

Why Does Clay Become Hard and Permanent in Firing?

Vince Pitelka, 2021

The nature of clay in the plastic state allows it to be formed into infinite sculptural and functional shapes, and while certainly fun and worthwhile in itself, the product of our endeavors would have little enduring value without the firing process. In any firing, once the temperature passes beyond dull red heat at about 900°F, all materials in the clay or glaze begin to dissociate to oxide form, leaving only a limited range of simple oxides to interact in the maturation of the clay body and glaze melt. For a more thorough explanation of this see the discussion of ceramic chemistry in *Clay: A Studio Handbook*.

The transformation in clay that take place in the firing process has to do with interaction of three primary categories of ceramic oxides—fluxes, stiffeners, and glass formers. Fluxes are melters or melting agents that have a solvent action upon more melt resistant materials and combine with silica to form glass. Refractories or stiffeners are highly melt-resistant materials that act as building blocks or structural matrix to provide the relative degree of physical structure and melt-resistance in clay bodies and glazes. The only stiffener of consequence in studio ceramics is aluminum oxide or alumina. Glass formers help create the glassy matrix that provide the binder in clay and the primary material in glaze. The only glass former of consequence in studio ceramics is silicon dioxide or silica.

The variable interaction of fluxes, stiffener, and glass former contributes to the unique qualities of different clay bodies and glazes. A careful and appropriate balance of these three types of ingredients is critical to achieve a stable clay body or glaze that matures at the intended temperature and has the desired qualities of appearance, performance, and safety/stability.

In the geologic formation of clay, most fluxes present in the parent feldspar have been leached away, but small quantities remain to react with silica, the essential glass former. The resulting glass acts as the binder between refractory particles. The amount of flux present within raw clays determines how far this process can proceed, and we often add accessory flux to achieve a denser, more durable fired product at a certain temperature. Adding flux lowers the maturing temperature of the resulting clay body, but also weakens the binding glass and gives a more fragile product. Thus, we only add the amount of flux needed to achieve the desired clay density and maturing temperature.