value application is when, by ensuring that the recycle meets strict, narrow specifications processes the

same way every time, your customers are able to serve higher-demanding applications. So, producing recycle for blown film, for example, the stabiliser technology ensures that you can filter fish eyes out, that you have a consistent melt strength and that consequently the bubble doesn't burst," said Holzner.

"In other words, a recycler selling this can now upgrade the recycling stream, specify closer tolerances and can guarantee to film producers that if they purchase this grade, there will be no viscosity variation, no melt index drift. For me, applications with high value are applications with long lifetimes. And that, as a recycler or a converter, it is possible to replace more virgin material with recycle with the help of additive technology."

What's next

Next to developing stabilisation technology, Baerlocher is also working on additives for HDPE - for recycled bottles, for example.

"Specifically, we are working on melt strength enhancers with a certain compatibilising effect," said Holzner.

One of the crucial issues in recycling is the quality of the collection and sorting process: how clean is the waste stream? For recyclers, up to a certain percent of 'contamination' is permitted - up to 5% PP in PE.

"Additives are used to help with the compatibilization of the different polymers and improve the further performance of the recycle," said Holzner.

Baerlocher is working on the development of additives for increased melt strength, improved processability, and, in addition, is collaborating with polymer producers on the optimisation of their stabilisation concepts.

"Currently, most resins are stabilised or additivated for one-time use: we are also working with polymer producers to enable them to add higher level of stabilisers, making their polymer grades again more suitable for recycling. In other words, we are working together with both sides of the value chain: with the polymer producers and the compounders."