Thermochromic Liquid Crystal Inks

Description

H.W. Sands' "Mood Inks" contain microencapsulated Cholesteric Liquid Crystal mixtures that react visibly to changes in temperature. We provide the Reversible Thermochromic Liquid Crystals (TLC) in a water-based ink formulation for application to clear polyester and PVC substrates.

H.W. Sands' most popular and ideal for human contact is our TLC ink, MSA5000. The MSA5000 is a water based screen ink which begins its color change at 25°C (activation temperature) with a 5 degree bandwidth.

Red Starts at 25°C
Green Starts at 26°C
Blue Starts at 30°C
Returns to Clear at 44°C

As with all TLC inks, the colors shown above by MSA5000 are best visualized against a dark (preferably black) background.

Application Suggestions

Solvent Compatibility

The thermochromic liquid crystal (TLC) inks are sensitive to polar solvents. At the time of printing the TLC ink, the use of volatile organic solvents (like those commonly used in screen printing - ketones, esters, etc.) should be avoided. These can penetrate the microcapsule wall and interact with the TLC mixture inside changing (and eventually destroying) the color reflecting properties. The interactions likely to occur between the TLC inks and any materials used with it to produce color change effects must always be considered. The color change properties of TLC inks are produced by a very delicate and sensitive arrangement of molecules, and it is very easy to change/destroy them without realizing.

Product Properties

All TLC inks begin their color transition with the color red, followed by green then blue. The TLC will revert back to clear if the temperature is raised enough beyond the post activation temperature. All transitions are reversible.

Pre-Activation Temperature	Activation Temperature	Middle Temperature
Clear	Red	Green

Activation Temperature + Bandwidth	Post-Activation Temperature
Blue	Clear

III. Activation Temperatures and Bandwidths

Temperature Range	Bandwidths
$0^oC – 50^oC$	$1^oC – 7^oC$

Printing Recommendations

A. General Considerations

The Thermochromic Liquid Crystal (TLC) Inks must be printed and dried in a completely SOLVENT-FREE environment. The sensitivity of TLC inks to oils, UV light and monomers used in UV inks should also be considered.

B. Screen Inks

Thermochromic screen inks can work on hand or automatic (rotary or flat-bed), sheet or web-fed screen printing equipment. It is preferable to use a medium or medium-hard (65 durometer) rounded edge squeegee. A monofilament polyester US 100 – 150 mesh (40 – 60 threads/cm) is recommended. For best color effect, print four passes with drying after the first two passes. Coverage of approximately 12,000 sq in per kilogram (based on 2 coats – 4 print passes) can be achieved.

C. Coating Thickness

The coating thickness of the TLC ink is an important aspect in obtaining the desired color change effect, in the final article. Generally, for inks of this nature, the thicker the coating the lower the onset of color (red start). Too thick a coating often results in the normally brighter colors appearing slightly milky. This is more noticeable at the red end of the spectrum. For the TLC inks, wet film thicknesses of around 150-300 microns (6-12 mil. approx.) which dry to approximately 50-100 microns (2-4 mil.) are recommended. Optimized coating thicknesses depend on the actual printing conditions.

D. Additional Coating Materials

As indicated above, additional coatings/inks (blacks, clear overcoats, etc.) are necessary, in conjunction with the TLC inks, to produce the desired effect. Such coatings, which may or may not be in direct contact with the TLC inks, should be water based or fully UV cured. **Materials containing volatile solvents should be avoided** (see section V). Tests for compatibility with TLC's should always be carried out before hand as even some "water based" inks can contain components detrimental to the TLC inks.

Heat and Drying

Rack or forced air. Temperatures up to about 90^OC (195^OF) can be used although lower temperatures ($60\text{-}65^OC/140\text{-}150^OF$) are recommended. When possible, apply heat from below, with gradually increasing temperatures. Maximum water-resistance will not be achieved for several hours after drying. Temperatures above those recommended will minimize the impact of the visible color change of the liquid crystal.

Stability

TLC inks are not scratch resistant or stable in UV light, and there will always be a need to protect them. The best method of protection is a clear heat applied over laminate, with low to no plasticizers and preferably strong UV absorbing properties and the TLC inks should ideally be dry before it is applied. It should be noted that if the temperature setting of the laminating machine is too high then damage can be done to the TLC's and it is therefore necessary to run a short test before running the complete job. The surface finish of the dry TLC inks is important to the quality of the color change images obtained and the use of a clear over laminate might also offer benefits in this respect. Also in some cases an overcoat or varnish can be used (again with UV absorbing properties) however care needs to be taken as many of these contain products harmful to TLC's and therefore again tests should always be carried out in advance to check suitability.

Storage and Handling

Store at ambient temperatures (20-25^{O}C) out of direct sunlight and preferably in the dark. The inks may separate to a small extent on standing for prolonged periods and should be mixed until homogeneous. If stored correctly, the TLC coatings have a useful shelf-life of three to six months.

All applications using the thermochromic products should be thoroughly tested prior to approval for production.