

## **Printing Ink Vehicles**

By volume, typically the largest component of a thick film printing paste is the organic components, or vehicle. The vehicle is one of the most critical components of a printing paste even though it typically does not remain in the final fired component. Polymer Innovations, Inc. (PII) produces vehicles for a number of applications. These vehicles are formulated, produced, filtered and pre-tested at PII. In most cases these vehicles can be mixed with required metal and ceramic powders to yield pastes which can be designed to offer a variety of drying rates, residual tackiness levels, various solids and viscosity levels all with exceptionally low attack or distortion on ceramic tapes.

Commonly, electrode vehicles are based on modified cellulose polymers such as ethyl cellulose (EC). These polymers have a number of defects including sometimes difficult polymer availability, marginal purity, low dispersing power and a need for the use of strong solvents which can cause both wet and dry distortion if printed on ceramic tape. PII has the ability to produce custom polymers designed specifically for this type of application. Several different vehicle chemistries have been identified to eliminate many of the problems associated with the EC vehicles. One product is based on a modified EC while the others are synthetic acrylic type polymers which can offer improved performance.

Printing vehicles contain the basic polymer dissolved in a low toxicity mixture of aliphatic hydrocarbon solvents with small amounts of active oxygenated solvents. The compositions also may include small amounts of stabilizers and tackifiers. Normally the compositions do not include dispersants but the synthetic based polymers have dispersion capability designed into the polymer which may or may not require additional dispersant. The dispersant which works best for the powder should be used in the paste formula. Typically the vehicles are sold more concentrated than actually needed and the paste formula would also contain a thinner. Various components of the paste can be pre-milled or dispersed in these thinners if desired. The use of thinners can also help reduce viscosity as well as the overall organics level of a paste.

Vehicles contain a rather narrow boiling point cut of solvents for a combination of good screen life and yet fast drying. Since the vehicles are formulated with predominantly hydrocarbon solvents a nearly infinite range of drying rates can be created. Pastes can be fabricated to yield practically no tack (or stickiness) when dry but will become tacky upon slight warming. Many pastes rely on residual solvent presence for tack resulting in a less consistent process, especially if cycle times are interrupted. However the vehicles discussed below rely on thermoplastic tack of the resins even when the paste is totally dry. This allows a much wider processing window for many tape-stacking operations.

## **New Series Vehicle Advantages:**

- Exceptionally low attack or distortion to ceramic tapes or polymer substrates in both wet and dry state.
- Improved dispersion characteristics and strong tendency to reduce metal “flaking” during milling.
- Good adhesion to substrate characteristics
- Tack (adhesion to next layer after drying) can be formulated over wide range and is existent even after solvents are totally gone.
- Tack can be heat activated for wider operating window of stacking operations
- Nearly infinite adjustable drying speeds available and blendable
- Concentrated and adaptable to 2 stage milling of ingredients if desired
- Narrow solvent boiling point range for good screen life yet easy complete drying
- Low toxicity solvents
- Clean burnout characteristics
- Delivered pre-tested and filtered

## **Recommended Vehicle Products For Trial:**

**VS36H and VS36L:** These products are based on a modified EC polymer designed to help with some of the weakness of EC based pastes. In particular they have been formulated for higher green adhesion to ceramic tapes after lamination and lower wet and dry ceramic tape distortion. These two products are identical except the 'H' uses higher molecular weight polymer while the 'L' contains lower molecular weight polymer. This means the 'H' has higher viscosity and the 'L' is lower viscosity and the two can be blended in various ratios to control final paste viscosity while keeping the organic solids amount in the paste constant. The preferred thinner is TS33.

**XA1-2:** This is an experimental vehicle based on a custom designed acrylic polymer with superior green adhesion and dispersion capability. The preferred thinner is TS33.

**AC6-1:** This is an experimental vehicle similar XA1-2 except the acrylic polymer has been designed to be more like typical ceramic tape binders and uses slightly stronger solvents. It also has superior green adhesion and dispersion capability. Thinner TS33 is acceptable.

**PII offers several other variations of the 'VS' & Synthetic Vehicle Series, varying in molecular weight and viscosity so please contact us for more information!**

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