Recyclable paper cooler

Environmentally preferable packaging for protecting temperature-sensitive products during transit

Introduction

This technical note provides information regarding the validation testing of Thermo Fisher Scientific's recyclable all-paper cooler demonstrating its ability to maintain appropriate temperatures during shipping. Please be aware this technical note contains representative data for summary purposes and is not the full validation report generated under our Quality System.

For decades, EPS coolers have been the preferred external packaging for cold chain shipments. EPS is lightweight, durable, and highly insulative, but also notoriously difficult to recycle since few waste processors recycle it. It often goes to landfill.

We have developed a viable, easily recyclable cold chain packaging alternative that will provide appropriate thermal and structural protection during shipping. Thermo Fisher's proprietary paper cooler consists of an outer corrugated box with a cardboard framework lined with perforated layers of paper insulation. Pockets of air trapped within the lining's paper layers insulate the interior of the box from exterior temperatures. The entire cooler is recyclable alongside other paper and corrugated cardboard materials.

To determine whether we could adopt this paper cooler as an effective alternative to our existing EPS coolers, we tested the performance of the paper cooler against strenuous industry shipping standards. The results of this experiment indicate that the paper cooler maintains temperature conditions compatible with product shipment for the expected shipping duration.

The number of ice packs used with the paper cooler may vary based on anticipated package transit times and seasonal temperature variations. The following describes original testing performed on the paper cooler using three ice packs of coolant.

Methods

Products tested and materials used

The paper cooler was tested alongside EPS coolers of equivalent size that Thermo Fisher currently uses. Product containers in representative sizes were placed within each cooler, along with two or three preconditioned ice packs for the EPS and paper coolers, respectively. Thermocouple temperature probes were positioned inside each cooler to monitor and record the internal temperature. Temperature probes were also placed in the environmental test chamber to record the actual temperatures of the simulated shipping profiles.

Simulated shipping

Temperature exposure. Thermal performance was evaluated by running the paper and EPS coolers through simulated shipping conditions specified by the International Safe Transit Association (ISTA) 7E Summer and Winter Profiles. The ISTA 7E profiles are the global industry standard for thermal transport testing of packaging in simulated shipping conditions; they are based on data gathered from real-world transport lanes during summer and winter months. Both summer and winter profiles were tested in order to assess the coolers' performance under high-heat conditions as well as conditions in which the coolers must insulate the product from cold temperatures. Shipping simulations were conducted three separate times and in two distinct certified packaging testing locations to encompass variability in chamber performance and personnel.

Handling. To simulate potential vibrations, compression, and impacts that packages may experience during distribution and transport, the paper cooler was tested according to ASTM D4169-16, Standard Practice for Performance Testing of Shipping Containers and Systems.

Equivalency. To show that the EPS and paper coolers were performing equivalently, a TOST (two one-sided t-tests) procedure was used. In the analysis, the average temperatures inside the EPS and paper coolers were used with an equivalence threshold of 2.5°C.

Results

The testing demonstrates that under the ISTA 7E summer profile the paper cooler performs equivalently to the EPS coolers. Figure 1 shows the temperatures recorded inside the environmental chamber (top), and the results of the TOST equivalency test (bottom) comparing the EPS and paper coolers. With an equivalency threshold of 2.5°C, the probability value (p-value) remains below 0.02 for the majority of the simulated shipping test, indicating there is a 2% or lower chance the paper and EPS coolers have internal temperatures that differ by more than 2.5°C. The p-value is greater for the first few minutes of the test, where there is greater variability in the initial temperature readings of the individual coolers. We recognize gel pack disposal is challenging, and we are exploring options to reduce the associated waste while maintaining performance standards.

Figure 1. Testing of coolers under simulated summer shipping conditions. Top: Ambient temperatures of ISTA 7E simulated summer profile. Bottom: p-values from a TOST equivalency test with a threshold of 2.5°C. The p-value indicates the probability that the EPS and paper coolers differ by more than 2.5°C; in this case the p-value remains below 2% for the majority of the test. The typical delivery window for our shipments is indicated by the shaded gray area.

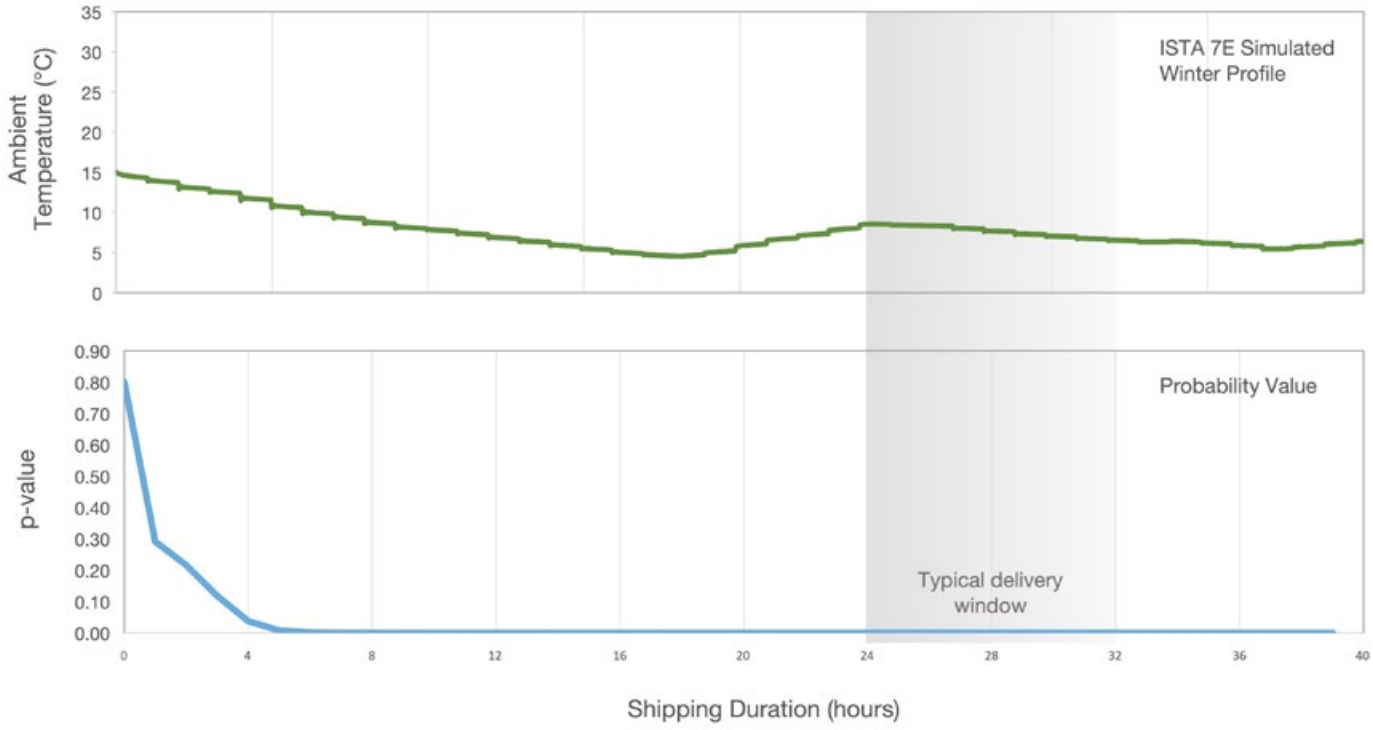

Figure 2. Testing of coolers under simulated winter shipping conditions. Top: ISTA 7E simulated winter profile. Bottom: p-values from a TOST equivalency test with a threshold of 2.5°C. The p-value indicates the probability that the EPS and paper coolers differ by more than 2.5°C; in this case the p-value remains nearly 0% for the majority of the test. The typical delivery window for our shipments is indicated by the shaded gray area.

The paper cooler also performs equivalently to the EPS coolers under the ISTA winter profile conditions, as seen in Figure 2. Under these conditions, the average internal temperature of the paper cooler is nearly identical to that of the EPS cooler. Here, aside from the initial variability, the p-value remains nearly zero for the duration of the test, indicating a ~0% chance that the paper and EPS coolers have internal temperatures that differ by more than 2.5°C.

Conclusions

These representative results validate the change from EPS to our paper cooler and provide assurance that the paper cooler meets the thermal requirements necessary to uphold our stringent product quality standards. The paper cooler delivers the same product protection to which our customers are accustomed; it is an effective alternative for cold chain shipments.

This study helps ensure customers will continue to receive the highest possible quality and significantly reduce packaging waste. For every 10,000 paper coolers we ship, we will keep more than 6,500 cubic feet of EPS out of landfills. The paper cooler is a win for our company, our customers, and our planet.

Find out more at **thermofisher.com/papercooler**

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