Introduction

Water-based paints account for roughly 80% of all paints sold in the residential market, and legislation is in place to increase the ubiquity of this product. The most common alternative, solvent-based paint, releases volatile organic compounds into the atmosphere with an adverse impact on the environment.

The main drawback of using water-based paint, and other similar chemical compounds such as epoxy, is that it can freeze at the same temperature that water turns to ice (32 °F). Water-based paint is made up of a mixture of components that, when frozen, can cause the segregation of existing solids and form a lumpy and ropy structure. This transition of liquid paint is irreversible and any affected paint should be discarded. Because of this permanent damage to water-based paint, it can be categorized as a temperature-sensitive product for shipment and handling purposes.

Insulated Products Corporation (IPC) offers an environmentally-preferred product, PopupLiner, that is fully recyclable and built to thermally insulate the contents inside a container. In this paper, the PopupLiner insulated box liner is introduced and its performance is assessed in preventing the freezing of water-based paint under cold conditions.

IPC's PopupLiner Insulated Box Liner

IPC's Environmentally Preferred Solution: PopupLiner

PopupLiner insulated box liners are IPC's innovative, high-performance insulated shipping boxes, which can be used to protect paint and grout against freezing during transit. Each PopupLiner unit is composed of two three-panel, tri-fold liners for a six-sided carton. PopupLiner thermal box liners are made of polyurethane foam and a proprietary ultra-radiant barrier that effectively reduces the flux of heat throughout the liner.

The insulated shipping liners are unique in that they provide an alternative form of temperature-control packaging that is both fully collapsible and compressible using IPC's patented technology. The self-inflating and expanding thermal liners arrive compact and vacuum-compressed in compression sleeves, and will automatically inflate to full thickness upon opening. This space-efficiency feature will save 75% in shipping and storage space as compared to the equivalent quantity of rigid coolers. These insulating liners are effective in protecting refrigerated, frozen, and room-temperature (RT) products for over 48 hours.

Cross section of PopupLiner Insulated Box Liner

Passive Insulation Results

A thermal test was devised to demonstrate the efficacy of PopupLiner insulated box liners in maintaining the room temperature (23 °C) of water-based paint during transport.

For this test, one gallon of water-based paint, pre-conditioned at room temperature (23 °C), was placed inside a box equipped with a 2" thick PopupLiner box liner. As a control sample, another paint container was placed inside a carton without a PopupLiner box liner. Temperature probes (type T thermocouples) were placed inside the containers submerged in liquid paint. The boxes were put inside an environmental chamber to be tested under winter conditions (ISTA 7D winter).

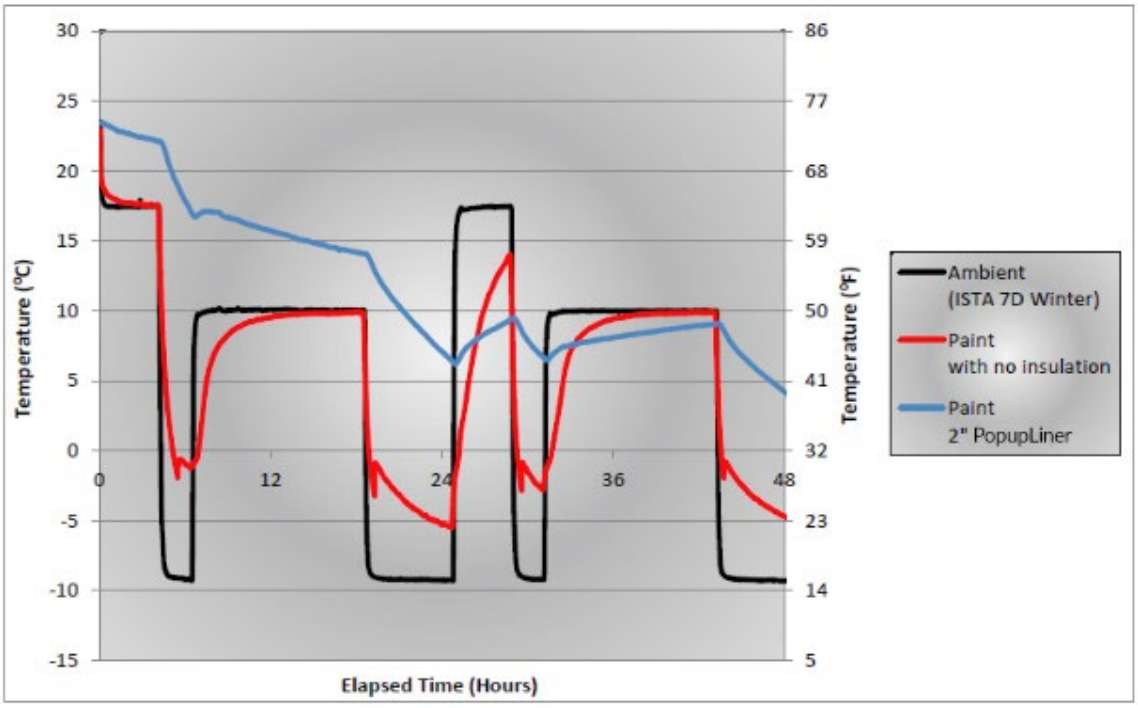
The temperature profiles of the oven and paint, with and without the PopupLiner box liner, are shown in the figure below. Without the protection of an insulated liner, the paint froze 4 times at sub-zero temperatures, while paint protected by the PopupLiner insulated liner dropped to 4 °C after 48 hours with no sign of freezing. The sharp upward spikes at sub-zero temperatures are indicative of freezing initiation caused by the release of latent heat of fusion during the phase change of water-based paint. This freeze-thaw cycle makes the paint unusable.

The test confirms that the PopupLiner box liner provides adequate and necessary protection against the freezing of water-based paint during transit.

Passive Insulation Results

1 gallon of water-based paint

A container of water-based paint inside a PopupLiner insulated box liner



The temperature profiles of the oven, and paint inside PopupLiner box liner. The red curve corresponds to the paint temperature when no insulation was used.

Summary

Shipping water-based (latex) paint during winter months requires special handling to protect against freezing temperatures, which cause permanent damage to the paint. An experiment was designed to evaluate the performance of the PopupLiner box liner in preventing the paint from freezing. A paint container was exposed to simulated freezing temperatures inside an environmental chamber.

The results of the test demonstrated that IPC's PopupLiner box liner maintained the paint temperature above freezing point for 48 hours under simulated winter conditions. Without the use of IPC's PopupLiner, the paint froze four times during the test.

About Insulated Products Corporation (IPC)

Since being founded in 1999, IPC has been an innovator of thermal packaging solutions. We have spent over a decade studying, perfecting, consistently producing and delivering effective cold chain thermal packaging to companies shipping medicines, foods, and industrial goods worldwide. IPC designs and manufactures, in-house, a variety of custom temperature control products for the cold chain shipping industry.

All of IPC's solutions provide high performance, while remaining space-efficient and green. We thrive on special requirements including custom sizes, extended shipping durations, unique temperature requirements, and sustainability.

Maintaining strict temperatures, maximizing payload, and minimizing weight and preparation time are the cornerstones of IPC cold chain solutions.
Contact us today to discuss your unique temperature assurance packaging requirements