pH Effects on WB4101 Binder Systems

The WB polymer we use in WB4101 and other lower plasticizer versions has some copolymerized acid groups which allow it to have very high dispersion and strength properties.

The WB polymer is not soluble in water but when some acid groups are neutralized with a small amount of high pH base material such as ammonium hydroxide or other base additive the polymer will become soluble in water.

The more of the acid groups which are neutralized the more the molecule will open up and the higher the viscosity will come and the better the dispersing properties will become.

As shipped from PII about 1/3 of acid groups are neutralized with ammonium hydroxide. In this state at 35% solids the viscosity is about 800 cps but if you add more ammonium hydroxide or other base to the concentrated binder the viscosity will increase dramatically. However, when the binder is diluted with water and in contact with ceramic powder the viscosity increase is much less.

Some common plasticizers we use are high pH basic materials. The PL002 is a weak base which usually enhances lamination and cutting properties, PL008 is a stronger base and helps with stability and dispersion while PL005 is very strong base even stronger than ammonium hydroxide. Also the stronger the base the stronger the dispersing properties can become.

So adding PL002, PL008 or PL005 is also like adding some base material and viscosity can go up or down depending on how much binder is present. For example with a small amount of binder with the ceramic like the first stage of ball milling sometimes the viscosity will go down with the addition of base and this is because the dispersion of the powder maybe a little difficult and more base makes the binder a stronger dispersant lowering the viscosity. In the same example when the rest of the binder is added in the second stage the base can make the viscosity of the binder go up and this can cause the slurry viscosity to go up.

So a lot of the time that is how it happens. The addition of base like ammonium hydroxide, PL002, PL008 or PL005 may make the first stage milling viscosity go lower but usually it makes the final slurry viscosity go up because in the final stage there is more binder present and the pH makes the molecules open up more and increase viscosity.

PII also supplies another plasticizer called PL001 which is neutral and has less effect on viscosity than PL002, Pl008 or PL005. PL001 is the plasticizer which is already in the WB4101. We normally recommend the PL002 for lamination or cutting improvement because when it combines with the PL001 already in the WB4101 it has a greater lamination effect than only adding a lot of PL001.

One advantage of the WB binder polymer is good strength, high tape density and easy lamination. Also as you can understand it has reversible water solubility. For example as mentioned it becomes water soluble with some small amount of ammonium hydroxide (which is already in the WB4101 formula) but when the slurry is cast the water and the ammonium hydroxide evaporate so the tape is now water resistant. However, if the water and ammonium hydroxide which was dried out in tape making is added back to the scrap tape it is possible to remake slurry.