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Glass Decoration with UV Inks

Glass Decorating Process

Traditionally, ceramic enamels are used for screen printing on glass containers called applied ceramic labels (ACL). These thermoplastic ceramic enamels become liquid when heated and are screen printed using electrically heated screens. On contact with the surface of a cold glass container, the ceramic enamels solidify immediately, but they have to be fired into the glass in a lehr at a temperature of up to 1,100-1,200 degrees °F. Then, the glass has to be annealed again by slowly cooling it down to room temperature for handling. This process can take several hours and is very expensive not only when considering the cost of energy used, but also in capital investment required for the lehr and the enormous floor space it occupies.

This traditional method of decorating glass containers and tumblers with thermoplastic ceramic enamels has several major disadvantages:

- Toxicity of Inks: Many of the frequently used enamels contain some lead and/or cadmium. Working with these colors requires decorators to test finished ware to insure compliance with FDA and California standards, and to file TRI reports with EPA.
- High Cost of Firing: Many decorators now calculate that the cost of firing is over one cent per item. With energy costs increasing rapidly in some states, this cost is escalating far faster than the selling price that these items will bear. This reduces profits significantly.
- Cost and Size of Lehrs: The tremendous size and cost of decorating lehrs remains an entry barrier into glass decorating. Lehrs can be over 100 feet long and due to a fairly precise firing time, they are often running a lower capacity than the decorating equipment which slows the entire process. There is also a high risk of reduced glass quality as a result of the heating and cooling process as glassware is fired.

Because of these disadvantages, for years decorators have tried, mostly in vain, to switch to U.V. inks in the decorating process. These organic inks solved the major problems of toxicity, cost, floor space and speed; however, they created a whole new set of problems.

Many U.V. inks required expensive spray pre-treatments with chemicals such as silane. Some needed to be baked after the U.V. cure to achieve any kind of decent adhesion. Some U.V. suppliers even demanded high licensing fees for the privilege of using their inks. Even after all these gimmicks, U.V. inks just didn't stand up to the industry standards for adhesion, abrasion resistance, and product resistance. Because of these unique disadvantages, U.V. inks on glass were primarily a niche market of decorative panels, game machine panels and such.

UVitro Technology

A new technology has been developed by Isimat called UVitro Technology (patent pending) for glass decoration that uses commercially available organic UV inks. These UV inks produce images with excellent adhesion and eliminate the problems associated with ceramic enamels.

There are three major components to this new technology:

- Pre-treatment units that provide adhesion and water (washing) resistance of the printed ink. The UVitro saystam is a plasma pretreatment unit in which an adhesion promoter is applied to the glass surface by means of a gas flame. By introducing a special mixture through the flame pre-treatment station, a physical barrier is left behind which allows the printed ink to mechanically bond to the surface of the glass substrate.
- UV inks which are special organic inks formulated for printing on glass containers. Tests have shown that several commercially available inks work with UVitro technology.
- Multi-color screen printing machinery with registration accuracy and print quality to reproduce nearly photo-quality images on glass.

U.V. decorating with UVitro technology is practical for bottles, tumblers, perfume bottles and jars. It can also be utilized with acid-etched, sandblasted, spray-coated or electrostatic coated containers and tumblers. Poor adhesion has been a problem in many of these segments when using U.V. technologies.

Acceptance Testing

Glass containers decorated with UVitro technology have successfully passed cross cur adhesion tape tests before and after the following tests:

- Dishwasher: Once the largest stumbling block for decorating household items like tumblers and mugs with U.V. inks, UVitro has now achieved positive testing after 300 washing cycles in a domestic dishwasher at 65 degrees °C using Calgonit tablets.
- Freezer: 48 hours at - 10 degrees °C
- Steam: 48 hours at 100% relative humidity
- Alcohol: 24 hours in a mixture of various alcohols and perfumes.
- Abrasion Resistance: Items have been tested with a positive outcome in filling lines including de-palletizing and palletizing.
- Multi-trip bottles: Development continues for resistance against caustic washing which is typical for multi-trip bottles. (We expect at least 10 cycles)

Technology Advantages

U.V. inks can produce superior graphics on glass containers at a lower cost that other inks and enamels. Print quality enhancements include an unlimited color range including special effects such as gold and silver as well as finer mesh which makes higher resolution graphics possible. Also, halftone and process color printing produce photo-quality images, and good opacity and brilliant gloss finish are achievable.

Process improvements include:

- Reduction in drying time from 90 minutes to a few seconds
- Color variation due to temperature fluctuations in lehr eliminated
- Inks contain no solvents, metals or toxic materials.
- Inks are easy to handle, no drying of ink in the screens.
- Inks cure instantly, ideal for use in high-speed printing machines.
- Excellent ink adhesion due to innovative UVitro pretreatment system.
- Cost reductions are achieved as no energy is required for firing, and no capital is needed for a lehr, push bar stacker or transfer conveyors. In addition, no floor space is required for a lehr and conveyors.

UVitro screen printing machines can be tailored to various specifications with up to 7 printing stations for bottles and tumblers and high printing precision. Production speed of up to 80 parts/minute are possible: in 2-up operation, 150 parts/minute is achievable.

Press controls enable decorators to adapt to various uneven glass surfaces while curing units are no larger than a shoe box and emit high intensity U.V. light for thorough curing. Heated screens are available on the same machine for printing ceramic enamels when needed.

This paper was presented at DECO 2002 in Arlington by Dave Miller of DECO Technology Group, Orange, CA. Isimat is located in Ellwangen, Gerrnany.

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