MICROENCAPSULATED TLC SLURRIES FOR USE IN RESEARCH / COATING APPLICATIONS

- **Pigments for the manufacture of temperature-sensitive coatings**

- **Temperature-sensitive tracer particles for use in fluid flow field studies (temperature field visualization)**

Optimized microencapsulated TLC slurries are offered for each of the above research application areas.

SLURRIES FOR COATING MANUFACTURE

TLC mixtures are offered in the form of microencapsulated slurries in water. The slurries are available in 33% and 40% solids content. The microcapsule diameters are centered in the range of 10-15 microns. The TLC mixtures are custom formulated to the required color change properties. These slurries can be used to make sprayable, printable, and paintable TLC coating formulations by addition to aqueous binders*.

*Please note—Always perform compatibility tests with the TLC and binder prior to use.

TRACER PARTICLES FOR FLUID FLOW STUDIES

Custom-formulated chiral nematic and combination TLC mixtures are also offered in the form of 33% solids slurries in water for use as tracer particles in fluid flow studies. An optimized microcapsule diameter range for such products has been determined to be 50-100 microns, and products with microcapsule diameter distributions in this range are recommended for this type of application. Other microcapsule diameter distributions can be made to order.

CUSTOM MANUFACTURE

All microencapsulated slurries for research applications, whether they are for use as the pigments in coating manufacture or as tracer particles in fluid flow studies, are manufactured to order. A complete custom manufacturing service is therefore available, enabling slurries to be tailor-made to customer requirements of, for example, color change properties, microcapsule diameter distribution and solids content.

Using LCR Thermochromic Liquid Crystal (TLC)
As Tracer Particles

GENERAL INFORMATION AND NOTES

- The materials can be used in either of 2 forms;
  a) Unsealed liquid crystal (which is oil)
  or
  b) Microencapsulated liquid crystal slurry (33% microcapsule solids in water)

  Colors reflected by the unsealed TLC mixtures will be brighter than those reflected by microencapsulated materials. However, unsealed mixtures will be less stable, be more susceptible to degradation and contamination and thus have shorter lifetimes than their microencapsulated counterparts. The use of microencapsulated TLC mixtures is recommended.

- Studies should always be carried out against a dark, preferably black background.

- The interactions likely to occur between the TLC and any materials used with it to produce color change effects must always be considered. The color change properties of TLCs are produced by a very delicate and sensitive arrangement of molecules, and it is very easy to change and even destroy the color play properties.

- The carrier fluids must be aqueous. Recommended fluids include water, glycerol, ethylene glycol, and other similar low molecular weight polyhydric alcohols. Using mixtures of such highly hydroxylated materials with water, it is possible to produce a range of carrier fluids with a variety of viscosities to suit most applications.

- The colors observed depend not only on temperature, but also on the angles of illumination and observation. Color play specifications supplied with materials have been calibrated using a technique with both incident and reflected light normal to the surface of a thin film of TLC. In the use of the materials as tracer particles in fluids, illumination and viewing are generally not carried out from the same direction, and color change properties will be different to those supplied in the materials specification. In addition, TLCs have different properties when used in bulk fluids as opposed to their use as thin films. It will thus be necessary for the user to recalibrate the color play properties of the materials to suit the particular method of use.

- As with all TLC applications, the better the illumination, the brighter the colors reflected by the TLC. However, the use of incandescent lamps close to the materials should be avoided if possible, as the materials are sensitive to UV light, and the color play properties will change on prolonged exposure. Color temperature profiles should be checked at regular intervals to ensure that no shift has occurred.

USAGE INSTRUCTIONS for LCR TLC as tracer particles

1. Some simple tests need to be carried out before proceeding.

   a) The **compatibility of the carrier fluid must be ascertained.** This can be done by adding some TLC (either the unsealed liquid or microcapsules) to a small sample of the carrier fluid and checking the stability of the color play response with time. (The unsealed TLC should be emulsified in the carrier). The color-temperature response should be stable for the duration of the study. Glycerol and water (at the viscosity extremes) are readily intermiscible and should have little effect on the materials.

   b) The **optimum doping level should be evaluated.** This will depend on the nature of the study, and whether the materials are used as the unsealed liquids or microencapsulated. As a starting guide, a doping level between 0.01 and 0.1% is recommended, however, it may be that the optimized level finally falls outside this range.

2. **Dispersing the TLC in the carrier fluid.**

   a) Microencapsulated **mixtures** can be added directly to the carrier fluid. The composition of the slurry provided (33% capsule solids) should be kept in mind throughout the test to keep check on the doping levels. Alternatively, the slurry can be filtered before use if the carrier is not 100% water, and the excess water in the slurry is not required. A record of the amount of water removed should always be kept for doping level calculations to be made accurately. Because the doping levels are relatively low (a 50 liter tank will only require 75ml slurry (33% capsule solids) to dope to a level of 0.05% capsules), it may be easier to add the slurry/microcapsules to a small sample of the carrier fluid 1:1 and then add this to the remainder of the carrier. An optimized microcapsule diameter range has been determined to be 50-100 microns for the TLC mixtures commonly used in this type of application, although other microcapsule diameter distributions are available.

   b) Unsealed **TLC mixtures.** Neat TLC mixtures have to be emulsified in the carrier fluid. This can be done using a suitable homogenizer, or high-speed mixer. Having calculated the doping level, the required amount of TLC should be added to a small amount of the carrier for emulsification. (100-250ml should be sufficient.) The emulsified TLC should then be added to the remainder of the carrier fluid. After addition of the TLC, continual agitation of the carrier is recommended to minimize the chances of the TLC droplets coalescing. Optimum particle sizes for the TLC droplets are in the range of 5-50 microns. Diameters centered around 10-15 microns for chiral nematics, and 20-30 microns for cholesterics are recommended as starting points. A 50-liter tank will require the addition of 25g emulsified TLC for 0.05% doping.

3. With the TLC dispersed in the carrier fluid, experiments can commence. For optimum performance, reference to the general notes overleaf should be made.

4. **Storage**. Microencapsulated slurries should be stored in a refrigerator (5-10^{o}C (40-50^{o}F)) when not in use - DO NOT FREEZE. Unsealed TLC mixtures should be stored out of direct sunlight at room temperature. If stored correctly, the materials should have usable lifetimes of at least 6 months for the microencapsulated products, and in excess of one year for the unsealed mixtures.