SUSTAINABLE TIMES

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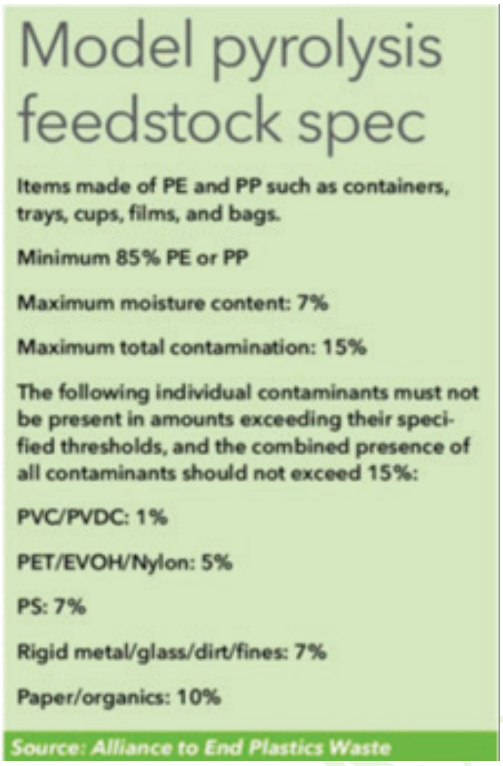
CHEMICAL RECYCLING – THE HOLY GRAIL?

What if there was an option to replace a material with another that has the same appearance, physical properties, remains safe for use in food packaging, and offers a lower carbon footprint? This may sound ideal, but the use of chemical recycling technologies holds the potential to make this happen. At the AMI Chemical Recycling conference in Houston, we attended with several hundred attendees. Representatives from equipment suppliers, technology providers, recyclers, converters, material suppliers, software developers, and others joined for several days of presentations, panels, and discussions. There was much excitement and interest to collaborate and learn more about this technology.

On day 1, we took a bus tour to Exxon-Mobil's facility in Baytown, TX. This facility expands over 5 square miles and is the location of their newest chemical

recycling investment. This facility houses a unit which has a capacity to produce 40kt (thousand tons) annually of pyrolysis oil that can be fed into their existing units for manufacturing of polyethylene and polypropylene products.

When we saw the unit, we all thought how fantastic it is that we can take all the plastic materials that aren't compatible with mechanical recycling, dump them into the unit, and transform them into new materials. Unfortunately, it isn't quite that easy. Large amounts of contamination cannot be tolerated as this yields a process with low efficiency and output (see the model pyrolysis feedstock specification compiled by the Alliance to End Plastics Waste). The materials fed into the unit must be consistent in type and density.



To ready the materials for the Baytown unit, ExxonMobil has partnered with a local recycler, Cyclix. This recycler is sourcing plastic materials from the greater communities, sorting, and preparing it for use in the pyrolysis process. From the industry perspective, recyclers such as Cyclix appear to be critically important.

Okay, so we have a recycler that supplies the appropriate materials for the pyrolysis unit, it is then converted into polyethylene or polypropylene plastic, and then what? Essentially, this material is indistinguishable from virgin, fossil-derived material. When it enters the manufacturing stream, we need a means to track the percentage of chemically recycled content. This is where ISCC+ certification and mass balance become important. Anyone that is engaged in the supply chain including the resin producer, the film maker, the converter, and even the customer needs to be certified. A key element of the certification is the use of the mass balance approach to tracking this chemically recycled material through the supply chain. This ensures that any type of labeling placed on the packaging indicating recycled content is science-based and credible.

APC is in the process of obtaining the ISCC+ certification and will be ready to assist our customers with integration of chemically recycled content in the next few months.

"DESIGN FOR RECYCLE" INNOVATIONS

Designing a package for recycling is not an overly challenging task but there are design considerations that must be considered. The packaging must be suitable for printing and brand recognition, offer the appropriate shelf life, protect the product through packaging to distribution, be suitable for conversion and filling on the customers packaging lines, and consist of suitable materials that are compatible with the recycling stream.

When it comes to the materials to use in the laminate design, there are established guidelines that can be referenced. These guidelines have been developed by the Association of Plastic Recyclers (APR) along with their membership which includes the MRFs (material recovery facilities) and recyclers. The MRFs and recyclers are the ones that collect your curbside recyclables, sort them, and resell them to the marketplace. To obtain the most value, they need high-quality materials and end markets that are willing to purchase these materials for use in the production of new products. The key is that the recyclers want materials that are in demand and offer the highest price to help offset the cost of their operations.

The guidelines are available on the Association of Plastic Recyclers (APR) website and can be viewed using the following [link]. These guidelines are listed by material type, i.e. PET, HDPE, PE, PP, etc. The guidelines themselves are broken down into categories including base materials, color, closures, dispensers, and attachments, additives and barrier coatings, adhesives. It may appear strange that there are so many categories, but packaging can be complicated. Recyclers want to ensure that every component of the materials they recycle are suitable for recycling and will not compromise the quality of the materials they are selling which could result in lower value to the end markets.

Within the guidelines, there is a series of color coding corresponding to the compatibility of the specific material with the recycling stream. Figure 1 shows an excerpt of the additives and barrier coatings section for PE (polyethylene). Preferred materials are highlighted in green and considered broadly accepted for use in the recycling stream. Detrimental items are highlighted in yellow and may pose issues with recyclability. Non-recyclable items are highlighted in orange and are not allowed in the recycle stream. The final category

Design Feature	Recyclability Category	APR Test Methods
ADDITIVES AND BARRIER COATINGS		
"Workhorse" additives historically used without issue	✓ Preferred	
SiOx and AlOx barrier coatings	✓ Preferred	
PVDC Coatings	✗ Non-Recyclable	
Additive concentration where density is higher than 1.0	✗ Non-Recyclable	
Other Additives and Coatings	? Needs Testing Untested barrier layers may yield Preferred, Detrimental, or Non-Recyclable results	FPE-B-01 FPE-CG-01
Metalized Layers	? Needs Testing Untested metalized layers may yield Preferred, Detrimental, or Non-Recyclable results	SORT-B-03 FPE-B-01 FPE-CG-01

Figure 1: APR Guidelines for PE - Additives and Barrier Coatings

"DESIGN FOR RECYCLE" INNOVATIONS

are questionable items shown in grey. These items are new to the recycle stream and testing is needed to determine if they are compatible.

As the industry continues to innovate on design for recycle packaging, there are often gaps in performance that the preferred materials cannot fill. One great example is metallized barrier. Metallized layers are often used in packaging as it provides optimal barrier properties versus alternative options and the appearance is often employed in the graphic scheme. Unfortunately for polyethylene as shown in Figure 1, metallized layers are highlighted in grey which means questionable requiring additional testing. Any laminate containing metallized films must undergo a series of tests before they can be considered for the How2Recycle label.

Laminates containing metallized materials must undergo two different tests. The first includes metal detection testing. This test ensures that the metal layers do not get detected by the various metal detectors on the recycled lines where these films could get mixed cans and other metals on the recycling lines. If acceptable, the second test is the critical guidance test.

The critical guidance test (see Figure 2) is used to compare the laminate containing the metallized film (termed the innovation) to a specified control material. This test seeks to ensure that the performance of the innovation compared to the control is within a certain maximum tolerance.

The test itself looks at the physical and melt

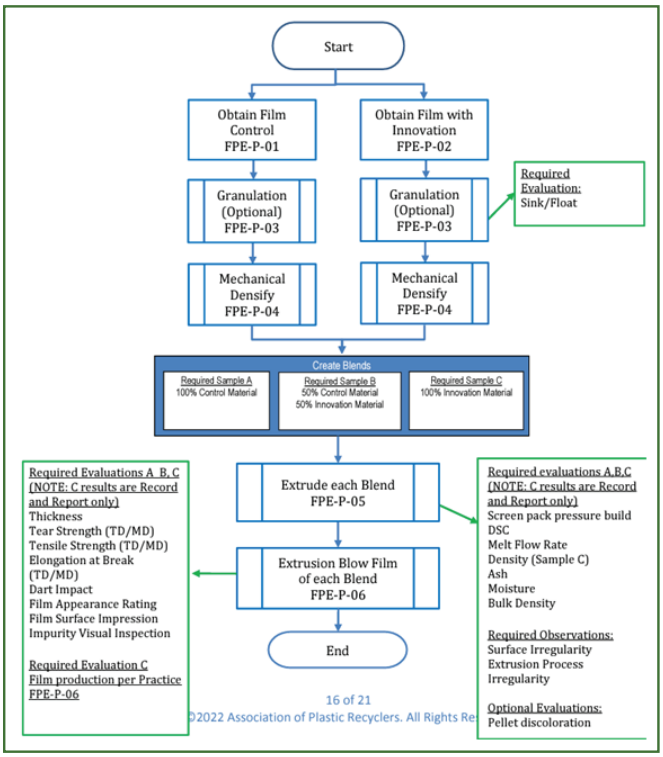


Figure 2: APR Critical Guidance Process for PE Films

characteristics of the material, physical properties, and the ability to consistently form a bubble within a blown film die.

The critical guidance test is very challenging, but the rationale is that the recyclers want to ensure that the innovations (i.e. metallization in this case) are compatible with the recycling stream and will not degrade the performance or quality.

This critical guidance is not exclusive to metallized film layers. There are many additional innovations that are being evaluated as the industry continues to work on redesign of traditional laminates to recycle-ready options.

OUR MISSION

Sustainable Times is a quarterly newsletter compiled by American Packaging Corporation that is designed to educate, provide industry highlights and keep you informed of sustainable solutions being developed by APC. If you have any questions, please feel free to contact your sales representative or Jeff Travis at jtravis@americanpackaging.com.