



Amber PET Bottles: Recycling Challenges and Opportunities

by Dr. Francis M. Schloss - Senior Fellow



The use of poly polyethylene terephthalate (PET) for packaging has seen tremendous growth that can be attributed to the material's ability to offer light weighting options, unique container designs, clarity, long shelf life (using special additives and/or multilayer structures) and recyclability. But unfortunately, only non-colored and lightly-tinted blue PET bottles offer reclaimers a high value in today's recycle market. This is because colored PET bottles have limitations for their reuse and therefore a much lower value.



PET reclaimers face daunting challenges in recycling non-colored PET bottles. The relatively low rate of PET bottle recycling in the United States limits how much good quality material can be obtained cost effectively. Other than limited supply, reclaimers have to deal with a significant loss of material that is not readily recyclable. While the material recovery facilities (MRFs) do a good job of enriching PET bales with good recyclable PET bottles, they still contain a host of items that create recycling issues.

Sorted PET bales can contain non-PET as well as colored PET bottles, bottles that contain product residue, labels and closures, and even non-colored PET bottles that are known to present recycling issues. While improved sorting at the MRF level can help with some of these issues, they are not able to readily identify and remove many of these clear problematic PET bottles during their material sorting process.

Problematic Additives

Therefore, multilayer PET bottles, and those that contain additives that are problematic to recycling (such as oxygen scavengers and ultraviolet light absorbers), can easily slip through and become part of the PET bale. Reclaimers must then try to identify and remove those items.

The use of PET to produce bottles and containers for oxygen sensitive products as well as carbonated beverages is limited to some degree by its barrier properties. These limitations can be overcome through the use of oxygen scavengers, multilayer structures and plasma coatings. But unfortunately, other than some plasma coating options, these barrier solutions present recycling difficulties. The oxygen scavenger and multilayer barrier bottles present PET reclaimers with issues that cause the rPET materials to yellow after melt reprocessing.

As a result, many brand owners who want to support sustainability initiatives by producing truly recyclable bottles have shied away from some technical developments that could give them additional right-weighting or longer shelf lives. They realize that these technologies would present problems to the PET reclaimers and, in turn, harm the very type of rPET they wish to buy for their own reuse.

Reclaimers Face Challenges

While end-use markets exist for high-quality, uncolored PET bottles, the same cannot be said for colored alternatives. If the relatively low volume of PET used for amber carbonated soft drink, beer and pharmaceutical PET packaging usage increases, items returned for recycling may reach a level significant enough to warrant their own stream. Additionally the brand owners would be under pressure to demonstrate that these packages can be sustainably reused in the production of new amber recycle-content bottles.

While reclaimers struggle to produce a high quality non-colored clear rPET product, they face many challenges. One of the most difficult problems for them to address is the natural tendency of even virgin PET to yellow as it is repeatedly subjected to additional melt histories during production of rPET pellets. This yellowing is accentuated by the presence of some additives such as ultraviolet light absorbers and oxygen scavengers, as well as residual multilayer barrier materials that cannot be removed in the recycling process. Reclaimers can add toners to mask this yellowing to some extent, but this adds cost and can make the resulting rPET material less bright when the toner level becomes too high.

Additionally, reclaimers know that they must do a very good job during their resorting process to eliminate as many known problem PET bottles as possible from these curbside bales. Typically, they will remove PET bottles that contain multilayer structures as well as others that contain additives that could present yellowing problems to their recycling process.

Reprocessing of Problematic Bottles

The reprocessing of these problematic bottles into rPET for other uses is poor since this material offers the reclaimers a much lower economic return. Additionally, colored bottles (other than those dyed light blue and to some extent green) offer reclaimers very low returns. There simply is not enough of any one color to allow for the development of a unique color stream.

For U.S. PET beer applications, approximately 10 million pounds of clear, green and amber bottles are created. This is far below the volume needed for the reclaimers to economically produce even a dedicated amber rPET product line. However, if amber PET pharmaceutical and beer packaging usage increases, the reclaimers will eventually face the need to develop an outlet for this material.

Potential for Yellowing

Beer is very light sensitive, which is why many beer products are packaged in amber-tinted bottles. Since PET naturally yellows with each additional melt history, the amber color might offer an ability to mask this attribute. A potential solution to mask this additional yellowing is a color adjustment that is still sufficient to block damaging ultraviolet and visible light when amber rPET is used in the manufacture of new beer bottles.

However, there is an underlying problem that producers will have to face if they wish to incorporate this amber rPET back into a monolayer amber PET bottle. The oxygen-scavenging additives that create these long shelf-life bottles, can be negatively impacted by various metals used in virgin resin manufacturing catalysts, as well as in the dyes used to tint PET bottles. The negative effect might be insignificant and overcome by simply adding more of the oxygen scavenger to the mix of virgin PET and rPET materials. But, there will need to be studies done to determine just how significant of a challenge this will be at the desired amber rPET use levels.

Varying Bottle Composition

Additionally, the amber PET bottles will be made by many different converters, each using their own unique oxygen scavenger and virgin resin. So an additional question to be answered is will the blend of these different amber bottle types be consistent enough throughout the MRF collection system to allow for a measurable, defined level of “deactivation?” This level of deactivation would then be remedied by ideally adding more oxygen scavenger in next generation recycle-content beer bottle production to overcome any issues.

It is conceivable that if the amber rPET is used at low levels, there may not be a measurable negative impact. But we will not have answers to these questions until recycle studies can be performed. While it is conceivable that all this amber rPET could be buried in the inner layer of a multilayer structure and thus isolated from negatively impacting the oxygen scavengers that would be incorporated into the outer layers, this may not be a good solution for amber rPET reuse.



The issue of carbon dioxide retention must still be addressed and amber rPET as the middle layer of a three-layer structure would require another barrier solution. If nylon were used, then more would have to be added to the virgin layers that might then cause haziness due to the inherent incompatibility of the PET and nylon materials. While more sophisticated five-layer structures may avoid this issue, this technology is not available to all involved in amber beer bottle production.

New Recycling Opportunities

Interestingly, a significant amber PET beer bottle market might allow for a recycling outlet for other non-colored yet problematic PET bottles. The types of bottles that are known to cause excessive yellowing during the reprocessing melting steps might be added to the amber stream as well. Thus, an opportunity to create a market for problematic PET bottles may be available that does not exist today. Again, rigorous performance testing would need to be done to understand how the incorporation of these types of non-colored PET bottles might impact such an amber recycle stream.

The recoloring of the resulting mix of different amber colors that also now contain clear PET bottles becomes critical so that this recycled material can be used to produce suitably colored new amber bottles that will meet both shelf-life and aesthetic requirements.

Now is the time to begin addressing this issue. The goal is to how best to handle an amber colored bottle stream in the future so that amber can add value to the reclaimer's operation rather than detracting from it.

About PTI

PTI is a global organization specializing in plastic packaging design and development, testing, performance and manufacturing efficiency. To learn more about PTI and our family of companies, visit pti-usa.com.