

# Binders and Pastes for Multilayer Ceramics

We offer the Only Water-Based, Non-Toxic Tape Casting Binder System that matches existing solvent processes by Polymer Innovations.

The innovative water based system is binder and surfactant in one, allowing manufacturers to achieve green ceramic tape properties that until now were only possible in solvent systems.

In combination with these systems, we also provide compatible paste systems and paste vehicles. These can be customized to composition, for piezo or for your current tape or fuel cell application (based on proprietary materials or ready to use compositions).

We also supply metallization pastes and paste binders. A successful product is the VT-series BME termination binder, fully compatible with the burn-out of copper containing systems.

## WB Series Water Based Binder System:

Product	Solids (%)	Typical level (wt. % in slip)	Comments
WB4101	35%	10 to 30	Water based binder with plasticizer (7%), basic defoamer, wetting agents and other additives. Binder also acts as ceramic dispersant and therefore typically 25-50% of the total binder should be included in the grinding stage.
WB40B-44	30%	10 to 30	Similar to WB4101 with a lower amount of plasticizer (5%) to make stiffer tapes
WB-40B-53	26%	10 to 30	Similar to WB4101 without plasticizer to make stiff tapes

<b>Binder Additives:</b>			
Product	Solids (%)	Typical level (wt.% in slip)	Comments
<b>Defoamers:</b>			
DF001	100%	.05-.25	Modified silicone copolymer especially effective when combined with DF002 but with some powders can cause crater or fish eye defects. Must be careful to not over dose as it can cause casting defects such as fish eyes.
DF002	100%	.05-1.0	Most popular and useful defoamer. Non-silicone mild defoamer most compatible so over dosing is not critical.
<b>Plasticizers:</b>			
PL001	100%	.2-1.5	Neutral pH plasticizer the same as the plasticizer used in WB4101 for increasing tape softness and lamination characteristics.
PL002	100%	.2-1.5	Medium/high pH plasticizer, similar to PL001 but more reactive with binder. Also increases binder dispersion power if included in stage 1. PL002 is effective for increasing the ease of tape lamination and helps with making cleaner cuts during chip dicing.
PL005	100%	.2-1.0	Very high pH plasticizer, similar to PL002 but even more reactive with binder. Strong reactivity can help manage certain difficult powders. If very reactive ceramics are causing problems such as precipitation of binder or adverse tape reaction it is often helpful to include PL005 in the formula. It also increases the dispersion power of the WB4101 and some other dispersants such as DS001, DS005 and DS009 if it is included in the grinding stage allowing more effective dispersion of nano powders. Due to high pH can make dried tape more susceptible to water attack.
<b>Steel Belt Release Agents:</b>			
BR008	100%	.5-1.5	Internal belt release additive (see comments under BR021). Added to first or second stage will help tapes release from steel belt casting surfaces. Should avoid premixing with the binder as it can cause temporary binder precipitation.
BR021	100%	N/A	The preferred belt release since it is used externally and does not adversely impact tape properties as an internal belt release can. BR021 is used by applying a coating to the steel belt before ceramic casting. Typically a dilute solution of about 5-10% in hydrocarbon such as naphtha or toluene is made and a very thin film applied to the steel belt by means of a felt wick type applicator far enough in front of the casting head so the solvents are dry. The BR021 can also be high shear mixed into a water emulsion for application if hydrocarbons should be avoided.
<b>Thick Casting Additives (Useful when casting greater than ~ 100 microns depending on the ceramic):</b>			
TK004	30%	.2-.6	TK004 and TK005 for water based binder are typically used in a 1:1 ratio and react together in the slurry to increase thixotropy for enhanced thick casting. These additives work to stabilize thick sections of tape during drying to allow thicker casts, help prevent cracking, reduce ceramic settling and increase thick cast uniformity. The increased viscosity can also stabilize small bubbles which may require more rigorous defoaming and more defoaming additives. Since the two additives react together, order of addition and mixing is critical and for more details see separate recommendations/videos for thick casting.
TK005	100%	.2-.6	
<b>Dispersing Agents:</b>			
<b>Note:</b> Normally the best dispersant for WB4101 is actually WB4101 itself since it is similar in nature to popular ammonium polyacrylate dispersants. The use of the popular ammonium polyacrylate dispersants will result in dramatically lower tape strength. Below are compatible dispersants for specific applications.			
DS001	40%	.5-2.0	Strong polymeric dispersant useful for most ceramics and compatible with the WB binders. Usefull with or without any other binder in dispersing stage.
DS002	100%	.5-1.5	A very strong phosphate ester miscible in water and most solvent systems. It is normally used with solvent based binders since it can cause loss of tape strength with WB4101.
DS005	50%	.3-1.5	Strong polymeric dispersant useful for most ceramics and compatible with the WB binders. Disperion strength is improved even more if there is a small amount of PL005 included in the first stage.
DS009	65%	.3-1.5	Strong polymeric dispersant with different properties than DS005 which makes it especially useful for zirconia ceramics and can be tried if DS005 does not work well.
<b>Wetting Agents:</b>			
BR010	100%	.01-.2	Modified silicone helpful in preventing pinholes, craters and mud cracking. It is particularly useful if it is noticed thicker tape is weaker than thinner tape and helpful when casting tape with a Hybrid System (mixing solvent with WB system). BR010 is also useful to reduce the adhesion of cast tape to silicone-treated PET film.
WT001	100%	.05-.25	Non-silicone, wets surface of powders. Does not increase siPET wetting. Acts as mild defoamer and has limited compatibility therefore a level too high for the formulation can result in fish eye formation.
WT006	50%	.1-.5	Water compatible acrylic leveling agent. Helpful in eliminating pinholes and craters.
WT005	100%	.01-.15	Modified silicone that is very effective wetting agent. Allows higher film thickness and reduces air-draft sensitivity of various coatings. This is a solvent-free additive.
WT007	100%	.01-.15	Modified silicone helpful in preventing pinholes, craters and mud cracking. May increase foam and reduce ability to laminate. It is particularly useful if it is noticed thicker tape is weaker than thinner tape and helpful when casting tape with a Hybrid System (mixing solvent with WB system).
WT012	50%	.05-.5	A modified silicone with main effect of increasing the wet-ability of the slurry on silicone treated PET film and can also help with managing more reactive ceramic powders.