Understanding Flocculation and Deflocculation in Claybodies

Vince Pitelka, 2021

In order to fully understand the behavior of claybodies and to deal with short claybodies that seem non-plastic and fracture easily when worked, we must understand the phenomena of flocculation and deflocculation. This is particularly important with porcelain, white stoneware, and white earthenware bodies containing a high proportion of raw kaolins, which sometimes contain trace amounts of soluble alkaline compounds that can dissolve in the moist claybody and render it unworkable in studio use.

Particles in a water suspension can have a negative, neutral, or positive electrical charge, and although a claybody is not a water suspension, the same chemistry applies. Particles with the same charge in a water suspension repel one another, similar to the behavior of positive against positive or negative against negative poles on magnets. But like magnets, dissimilar charges attract. Adding a minute amount of alkaline material to a water suspension will deflocculate the mix, introducing like electrical charges, causing the particles to repel one another. Adding a minute amount of acidic material will flocculate the mix, introducing opposite electrical charges, causing the particles to attract one another. Think of a flock of birds—deflocculation causes particles to separate; flocculation causes them to flock together.

Deflocculation is desirable in a casting slip where repulsion between particles allows a fluid mix with far lower water content and thus far less drying shrinkage in the casting. Deflocculation is highly problematic in plastic claybodies because the repulsion between particles diminishes both plasticity and friction points. Because processed kaolins are occasionally slightly alkaline, it's wise to add a small amount of Epsom salts (magnesium sulfate) as a flocculant when mixing porcelain or whiteware bodies. Use ½ of 1% of the dry batch weight, dissolved in a little hot water and added to the water in the clay in the mixer before the dry materials. For mixed clay that seems short, a squirt of Epsom salt solution thoroughly wedged (or repugged) into the clay usually improves plasticity dramatically. It can do no harm, and if trace alkalinity is present, Epsom salts will neutralize it and flocculate the claybody. Vinegar also works, but the acidic content evaporates over time, while Epsom salts do not.

Midrange and low temperature claybodies often contain soda feldspars like nepheline syenite that release sodium ions into the clay over time. Even if you add Epsom salts, at some point the sodium ions can overpower the flocculant and render the clay unusable. Many are the porcelain and whiteware bodies that have been discarded when they could easily have been fixed with a squirt of saturated Epsom salt solution and a little wedging or repugging. The working characteristic of a deflocculated claybody is called thixotropy, and such a claybody is said to be thixotropic. After sitting for a while, the particles nestle together, increasing contact points and perceived stiffness, but as soon as the clay is mobilized by wedging or dropping, the

water layers reactivate and the particles repel, decreasing friction that normally provides structure in a plastic claybody. A thixotropic claybody is interesting to experience, but pretty much useless in the studio. If it happens to a significant quantity of mixed clay, weigh it, put it back in the mixer, estimate dry weight by subtracting 25% of the wet weight, and add ½ of 1% of the dry weight in Epsom salts dissolved in a small amount of hot water and slowly disperse it into the clay as the mixer is operating. The change will impress you.