TEMPAID™
COLD CHAIN PACKAGING

Sustainable Insulation Evaluation Report

Performance Analysis of TempAid™ Biodegradable EPS Coolers

TempAid Cold Chain Packaging

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Introduction

TempAid is currently manufacturing a new EPS (expanded polystyrene) cooler line that has been tested to be 92% biodegradable in most landfills.[i]. This new product line not only addresses the need for a more sustainable solution to the growing problem of waste accumulating in our landfills today but is also proven via qualification in TempAid Labs to be as effective in temperature stability as standard EPS coolers on the market today.

EPS, also known as Styrofoam, is a widely used material for packaging due to its insulation properties, shock resistance, low density, rigidity, and low cost. In 2018 there was already a lot of EPS waste generated. In fact, that year, the United States alone generated 80,000 tons of EPS packaging, with a negligible amount (less than 5,000 tons) recycled[ii]. This number is expected to grow an average of 9% per year.

Figure 1 EPS biodegradable coolers look just like standard coolers. They are available in over 20 sizes of both standard and high density versions.

Although EPS is a fantastic packaging solution, today's challenge is the growing waste created by increased temperature-sensitive biologic-based pharmaceuticals and meal kit distribution during the Covid-19 pandemic. The reason being that EPS is 98% air, making it a low-density solution that is economically unviable to store and transport for recycling. Therefore, most of it ends up in landfills, negatively affecting the environment due to its non-biodegradability. This problem has resulted in an increase in research attention towards biodegradable alternatives.

About the first biodegradable alternative to standard EPS coolers

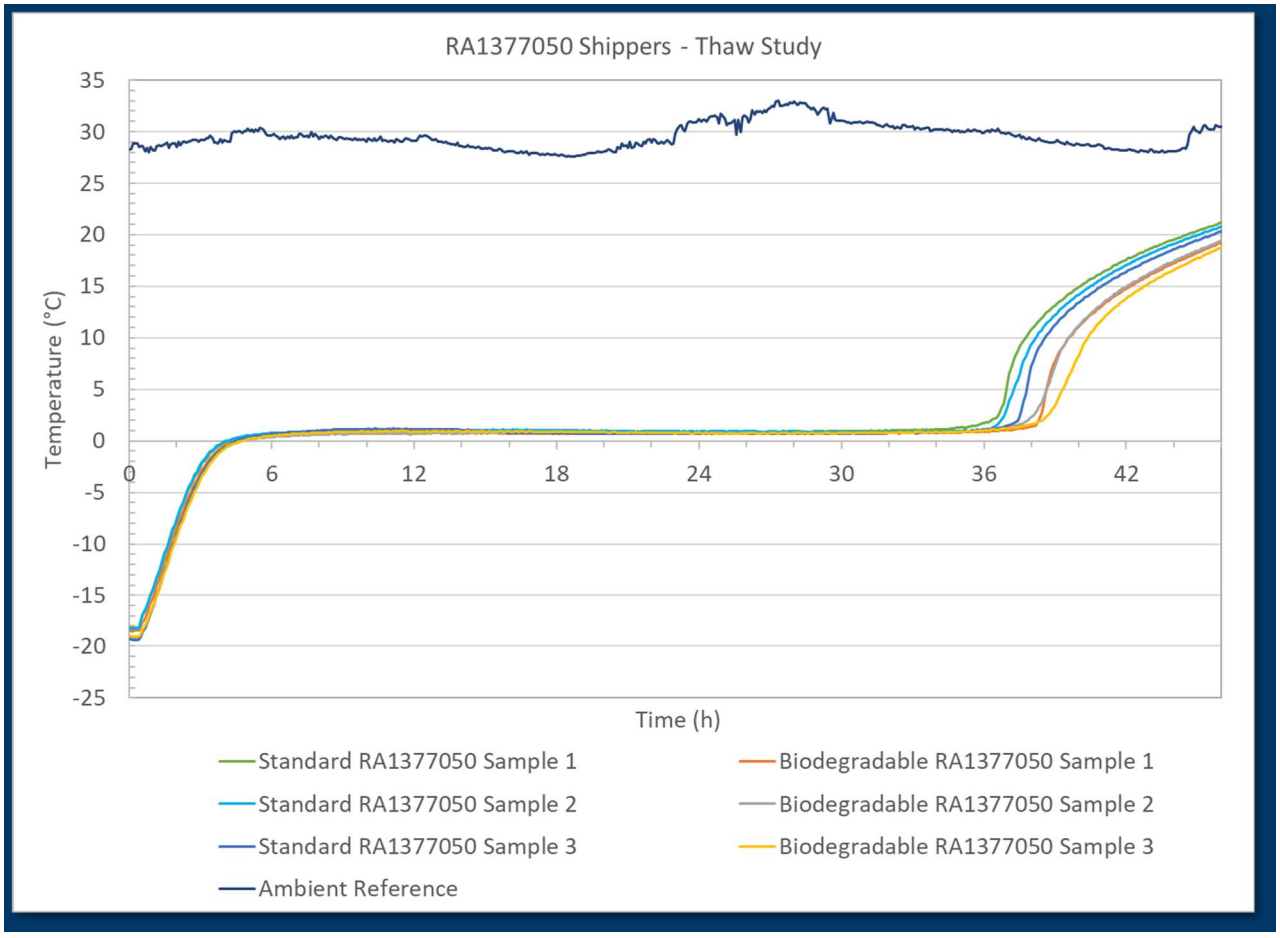
TempAid has created the first biodegradable EPS cooler on the market tested for vaccine, pharmaceutical, and food shipments using a licensed, proprietary resin homogeneously distributed throughout standard EPS coolers during manufacturing. The resin transforms the EPS cooler into a product with a new end-of-life story. Containers made using this resin have been shown to biodegrade 91.9% over four years under conditions that simulate both wetter and biologically active landfills using ASTM D5511 testing. In comparison, standard EPS containers only degraded 5.75% over the same conditions and same four-year period. This is almost 16x the degradation rate of standard EPS during the same period.

The resin changes the properties of the coolers to promote microorganism consumption of polystyrene surface carbon atoms. As a result, the coolers break down into the same compounds as those formed in the decomposition of organic material, i.e., methane, carbon dioxide, and inert humus. The TempAid biodegradable EPS coolers can be molded to any size and look the same as standard EPS shippers. Testing of the biodegradable EPS coolers has shown to have similar thermal properties as traditional EPS coolers.

The product testing process

Qualification testing was performed on three different types of coolers, comparing the biodegradable and standard EPS versions in triplicate, totaling 18 shippers. Testing involved packing the shippers with gel packs and attaching a resistance thermal detector (RTD). Once packed, the shippers were placed in a freezer at -20°C. Upon test initiation, the shipper's internal temperature was monitored, and the data was collected. After the freeze test was completed, the time taken for each of the shipper's gel packs to go from +5°C to -5°C was averaged, and the percent difference between the biodegradable and standard EPS shippers was determined. Next, the shippers were placed in a room-temperature environment at 25-33 °C. Upon test initiation, the shipper's internal temperature was monitored, and the data was collected. After the thaw test was completed, the time taken for the shipper's gel packs to go from -5°C to +5°C was averaged, and the percent difference between the biodegradable and standard EPS shippers was determined.

As an example, the thaw test with the biodegradable and standard RA1377050 shippers is shown in Figure 1 below.



Testing results

The percent difference between the average time taken for the gel packs to go from +5°C to -5°C within the RA1377071HD*, RA1377050, and RA1377092HD*[iii] biodegradable and standard EPS coolers were 1.8%, 2.7%, and 4.8%, respectively (Table 1, 2, and 3). The percent difference between the time taken for the gel packs to go from -5°C to +5°C within the RA1377071HD, RA1377050, and RA1377092HD biodegradable and standard EPS coolers were 2.1%, 3.8%, and 5.3%, respectively (Table 1, 2, and 3).

Table 1: Freeze and Thaw Test Results of the Biodegradable and Standard RA1377071HD Coolers

Cooler Model Number	Test Profile	Biodegradable or Standard EPS Cooler	Sample Number	Hours between +5°C & -5°C	Average Hours between +5°C & -5°C	Difference Between Biodegradable & Standard Coolers
RA1377071HD	Freeze	Biodegradable	1	33.5	34.4	1.8%
		Biodegradable	2	34.6		
		Biodegradable	3	35.1		
		Standard	1	34.3	33.8	
		Standard	2	32.3		
		Standard	3	34.75		
	Thaw	Biodegradable	1	26.1	25.4	2.1%
		Biodegradable	2	26.2		
		Biodegradable	3	26.0		
		Standard	1	25.5	25.9	
		Standard	2	24.7		
		Standard	3	25.5		

Table 2: Freeze and Thaw Test Results of the Biodegradable and Standard RA1377050 Coolers

Cooler Model Number	Test Profile	Biodegradable or Standard EPS Cooler	Sample Number	Hours between +5°C & -5°C	Average Hours between +5°C & -5°C	Difference Between Biodegradable & Standard Coolers
RA1377050	Freeze	Biodegradable	1	50.6	49.6	2.7%
		Biodegradable	2	48.3		
		Biodegradable	3	50.0		
		Standard	1	49.5	48.3	
		Standard	2	49.0		
		Standard	3	46.3		
	Thaw	Biodegradable	1	36.0	36.2	3.8%
		Biodegradable	2	35.9		
		Biodegradable	3	36.6		
		Standard	1	34.5	34.8	
		Standard	2	34.8		
		Standard	3	35.1		

Table 3: Freeze and Thaw Test Results of the Biodegradable and Standard RA1377092HD Coolers

Cooler Model Number	Test Profile	Biodegradable or Standard EPS Cooler	Sample Number	Hours between +5°C & -5°C	Average Hours between +5°C & -5°C	Difference between Biodegradable and Standard Coolers
RA1377092HD	Freeze	Biodegradable	1	71.8	71.1	4.8%
		Biodegradable	2	74.0		
		Biodegradable	3	67.4		
		Standard	1	68.9	67.8	
		Standard	2	65.2		
		Standard	3	69.2		
	Thaw	Biodegradable	1	47.9	47.7	5.3%
		Biodegradable	2	47.8		
		Biodegradable	3	47.3		
		Standard	1	44.7	45.3	
		Standard	2	45.4		
		Standard	3	45.7		

The average of the percent differences for the freeze and thaw was less than or equal to 5% and were 3% and 4%, respectively (Table 4). Therefore, the biodegradable EPS is thermally similar to the standard EPS.

Table 4: Summary of Test Results

Test Profile	Cooler Model Number	Percent Difference between Biodegradable and Standard Coolers	Average Percent Difference between Biodegradable and Standard Coolers	Average Percent Difference Less than 5%
Freeze	RA1377071HD	1.8	3	Pass
	RA1377050	2.7		
	RA1377092HD	4.8		
Thaw	RA1377071HD	2.1	4	Pass
	RA1377050	3.8		
	RA1377092HD	5.3		

About TempAid EPS Bio Coolers

EPS bio coolers are available in over 20 sizes and in both standard and high-density versions. The company also has developed a drain-friendly gel pack to accompany these new coolers. Both solutions are available today in volume with competitive pricing.

Contact TempAid sales today for samples or detailed testing data of the solution's temperature stability and biodegradability.

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[i] *The resin used in Bio EPS coolers biodegrade 92% over four years. They were tested under conditions simulating both wet and biologically active landfills using the ASTM D5511 test. The extent of degradation and stated rate do not mean the product will continue to decompose. The data stated above has been provided in good faith and believed to be reliable, it does not constitute a part of our terms and conditions*

[ii] [ii] https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/frequent-questions-regarding-epas-facts-and)

[iii] HD = High Density EPS