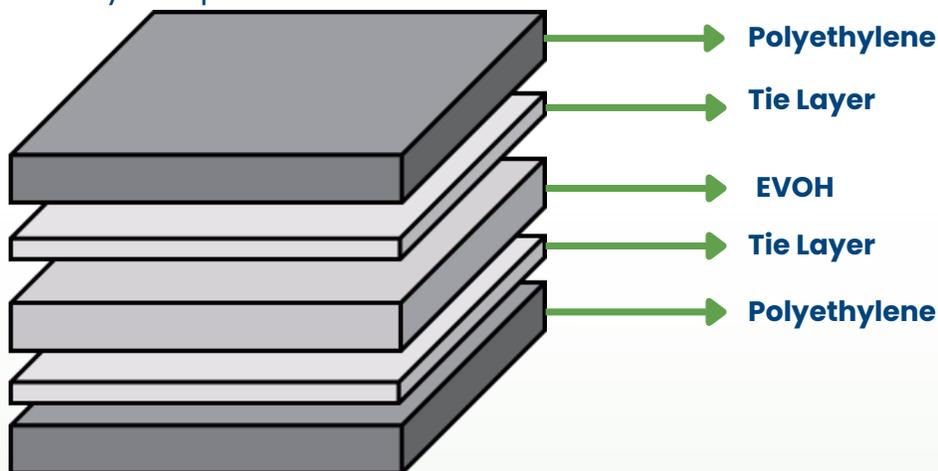


Ingenia Extrusion Brief

Compatibilizers

There are dozens of polymers used in everyday life, each with a different chemical structure. Often, these different chemical structures prevent the polymers from fully blending together in the extrusion melt when they are recycled, either at factories where they are processed or at the end of life when packaging is collected and processed by Recyclers. The composition of polyethylene and polypropylene, which is very close, is different enough that the materials are not miscible in the melt. Some plastics are polar (EVOH, polyamide, etc.), while others are non-polar (polyethylene, polypropylene, etc.). Like oil and water, these polymers with different polarity don't mix. When melted and blended together, one polymer will form spheres (a dispersed phase) in the other polymer's matrix. This immiscibility leads to a hazy material with weaker physical properties. In blown film applications where recycle containing multi-material scrap film is present, poorly compatibilized films experience defects, lower tensile and tear strength as well as poor elongation at break. Molded parts made from multiple polymers in the blend are typically much more prone to breakage and have a less uniform surface finish.

EVOH and polyamide are often used as barrier layers in multilayered films used in food packaging. These polar polymers also commonly contaminate post-consumer bales of polyethylene that are packaged in recycling plants. These multilayered films and contaminated bales result in a lower quality recycle, limiting the number of end market applications for recycled plastic.



Example film structure

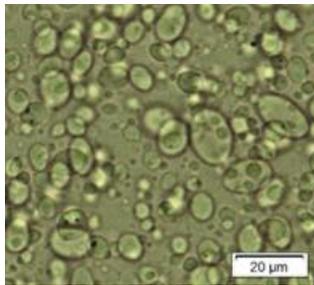
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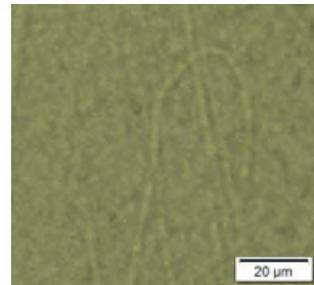
How compatibilizers work

To overcome this problem, recyclers can use chemicals called compatibilizers.

Compatibilizers act as a bridge between the polar and non-polar plastics, allowing for more intimate mixing – and therefore a more resilient high-quality product.



Polyamide in polyethylene
without compatibilizer under a
microscope



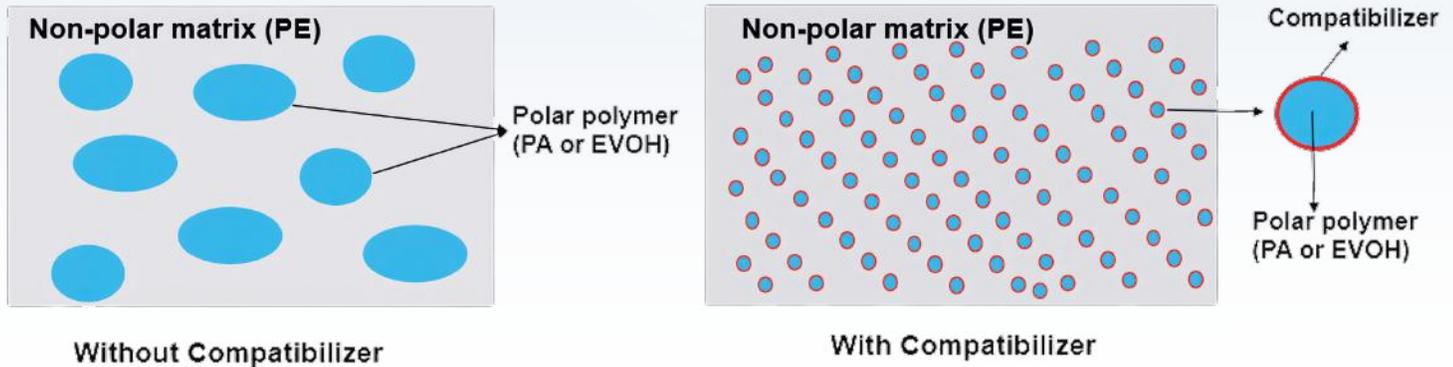
Polyamide in polyethylene
with compatibilizer under a
microscope

Using compatibilizers can allow multilayered plastic films to be added into recycling streams without a marked decrease in quality of the product. They also allow recyclers to save time and lower costs through a less rigorous sorting process. Compatibilizers allow plastic producers to access recycled polymer feedstocks for more applications.

There are a variety of compatibilizer technologies. Some are composed of polymers with polar and non-polar regions that encourage the compatibilizer to exist as a bridge between the various polarity polymers. The compatibilizer can also be a copolymer between the various polarity polymers.

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Compatibilizers



Other compatibilizers are made of catalysts that chemically stitch the polymer chains together. This results in a material where the polymer chains are longer than the starting material. This is particularly valuable in the context of post-consumer recycling, where the recycling process can break polymer chains via shearing or processing at high temperatures. These compatibilizers can help recycled resins behave closer to their virgin resin counterparts.

In summary

Compatibilizers allow immiscible polymers to be combined into a single, cohesive material. They are especially helpful in recycled materials where different plastics can be mixed, either accidentally by contamination or on purpose in multilayer films or in parts that require an overmolding of a different material. Ingenia has a portfolio of compatibilizers and the technical knowledge to improve your multi-material recycled stream.