

when it is dried

these clays containing more clay substance will show high shrinkage. Because of high shrinkage, some clays are difficult to dry without cracking. The outside tends to shrink faster than the inside. The surface crack results.

High shrinkage and, therefore, the tendency to crack is decreased by iron plates, non-shrinkage additions, sand is sometimes added to a plastic clay to reduce shrinkage in the manufacture of brick. Flint and felspar perform the same function in unglazed porcelain and they do the same in fire bricks. Lower the shrinkage of clay, better is it for the purpose of making maintaining plasticity is required for practicality.

### The effect of heat on clays

While considering the effect of heat on clays, it is necessary to note, that a clay is composed of a mixture of mineral fragments consisting only part of actual clay substance. The clays are chemically called Hydroxyl Aluminium Silicates ( $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$ ). This will be used to illustrate the effect of heat on this group of minerals.

Upon heating a clay above  $100^\circ C$  ( $212^\circ F$ ), in open air, all mechanically combined absorbed water is converted into steam and passes off. Above this temperature clay is free from uncombined water and it is hard. In this process of drying the clay substances change from soft plastic material to a hardness. From this stage again the clay may be brought back to plasticity by adding water.

When the Hydroxyl Aluminium Silicates are heated to approximately  $752^\circ F$  ( $400^\circ C$ ) or above, the clay mineral breaks down and loses the chemically combined water, the  $2H_2O$  of the kaolinite mineral. This dehydration occurs at about  $750^\circ C$ .

At the temperature between  $1200^\circ$  to  $1300^\circ C$  the Alumina and Silica will combine to form Mullite ( $3Al_2O_3 \cdot 2SiO_2$ ), the only stable high temperature material composed of Alumina and Silica. All clays when heated to this temperature will develop needle-like crystals called "Mullite". Mullite is stable and will not change upon further heating until its melting point is reached.

### The firing stages of clay

1. Dehydration ( $20-150^\circ C$ ), mechanical Dehydration or "water smoking" ( $150^\circ C-600^\circ C$ ), chemical dehydration or "chemical water smoking"
2. Oxidation ( $350^\circ C-950^\circ C$ )
3. Vitrification ( $900^\circ C$  to plus, followed by fusion)