

Not so very long ago plastics ended up on the garbage dump after their use phase. Now we know that this trash is a valuable source of energy and raw materials: much of the plastic waste can be more sensibly used in energy recovery or as a resource for mechanical recycling.

BASF is aware of the growing importance of the recycling sector for society at large via the increasing interest in specialty additives for the recycling of plastics. BASF additives do more than just facilitate recycling; they also help some recyclates to achieve high performance characteristics, superior even to virgin product: The keyword is upcycling, not downcycling, which means upgrading instead of downgrading. This is BASF's practical response to the challenge posed by higher recycling quotas.

Additives for stabilizing recyclates

Mechanical recycling is more than a matter of collection and remelting. Virgin material and recycled material generally differ greatly. One of the many reasons: the reprocessing of post-use plastics involves heating and drying, which consumes the thermal stabilizers originally present in the plastics. Recyclates without further treatment are therefore usually less stable to the thermal stresses of further processing compared with virgin material.

This problem can be solved by adding new stabilizers. Every batch of post-use plastic has its own history, but BASF possesses all-embracing know-how in the analysis of recycled plastics and develops optimum complementary additive packages tailored to the planned new use. Even assessments of the food contact compliance of newly stabilized material are possible on demand where deployment in critical applications is intended.

Downcycling through processing and re-processing

The polymer chains of a recycled plastics material are exposed to harsh conditions, not just at the reprocessing stage but even the original compounding and processing can lead to a reduction in the average molecular weight. There are the further stressors to which they are exposed during their "active life", for example due to aging reactions, hydrolysis and contact with acids, laundry detergents or other aggressive media.

Therefore, neither fresh recyclates nor even scrap and faulty batches from the manufacturing process I have generally been able to compete with the material properties of virgin material itself.

High-quality PET thanks to Joncryl ADR

A special case is polyethylene terephthalate, PET, a plastic not actually produced by BASF. It is precisely its recyclability which gives this plastic distinct competitive advantages over other transparent plastics: it is well-known that all over the world PET bottles are collected, comminuted, washed and pelletized on a huge scale. The pellets obtained are remarkably uncontaminated with other types of plastic.

Therefore, mechanical PET recycling makes much sense compared with some other plastics where this purity can only be achieved at significantly greater expense and inconvenience. Nonetheless, even the use of recycled PET polyester was for a long time limited to simple applications such as fiber production; melt strength was not sufficient to manufacture high-grade packaging because of the shortened chain lengths of the molecules. The result: downcycling which means mere usage in applications of lower quality.

The problem with insufficient melt strength of PET recyclates can be solved by using functional additives from BASF such as Joncryl[®] ADR. These are chain extenders, i.e., molecules that attach to the ends of broken polymer chains. They act like an adhesive which sticks the split polymer chains back together again and so repairs or “heals” them at a molecular level.

Not just the original chain lengths and hence melt strengths are restored as a result; the molecular chains produced can be even longer than in the original material, depending on the amount of additive incorporated. Therefore, the restored material cannot just be used to make bottles again; it can even be processed into sheets that are thermoformable into packaging - such as cups for the food industry.

Moreover, Joncryl ADR additives can also endow the recycled polyester with completely new desirable properties. Chain extenders having multiple reactive sites can link polyester fragments together to form highly branched polymers of high molecular weight which are completely unobtainable in the first place via conventional polycondensation reactions; they then also display correspondingly interesting mechanical properties. Joncryl ADR 4300 equips recycled PET for example with increased tensile strengths useful in packaging straps or high-tenacity fibers.

Increased aging and weatherability resistance

Yet Joncryl ADR is only one of many additives from BASF to facilitate the recycling of plastics. The Recyclostab[®] range enhances the processing stability and aging resistance of polyolefins and thereby enables the recycling of LDPE films and automotive battery casings for example. Recycloblend[®] products are used for recycling of PP/EPDM bumpers - their size and ease of disassembly makes them a further good source for mechanical recycling. Recyclossorb[®] is used in the recycling of HDPE from bottle crates. It increases the weatherability of polyolefins and so makes it possible for recyclates to be used outdoors.

Based on BASF’s formulation and molding know-how, the offering in addition to the standard products also includes customer-specific formulations optimized to the special requirements of the particular use for the recyclates.

All the recycling-specific products are also very user-friendly - an important issue in the recycling industry and its many small companies.

Petra 7030 – Recyclate in the USA

Exclusively in the USA, BASF offers Petra[®] 7030, a special easy-flow injection-molding PET with 30 percent glass fiber content, based on recycled material. Petra 7030 combines high strength and stiffness with very good dimensional stability, low creep and good high-temperature properties. Because of its good flow properties, the products fabricated from the material have a high-quality surface finish even without painting. Petra 7030 has already come to be used in the so-called 111 Navy Chair, manufactured by the furniture maker Emeco and presented during the design competition of the North American plastics fair NPE 2012. It is made from recycled PET bottles: a nice example for upcycling, the opposite of downcycling.

Process additive Irgatec

Moreover, BASF has recently been exploring technologies to control the viscosity of polyolefin recyclates by means of the process additive Irgatec[®]. The viscosity of polypropylene recyclates can vary greatly, among others because of the admixture of non-polypropylene polymers. Peroxides have traditionally been used to adjust the flowability in reactive extrusion, but the handling properties are difficult. The Irgatec technology is distinctly safer and simpler to use being based on a different chemistry.

More plastic recovery in Europe

BASF is committed to maintaining its market presence in the future with specific offerings for the recycling industry. In 2011, according to PlasticsEurope, 2.4 percent more plastic was thrown away than in the year before, altogether 25.1 million metric tons in Europe. Almost 60 percent of that was subjected to recycling. The remaining 40 percent, a considerable 10 million metric tons, was landfilled. But soon there is a stop to be put to burying this treasure: Early in 2013 the European Commission decided on “Zero Plastics to Landfill by 2020”.



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