TeTechS
save resin. save money. save the planet.

Application Note| Case Study| Technology Primer| White Paper

# Resin Saving Solution for Multi-Layer Co-Extrusion Blow Molding Lines

TeTechS Inc.

## Why Multi-Layer Structure?

To extend shelf life for packaged food and beverage products while preserving their freshness, it is essential to protect them from exposure to oxygen. For products such as coffee, it is key to make sure they keep their aroma, and for carbonated drinks it is important that their carbon dioxide (CO2) does not escape before consumption.

To reduce plastics packaging production cost and at the same time minimize their environmental impact, lightweighting has become a major trend in plastics packaging industry. However, reducing wall thickness of plastics packaging without adding proper oxygen and/or $CO_2$ barriers to the packaging design dramatically impacts product shelf life.

Ethylene vinyl alcohol copolymer (EVOH) is one of the most used barrier resins to design multi-layer plastics packaging. EVOH is known for its excellent barrier properties against gases such as carbon dioxide and oxygen. EVOH is also gaining worldwide recognition as a barrier material against organic substances such as aromas, flavors, fuels, and chemicals. Although EVOH has found variety of applications, it is primarily produced to be used as an oxygen barrier, mainly in food packaging.

Extensive experiments have shown that properly designed multi-layer plastics packaging can improve oxygen ingress or $CO_2$ egress by a factor of 10 or more over the course of the product's shelf life.

## Why Minimum Coverage is Important and How is Controlled and Monitored Now?

Barrier layers are used in plastics packaging in combination with other types of polymers such as PP, PET, and HDPE to form a multi-layer sandwiched structure. One of the most important parameters to be controlled during production is the thickness of each layers, particularly that of the barrier layer. It has been shown that the thickness of the barrier layer is inversely proportional to the oxygen permeability. Below a critical thickness, the barrier layer can not effectively stop oxygen permeation. Consequently, product's shelf life is drastically reduced.

While for the food packaging typically a few microns of an EVOH layer is enough to block oxygen ingress, in other applications such as in floor pipelines or geomembranes, EVOH layers with thicknesses in the ranges of hundreds of microns are required.

Manufacturing processes of multi-layer structures such as co-extrusion blow molding have significant impact on the thickness distribution of the barrier layer in the final product. For example, during blow molding process, a softened multi-layer parison is formed and then is shaped into a mold by mechanical stretching and pressure. This process impacts the thickness of the layers in different areas of the produced plastic containers such as sidewalls and corners.

One of the biggest challenges is to measure and control the thickness of the barrier layer in a multi-layer container in real-time during production. The dominant measurement method involves cutting samples and measuring layers under a microscope. This is a time consuming process and can only be done on few points on the sample and is repeated every few hours.

## Why Real-Time Data on Resin Distribution is Absolutely Needed?

Data-driven decision making is a powerful approach for tightly managing any business. Without data, blow molding operators are running blind. For example, to obtain resin distribution data for the barrier layer, a typical measurement frequency is about once every 8 hours on a small number of points. With such limited data, operators cannot efficiently run their production lines and are forced to overshoot resin to achieve minimum coverage everywhere. Real-time data on resin distribution changes this. As real-time data flows in, operators can now make immediate informed decisions to monitor and optimize resin distribution.

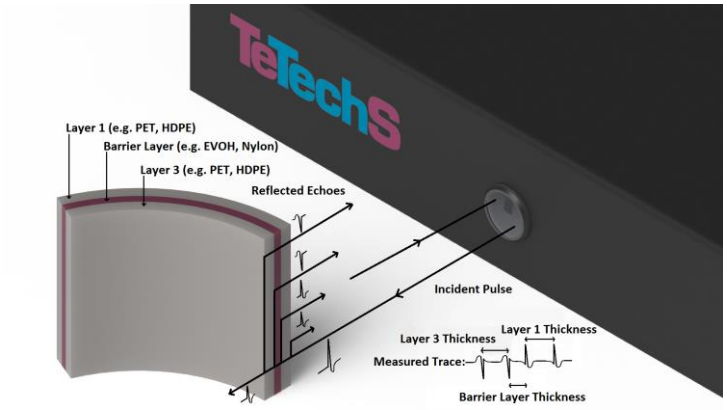
Since resin is the number one cost driver for most blow molding facilities (notably the barrier resins tend to be 6-8X more expensive than base resins), the profitability of a production line depends greatly on intelligent resin usage.

## What is an Ideal Solution to This Long-Lasting Problem?

Any proposed measurement solution to this problem must be a non-contact, non-destructive, fast, and accurate technique. An ideal solution must also offer following essential features:

- measure opaque, transparent, and colored plastics
- measure all types of plastics polymers
- measure true thickness values for individual layers

These requirements are only achievable with light-based measurement techniques. Within the electromagnetic spectrum, only terahertz waves- a form of light with its wavelength falling along the electromagnetic spectrum between microwave and infrared- can address all these requirements and has distinctive advantages over optical, x-ray, and ultrasonic.




Thickness Measurement Principle based on Terahertz Pulse Time-of-Flight.

Terahertz time-of-flight measurement technique is ideal for multi-layer thickness measurement in plastic containers. The layer thickness is calculated based on the speed of light in the material, hence it is a "true thickness" measurement with no on-going calibration required. Terahertz waves can measure all types of polymers, they pass through opaque, colored, and transparent plastics, and can accurately measure thickness of multiple layers with better than 1 micron accuracy. An automated and hands-off turn-key solution- such as TeTechS' PlastiMeasure- can offer a gauge R&R less than 4%.

## Why Circular Economy for Plastics Starts with Resin Saving?

Millions of tons of resin can be saved each year at upstream by using resin saving solutions at plastics manufacturing plants. Hance, circular economy for plastics starts with resin saving at the production stage. Two trillion plastic containers manufactured every year globally, which equates to $47B material cost. One gram less resin per container saves $3.6B for plastics packaging industry and cuts off 2 million Tons of plastics entering the recycling loop, or worse, ending up into the landfills and oceans. Overshooting resin can not be part of a sustainable packaging design and must be addressed once and for all.