Basic Ceramic Terms: *Valdosta State Univ. - Compiled by Michael T Schmidt SP'08*

Bat: In North America, 'bat' most often refers to a wood, plastic, or plaster disk which are used on the potters wheel. A bat is held in place by pins, an interlocking arrangement, or "attached" using wet clay or slip. Ware can then be thrown on the bat and the whole thing removed to make another piece. In Europe the term 'bat' refers to kiln shelves (i.e. UK). Thus 'bat wash' is kiln wash.

Bisque, bisquit, bisque-ware: *First firing of ware usually at a low temperature (012-04) to drive off water and harden ware so as to facilitate glazing.* The practice of prefiring ware without glaze to make it impervious to water, easy to handle, or vitrify it. Glaze is then applied and it is fired again. **'Low' bisque** firing is typical for pottery and ceramics while vitrified bisque is done for bone china and some types of stoneware. Low bisque should be fired as high as possible to burn away all carbonaceous matter, yet low enough to provide enough absorbency to make glaze application easy. **'High' bisque** firing is done to mature the body (i.e. bone china) and subsequent firing is usually done to apply a low fire glaze. Such glazes must have special additives to make them gel and stick to the ware (i.e. calcium chloride, gum); these glazes take much longer to dry.

Coiling: A method of hand-building pottery in which the clay is rolled out into long, narrow ropes of clay that are placed one on top of another and joined to build up the form. Either the coils are left visible or the joints are smoothed over.

Dunting: Cracking that occurs in ceramic ware that is cooled too quickly. Dunting can exhibit itself as simple hairline cracks or ware can fracture into pieces. Ware of uneven cross section, ware with glaze that fits poorly, or large pieces (i.e. large flat plates) are often subject to dunting. Ware with high amounts of cristobalite or quartz undergoes sudden volume changes when heated or cooled through the inversion temperatures of quartz.

Earthenware: A clay fired at low temperatures (cone 010-02) where it does not develop maturity (vitrify). Earthenwares are porous and therefore not as strong as stonewares and porcelains (sintering is the primary particle bonding mechanism). Earthenware glazes are usually very bright colored and if the glazes are properly fitted, earthenware can be quite strong and functional. **Terra Cotta** is a special type of earthenware where red burning clay is used, *see terracotta.*

Engobe/Colored Slip: A white or colored slip applied to clay as a coating or by slip trailing, usually at the leather hard stage. Engobes are formulated with less clay content than slips. A slip shrinks with the ware as it dries. A engobe formulated for application to dry or bisque ware cannot shrink excessively. Also, a higher percentage of flux in an engobe helps it to bond to the surface during firing. A slip, on the other hand, bonds to the surface during drying by the interlocking of the flat clay particles at the interface between the damp clay and wet slip.

Firebrick: A brick capable of withstanding high temperatures without deforming. 'Insulating firebricks' (IFB) have the additional advantage of acting as good insulators due to the large pockets of air in the matrix of the brick. There are many different kinds of firebricks available, some very expensive. Types are categorized for their heat duty and the types of materials and atmospheres they must come into contact with.

Flashing: The impingement of flame on a piece in the kiln. Flashing causes "discoloration" of the clay body, colored slip or glaze. Often a desired efect in vapor amosphere kilns, such as - Salt, soda and wood firing.

Flux: A substance that lowers the melting or softening temperature of the mix or compound in which it is present. The degree of melting that occurs depends on the particle size of the powders present and the melting temperature of the individual particles. It also depends on whether material particles present are premelted and whether they soften or melt suddenly. Fluxing oxides are those of the RO group and include ones like K2O, Na2O, CaO, Li2O, MgO. B2O3 is actually considered a glass former but it is also regarded as a flux by virtue of its low melting temperature.

Glaze: A thin glassy layer formed on the surface of fired ceramic. Glazes are a finely ground mixture of mineral and man-made powders tuned to melt and flow at a specific temperature. Many clays will melt well at higher temperatures and thus qualify as 'slip' glazes. Glazes are normally mixed with water, suspenders, and hardeners to make them harden on drying and produce a suitable consistency for application by painting, dipping, or spraying.
Glazes are often classified (e.g. unleaded, raw, fritted) to designate type within a specific industry or type of ceramic ware.

Greenware: Unfired clay, from wet to bone dry, typically greenware refers to clay which is dry and ready to be bisque fired.

Grog: A granular material made from crushed brick, refractory rock, or other pre-fired ceramic product. It is added to bodies to reduce drying and firing shrinkage and thermal expansion, increase stability during firing, and to add texture.

Kiln: A "furnace" for firing clay work or pottery, made of refractory & insulating materials, such as firebrick or thermal fiber blanket.

Leather-hard: Stage of the clay between plastic and bone dry. Refers to that state in the drying of a raw clay piece, when enough moisture has air-dried so that the piece can be lifted without distortion and yet is damp enough to be worked further; carved, burnished, joined, etc. For example, this is the stage handles are applied to mugs, or a bowl would be trimmed.

Mature: A term referring to the degree to which a clay or glaze has **vitrified or melted** in the kiln. A 'mature' stoneware or porcelain clay is normally one that is dense and strong, a 'mature' glaze flows well and heals imperfections to provide a good covering. Like the term 'vitrification' mature needs to be taken in context. A mature **sintered** refractory, for example is quite porous and would be considered immature for other uses.

Oxidation: A firing where the atmosphere inside the kiln has sufficient supplies of oxygen to satisfy chemical reactions in the glaze and clay which use it. Typically, electric kilns are synonymous with oxidation firing, however they often have "stagnant" air flow and thus may fire to a more neutral atmosphere (direct-connected kiln vents improve this).

Oxide: An oxide is a molecule like K2O, Al2O3. They are the most basic form of matter that kiln temperatures can normally decompose materials into. Thus for calculation purposes we view fired glazes and ceramic materials as made of oxides. An oxide is a combination of oxygen and another element (designated "R"), there are only about 12-15 common oxides that we need to learn about. Each has specific effects on a fired glass. Glaze formulas compare relative oxide amounts. Oxides are divided into three categories that recognize their functions. There is a correlation between the amount of oxygen in each class and the contribution that class of oxide makes. Fluxes are designated RO, intermediates R2O3 and glass formers RO2.

Plasticity: The quality of clay which allows it to be manipulated, worked or stretched into different shapes and hold it's shape without cracking or breaking, ie elastic or workable.

Porcelain: A clay body which, when fired, becomes very mature and usually translucent. Porcelain is normally quite white and fires to a very smooth pleasant surface. Porcelain clays lack iron impurities and are ground to very fine particle sizes. Plastic porcelain clays tend to be shorter than their stoneware or earthenware counterparts. Porcelain casting slips achieve the whitest and most translucent results.

Pyrometric Cone: A pyramid-shaped ceramic device used to quantify the amount of heat delivered by a kiln. These devices (cones) are formulated from different mineral mixtures (clay and flux materials) and numbered accordingly. Cones are chemically formulated to *ruse* and bend at a predetermined heat.They are placed in a kiln so they can be viewed (or positioned in a Kiln Setter) during firing and when a cone begins to bend it is closely monitored and the firing is terminated when it reaches a specific position (temperature). *Or in some electric kilns it shuts off a kiln setter.*

Raku: The raku process is an economical way of firing ware in reduction to achieve metallic and carbon effects. Normally ware is heated in a kiln until the glaze is melted to the desired degree then it is removed with tongs and put into a container of organic or combustable material (i.e. sawdust, paper, straw) where it is cooled. The organic material burns and uses the available oxygen in the container and the metallic effects develop. Because of the heat shock during heat-up most people bisque fire ware before rakuing.
Raku ware is usually crazed and very porous and lacking in strength. Thus it is only suitable for decorative ware. Metallic effects that looked great out of the firing can tarnish and disappear with time and people have developed ways to preserve these with various fixatives and surface treatments. **Raku:** A Japanese word which loosely translates as ´enjoyment´, and which strictly only refers to pottery by the potter who holds the Raku title. In the West, however, the work has become associated with a particular technique which generally involves fast firing ware in the kiln, then carbonising the ware by removing them directly from the hot kiln to a covered container of combustible material such as leaves, paper or sawdust - Post Fire Reduction.

Reduction, Reducing Atmosphere: *A kiln atmosphere which is deficient in free oxygen.* This condition is accomplished in *gas kilns* by increasing back-pressure or *reducing the amount of primary air available to each burner.* The result is an increase in gases like carbon, hydrogen and CO. These are very aggressive in wanting to combine with oxygen. Hydrogen is small and particularly oxygen-hungry and can thus steal it from within clay bodies and glazes. **Reduction** firing produces different colors and visual effects because metallic oxides willing to give up oxygen convert to their reduced or more metallic form. Good examples are copper which burns red *(it fires green in oxidation)* and iron which becomes a powerful flux and produces earthtone browns (it is refractory in oxidation). Because almost all natural clays contain iron, *reduction* firing normally gives completely different clay surface effects than oxidation.
Many people do a period of oxidation at the end of a reduction firing to clean the atmosphere and soak the glaze to heal bubbles that result from the active volatilization (an accompanying bubble formation and surface disruption) that reduction induces. In many cases color breaks in glazes are a result of localized reoxidation of the melt surface. The effect depends on glaze thickness and evenness of coverage. Tenmoku glazes are an example of this, the brown thinner areas are oxidized.
It can be a challenge to reproduce the same effects in firing after firing using the *reduction* process. Many people have developed great skills in this area. However the oxygen probe is promising to revolutionize *reduction* firing, especially for small scale industry and hobby operations. It provides a direct measurement of the amount of reduction and enables one to more easily maintain the critical balance between oxidation and incomplete combustion. While these devices are quite expensive there are very few people employing this process that are not at least planning to get one.
Reduction firings are not without hazard. Any form of incomplete combustion can generate smoke and deadly gases. CO for example, is deadly and is colorless and odorless. It is important that gas kilns be vented well and if possible that a CO alarm be installed.

Refractory: Resistance to heat. The ability of a material to withstand heat without deforming or melting. Kiln shelves and firebrick are refractory. Many clays and minerals are also refractory. A fireclay with a PCE of 35 is said to be a super duty fireclay.

Slip/Slurry - Suspension: A slip or slurry is a suspension of clay and mineral particles in a water medium. It is typically either: A glaze consisting primarily of clay ingredients. It is typically applied to wet or leatherhard clay. Slip can be glossy or matte and a variety of color or texture.
A clay slurry (casting slip) poured into molds to be cast into shapes. The slip is usually deflocculated to minimize water content and fine tune viscosity. The deflocculation process involves using special chemicals (such as sodium silicate) that enable the creation of a fluid clay-water slurry with a very low water content.

Short: Non-plastic; poor in working properties, cracks, crumbles or breaks.

Slake: To Moisten and break down dry clay with water. Typically this is done to reconstitute dry clay and *reclaim or recycle.*

Soaking: The practice of holding the kiln at final firing temperature for a period of time. This is usually done to mature the clay and give the glaze opportunity to flow and heal imperfections. The advent of electronic kiln controllers has made it possible for anyone to soak. Soaking is especially advantageous for glazes with a stiff melt (i.e. low temperature zirconia whites) and for porcelains that require translucency, density, and glassy surfaces.

Stoneware: A high fired ceramic material that is vitreous or semi-vitreous, not translucent, and often made of clays that are not highly refined. Stonewares can be brown, buff, grey or white. Stonewares commonly have some speck and some particulate material such as sand or fine grog.

Terra cotta: 'Terra Cotta' *(Italian for 'cooked earth')* is red burning earthenware, generally unglazed. *Terracotta* is normally used to make sculptures, tile, planters, garden and architectural ware. If ware is glazed the ware is often referred to as 'red earthenware' rather than the term 'terra cotta', *see earthenware.*
Red clays have more flux impurities and fire to a harder stronger matrix than white burning materials at the same temperature. Still, terra cotta bodies fire to a porous matrix at cone 06-04 and do not have anywhere near the mechanical strength of vitrified stoneware bodies. Without significant additions of expensive frits it is impossible to vitrify a body at these temperatures. However many terra cotta clays do develop rapidly after cone 04 and turn from red to brown in the process. It is possible to produce fired ware that rivals stoneware in strength at cone 02-1, however few people do this because the clay is so volatile, slight overfiring will produce warping or bloating. In addition to cost one of the primary advantages of the terra cotta process in the warm red colors of the raw clay surface. In addition glazed low fired terra cotta remains red whereas at higher temperatures the glaze matures the surface and turns it brown.
Some terra cotta pieces may be glazed on the inside. Because terra cotta ware is weak and porous it is very important that the glaze and body thermal expansions match. The clay-glaze interface is not well developed (the glaze is not stuck on as well as stoneware) so a measure of resistance to chipping and crazing can only be achieved by a well melted glaze of low enough thermal expansion to resist crazing. In the past inexpensive lead compounds were used on terra cotta because they contributed exactly these properties plus they gave very bright and vibrant colors. Today boron glazes are employed. While safer to use they do not have the ideal set of properties that lead based compounds had.
'Majolica' refers to the use of a terra cotta clay with an opaque white glaze decorated with colored overglazes. Today red clays are used in this process because they provide maximum strength at low fire. In the past white low fire materials were not available.

Thermal shock: Stresses imposed on a ceramic by the volume changes associated with sudden shifts in temperature. Ceramic materials with good thermal shock resistance are able to withstand sudden temperature changes without cracking. Cracking usually occurs when one part of an item is a different temperature than another part and therefore expanding or contracting at a different rate. Fired ceramic does not withstand thermal shock nearly as well as other materials like steel, plastic, wood, etc. Ceramic is hard and resistant to abrasion but it is brittle and propagates cracks much more readily.

Thixotropy: Thixotropy refers to the way a slurry's viscosity changes with time and motion. A good casting slip is the product of maintaining the specific gravity, viscosity and thixotropy. It should have the required specific gravity, be tuned to the needed viscosity yet gel after a set time to prevent sedimentation.
Plastic clay is sometimes called *thixotropic.* This usually refers to material that is very elastic, can be pulled and twisted like taffy, and does not set until left still for a time.

Tooth: Roughness in a clay; course grain structure. Clays with high amounts of gorg, sand or course particls are said to have tooth. The additon of grog often aids in the drying process and cuts down on shrinkage, *see grog.*

Vitreous, vitrification: 'Vitrification' is a process. As clay is fired hotter and hotter, it reaches a point where, if cooled, it will produce ware of sufficient density and strength as to be useful for the intended purpose. The intended purpose may well require some porosity to gain another more important advantage (i.e. stability in the kiln, resistance to blistering). However 'vitreous' ware is usually functional, water proof, sanitary, hard, and strong. Ware that has fired dense and strong is said to be 'mature'.

Wedging: Freeing a clay of air and working a clay into a state of textural and moisture uniformity by an action of the heel of the hands and/or by cutting and pounding. *Wedging* clay is similar in action to kneading bread dough. Clay tends to set up over time and the process of wedging it loosens it up. It is not uncommon for the clay to soften dramatically on wedging, this is thought to occur because of of mobilization of water between the flat particles of clay and the disruption of a stable electrical charge pattern between water and clay that develops over time. Wedging also performs the function of lining up the flat clay particles concentric to the center of the mass allowing them to slip over each other more easily in that direction.