

Evaluation of How New PET Bottle Variants Affects the Recyclability of PET

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ABSTRACT

Recently, there have been a number of PET food containers introduced into the market that have barrier layers associated with them. These barrier layers are designed to reduce the diffusion of either oxygen or carbon dioxide into or out of the contents. Before these containers are introduced into the market a determination of the recyclability of these containers into either fiber applications or into bottles has to be assessed. This paper discusses several organizations that are involved in this type of evaluation, some of the techniques that are used, and several key properties that are determined.

INTRODUCTION

In the year 2000, over 700 million pounds of PET was diverted from the landfill and recycled into numerous end-use applications. These end-use applications include fibers, sheet, film, strapping, beverage containers, engineering resins and chemical recycling of the monomers. As the market for PET beverage containers (carbonated soft drink and water) becomes saturated, packaging manufacturers are pursuing additional markets. These markets include food, beer, and liquor to name a few. However, as PET packaging becomes more accepted for new uses, the barrier requirements of these new packages has to be enhanced. These new barriers will either keep CO₂ in or oxygen out to improve the taste as well as reduce spoilage of the contents. These improvements to the packing technology can cause unforeseen consequences on the downstream recyclability of PET. This paper will discuss the steps that a packaging manufacturer can go through to evaluate how this new technology can affect the PET recycling process.

This evaluation process is covered in guidelines offered by the Association of Postconsumer Plastic Recyclers "Champions for Change" program. It should be noted that this program is voluntary, cooperative, and focuses on the important issues raised by any changes in a package. The APR recognizes this cooperation with the Partnership Award but APR does not certify recyclability and APR does not require companies to reveal confidential information.

When a packaging manufacturer introduces a new package or a packaging variant into the market, Wellman is willing to work with that manufacturer to evaluate what effect their new variant package has on the recycling process.

BOTTLE VARIANTS

Bottles can be varied in several ways; including changes to the closures, changes to the labels, sleeves, base cups, the color of the bottle, additives in the PET itself, the presence

of multi-layers, coatings, and even the variation of the polyester monomers. If closures are altered, will they come off easily in the granulation process or will they be easily separated in the down stream removal processes? Will the construction of labels affect the process (e.g. PVC); will they separate out in an air elutriation process or in a sink/float process? Will the colors bleed off of the label and affect the color of the final PET flake? How easy will it be to remove sleeves? Base cups are becoming a thing of the past. There are various shades of green bottles; additives are sometimes present to resist the harmful effects of UV light on the packages' contents. Barrier layers can be comprised of multi-layers such as EVOH and aromatic nylons, as well as coatings such as silica and epoxies. If the chemical composition of the polyester is altered too much (e.g. PEN or high levels of co-monomers) could that affect the end-use properties such as fluorescence or the dyeability of fibers? The new bottle variant will be evaluated as if it were a contaminate in the existing PET bottle stream while realizing that it may prove to be more recycling friendly than the existing bottle. The concentration of the variant in the PET bottle stream will not be uniformly distributed and will be tested at levels higher than its expected market penetration. The potential impact of the variant must be assessed on the consumer market, the collection system, the recycler's process, the fabricator's process and the end-uses.

CONSUMER MARKET

Market information must be obtained on the bottle variant prior to its entering the market. For example, what would the expected market penetration be (e.g. how would the level of the contamination of the recycle stream be affected). In what bottles will the variant be used in? What are the expected contents of the bottles? What are the sizes and shapes of these bottles? Will the bottle be recognized as PET that can be recycled? There are issues with PVC bottles working their way into the PET recycle stream that has to be addressed. Will the bottle variant open new markets and thus increase the amount of material available for recycling?

COLLECTION SYSTEM

The impact that the variant has on the collection system should be evaluated prior to entering the market. For example, will its recyclability be affected in deposit states as well as in curbside stores? Will modification be needed in the collection infrastructure in order to handle the variant? How about variant look-a-likes such as PVC? If there is a bottle variant out there, for example PEN; can its value be captured independently?

RECYCLER'S PROCESS

One must determine how the variant affects the recycler's process and that is where a packaging manufacturer can work with recyclers, such as Wellman, to identify any issues. For example, will debaling be affected by the variant (e.g. bottles sticking together more than normal)? Will new sorting technologies be needed to separate out a bottle variant if it is determined to be an issue? Will washing of the bottles be affected by the bottle variant? How about granulation of the bottles with the variant present?

Sometimes there will be a load of bottles that are predominately one particular bottle variant and it is possible that an additive in the variant can coat the granulation knives. Can the labels be separated out efficiently? Will the quality or quantity of the waste stream be affected? Sometimes when a variant is incorporated into a bottle the amount of waste will increase. Although the quality of the remaining PET is not affected, its cost will increase to the recycler due to decreasing yields. Another question that has to be answered is if the air quality will be affected to any measurable extent during the recycling operation. Will there be increased screening losses due to an increased generation of fines? As mentioned before it has to be determined if there will be a change in the cost and/or productivity of a process. And finally, any changes in the value of the cleaned flake should be noted.

END-USES

Once the effect that a bottle variant has on a recycler's process is assessed, an appraisal of the end-use properties has to be made. One of the largest end-uses for recycled PET is as a fiber product. In a pilot plant scale, fibers are spun from recycled PET containing varying levels of the bottle variant and a study is made of how the actual spinning process itself is affected by the variant. Other fiber properties that are evaluated include tenacity, color dyeability, fluorescence, and shape retention. If the end-use market were to be sheet, film, or strapping an assessment of handling, screen life, processing and final properties are important. If the recycled PET were to find its way into an engineering resins application, an assessment on the variants effect would have to be made with respect to the compounding process, mechanical properties of the final product, any changes in electrical or flame retardant properties as well as changes in the rates or the total level of crystallization. Another question that has to be addressed is how the variant will affect various chemical recycling activities such as methanolysis, glycolysis, hydrolysis, or saponification. Finally, can the PET bottle variant be recycled back into bottles in a process known as bottle-to-bottle recycling? Properties that have to be evaluated in the final product include color, haze, taste, barrier properties and even thermal properties.

CONCLUSION

Change is a way of life. PET packaging technology is constantly changing to meet ever changing and more demanding requirements. The recycling industry is trying to keep up with the change through an organization called the Association for Postconsumer Plastic Recyclers. Recyclers are willing to work with bottle variant manufacturers to make an assessment on how the variant will impact the recycled PET stream. Guidelines have been published by the APR and are available to the public at the following website: www.plasticsrecycling.org. The APR, and Wellman, are willing to work with bottle manufacturers to ensure that the needs of all stakeholders are addressed.

The critical factor will not be if we can recycle a given material, we can. The deciding factor will be if a cost advantage can be provided and are we willing to change. Constant change has become a way of life.