Claybodies and Components

Vince Pitelka, 2021

Pure naturally-gathered clays rarely satisfy all our needs for a particular application. Claybodies are mixtures of clays and other materials designed to give specific working qualities in the plastic state and aesthetic and practical qualities when fired. In formulating a clay body, we try to select clays that are already closest to the characteristics we seek. For example, a lowfire terracotta sculpture body would be composed primarily of common earthenware clay like Redart for the classic red color and low firing temperature, but would also contain fireclay and grog to increase refractoriness and working structure and decrease drying and firing shrinkage.

Remember Green Packing Density and Distribution of Particle Sizes - The best claybodies combine clays that introduce a broad variety of particle sizes. Most natural earthenware and stoneware clays and some fireclays feature a wide range of particle sizes, while kaolins are primarily coarse, and ball clays and bentonites are very fine. A claybody containing a broad range of particle sizes will be very plastic with good working structure, good dry/bisque strength, and reasonable drying and firing shrinkage. For more information, see the handout, "Green-Packing Density and the Effects of Particle Size on Clay Performance."

Non-Plastic Components of Clay Bodies

In claybody formulation, the plastic components are the clays, while everything else added is non-plastic and will interfere with plasticity. That's usually not a disadvantage because excessive plasticity is problematic, and non-plastics provide wet working structure and various advantages in the firing of the claybody. For studio claybodies, non-plastic materials rarely make up more than 50% by weight of the dry batch recipe. There are three primary categories of non-plastic additions—fluxes, silica/flint, and tempering materials like sand or grog.

Fluxes—Naturally occurring clays contain some flux, but depending on the desired firing temperature and maturation qualities we often add supplemental flux. In midrange and highfire stoneware and porcelain bodies the supplementary flux is usually feldspar, which contains potassium and sodium, both powerful and effective clay body fluxes.

Historically, the most common lowfire flux was iron, already present in naturally occurring earthenware clays. Iron is still the preferred flux in reduction fired terracotta, but in oxidation-firing, iron remains in its red ferric state as a stiffener or refractory, but in a reduction atmosphere in a fuel kiln, ferric iron converts to ferrous iron, a very powerful flux. For lowfire bodies to be oxidation-fired in electric kilns, or when greater vitrification or whiter color is required in reduction firing, common lowfire fluxes are talc (magnesium silicate) or a calcium borate frit like Ferro 3124. Frits are combinations of ceramic raw materials formulated in industrial circumstances, melted to a glass, and reground to powder. Boron is an especially

effective low-temperature flux, but natural sources like borax and Gerstley borate are at least partially soluble in water, rendering them unsuitable as a clay body flux. The fritting process drastically reduces solubility.

Any significant amount of iron in a claybody intended for reduction firing must be considered a body flux, and other flux additions should be adjusted accordingly in order to avoid firing problems like bloating and slumping. Significant iron is frequently added to midrange oxidation bodies intended for electric firing in order to give a toasty red-brown color, but the same clay body fired to midrange in reduction will often bloat and slump when the iron converts to the ferrous form, resulting in a serious oversupply of flux.

Remember that adding flux to a claybody always involves a tradeoff. Flux lowers the maturation temperature by accelerating formation of the glassy phase and encourages a denser fired product, but also produces a weaker glass. The solution is to add just enough of the right fluxes to achieve the desired maturation temperature and a reasonably durable fired product.

Silica/Flint—Clay is an aluminum-silicate mineral, and naturally-mined earthenware and stoneware clays contain a good balance of alumina and silica. There is always enough alumina present, but a small addition of flux is often added to determine maturation temperature and fired quality. Kaolins are higher in alumina and thus midrange and highfire porcelain and porcelaneous stoneware bodies generally require additional flint to ensure an adequate glassy phase and proper vitrification.

Tempering Materials—When designing claybodies for greatest working structure, reduced drying shrinkage, and/or gritty texture we often add tempering materials like grog or silica sand. Grog is just previously fired clay re-ground and graded to sand-like grit. We can choose from many grit sizes of sand and grog depending on the desired working qualities and fired texture. Fine-textured or gritless claybodies are very popular, but with no tempering materials added, they can be highly problematic in workability and potential firing flaws. Many seemingly-gritless claybodies have particularly good working properties due to the presence of very fine kyanite or mullite grog in the 100 to 200-mesh range. You can barely feel it's presence in working the clay, but those grog particles are still like huge boulders compared to the clay platelets, and greatly enhance working structure.