The Pottercraft of Pern

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The Pottercraft's Products

So a potter sits around all day messing about with potters' wheels and producing lots of vases and jugs? Wrong. A great deal of what potters do doesn't involve wheels, and a great deal of what they produce is more practical and less elegant that a vase. The mainstays of the pottercraft are:

- ***Bricks.*** If for nothing else, the Pottercraft will have to produce bricks to build its own kilns. Heat resistant bricks will be in demand by the Smithcraft for their smithies and forges. Bricks will also be used in construction of holds, halls, bridges, etc. The Pernese mainly use stone as a building material and will – if possible – tunnel into a cliff or hillside when constructing a hold. But in some places this is not feasible or practical, and bricklayers will take the place of stonemasons. The Pottercraft will consult with the Smithcraft on the types and properties of bricks needed for a particular building. Some bricks are only suitable for internal construction like chimney shafts, whereas others are tough and durable enough to support a building of several storeys.
- ***Roof tiles.*** Thatched roofs aren't really an option for the Pernese, so in regions where there aren't slates suitable for making Thread-proof roof coverings, then clay tiles will be used. Local clays will have differing trace elements and impurities, so different regions of Kadanzer may have distinctive colours of roof tiles – varying from deep red through orange to a muted blue-grey.
- ***Quarry tiles.*** Lacking industrially produced concrete paving slabs, the Pernese can produce unglazed clay equivalents. If the local stone is unsuitable for the job, then a local potterhall will be able to step into the gap and provide heavy duty tiles or bricks for flooring and paving. These can be moulded with a rough or ridged surface to make them less slippery in wet conditions.
- ***Wall and hearth tiles.*** These will vary from the purely decorative to more practical tiles that provide heat resistant or waterproof coverings for walls and floors.
- ***Tableware.*** Common or garden everyday crockery – plates, bowls, klah mugs and the like. Rounded vessels like cups and jugs will be produced on a wheel, whilst flat vessels like plates and dishes will be pressed or slip-cast.
- ***Ovenware.*** Heat resistant crockery that will not crack or discolour when placed in ovens and on hearths.
- ***Pipes.*** Both the Pottercraft and the Smithcraft will be involved in producing water pipes, guttering and so forth for the plumbing needs of holds, halls and weyrs. Ceramic pipes don't corrode, but they will break more easily than metal pipework, so the lifespan of the two may end up about the same. As metals are relatively scarce on Pern, ceramic pipes will be much cheaper than their metal counterparts.
- ***Sanitary ware (baths, sinks and necessaries).*** Whilst your average cotholder might make do with a wooden bath or sink, a more wealthy holder might order a ceramic bath, wash-basin or toilet bowl. Baths are the largest and heaviest individual items that a kiln will ever fire.
- ***Decorative wares.*** This is the fancy stuff that has more aesthetic than practical uses. Statuettes and other ornaments, extremely delicate or highly decorated china that won't stand everyday use, and so on. The Pottercraft's equivalent of the pretties that a glassmith might produce for a wealthy customer.
- ***Decorative architecture.*** This will only be seen on the most prestigious of holds and halls – unless an eccentric Lord Holder of previous generations had money to burn. Terracotta and faience cladding are used to produce decorative 'twiddly bits' to adorn the interior or exterior of a building. Statues, friezes, plaques, pillars, roof finials, fancy chimney pots, and other decoration. Whilst the Pernese aren't likely to go to the extremes of constructing and decorating a terracotta building like the Albert Hall or Natural History Museum in London, this adornment will appear here and there. Anything that can be done in stone can be duplicated in terracotta, with the added bonus that a repeated decorative element can be produced in a mould rather than carved individually every time.

Clays and clay mining

Clay minerals are formed when various rock types are chemically weathered – for instance granite weathers to form kaolin (also known as china clay) and volcanic ash weathers to bentonite (used in high quality paper making, which is beyond Pernese technology). These clays are only of interest to the Pottercraft when deposits of relatively pure clay have been formed. A clay-rich garden soil isn't usually much use for producing ceramics.

Clay deposits found at the surface can be used by the Pottercraft, particularly for brick-making, but clays mined from below the surface are generally of a better quality for tableware and other ceramics. As these underground clays haven't been exposed to surface weathering processes for some considerable time, their properties, water content and so forth are more consistent and more predictable. Processing these clays into a useable form is therefore more controllable.

Mining for clays can be an offshoot of other mining activities – for example coal seams often have clay seams associated with them – or clays can be mined for directly. The Minercraft and the Pottercraft will therefore have close links. And remember that mining for clay can be a hazardous procedure. With clays' propensity for swelling and shrinking depending on their water content, clay tunnels and clay faces can have serious wall collapses and slumps.

Different clays have different properties. Some clays fire to a white colour, others red, buff or bluish. Fireclays produce heat-resistant ceramics. Small potterhalls will be set up where deposits of good clay are found, and may specialise in the particular product that their local clays favour.

Of course, the other main resource the potters need for their craft is fuel. Kilns require enormous amounts of wood, charcoal or coal to run. These resources will have to be available locally to a potterhall.

Processing the clay

If you are really, really lucky, you have on your doorstep a clay that contains all the perfect constituents and can go straight from the ground to the potter to the kiln without any other processing needed. However, that will be the exception rather than the rule, and most clays need a lot of work to get them into a useable state, especially if you are after a particular product, or a range of products. After all a clay that makes great porcelain will make lousy bricks!

Raw clay is mixed with water to form a slurry called slip. It is then strained through sieves to remove impurities and grit, and if possible iron particles are removed by the use of natural magnets, like lodestone. The clay is then dried. This can be through natural evaporation, or by pouring it into a trough with heated flues underneath, or by pouring it into woven bags which are then squeezed in a press until the water is forced out. If tiles and small wares like teapot lids are required, the clay is dried even further and ground into a powder. After drying to the required consistency, the clay may be used immediately, or it may be stored in a damp cellar for several months to let it ferment and "mature". In temperate climates the clays for brick making and tile making are usually left in pits to be weathered by rain and frost for long periods before straining and drying. In some regions, pottercraft products are therefore seasonal!

It is during this processing that the other raw materials to temper the clay are added. The most common of these are flint, bone and sand, but many other materials can be used. Both flint and animal bone are first calcined: that is they are heated in a kiln to make them more brittle. Water is then added and they are ground to a thick paste, and mixed into the clay slip. Bone ash is required for making bone china (a type of porcelain), whilst flint and sand will vitrify during high temperature firing, making the resultant ceramics harder and non-porous. Grog – crushed and ground fragments of previously fired pottery – may also be added to the clay to temper it. Temper allows water to evaporate more evenly from the clay, thus minimising shrinkage and preventing cracking. Sometimes the temper also assists in vitrification.

When needed, the de-watered clay is weighed and mixed with a specific volume of water. Clay for throwing on a wheel or pressing in a mould has to be plastic. The clay and water mixture must therefore be kneaded like dough until air bubbles have been eliminated and a uniform consistency is reached. This is a laborious and time-consuming task, usually assigned to drudges or apprentices. However, if a master potter has a specific commission from a Lord Holder, he or she may want to take the raw materials all the way through the process themselves, to get a 'feel' for the clay.

Making the Green Wares

Wares are produced in three ways: by throwing on a wheel, by pressing into a mould or by slip-casting into a mould. Mould-pressing requires plastic clay, which is pressed into a plaster mould. In slip-casting, a more watery clay-slip is poured into the plaster mould. In both cases the plaster absorbs the water from the clay, drying it out until the shaped clay item can be removed from the mould. A drying stove or hot cupboard will speed up this process. Apprentices will commonly be employed as mould-runners to carry empty moulds to the journeyman doing the pressing and to take the filled moulds off to the drying stove. At this stage the products are known as green wares or clay wares.

The green wares are next trimmed (fettled). It is at this point that cup handles and embossed decoration are added. The wares then have to be further dried before firing. Drying is often done in the open air, albeit under cover of a roof or awning if the climate is one where rain is common. Alternatively, a drying oven or chamber can be used.

Firing and Kilns

Some types of ceramic wares only need to be fired once – the biscuit or bisque firing. Products like bricks, pipes, quarry tiles, salt-glazed stoneware and ornamental porcelain without decoration or glaze, needed only this single firing. Decorated and glazed porcelain or earthenwares require two separate firings: an initial biscuit firing at a very high temperature, and a second glaze firing at a lower, but more carefully controlled temperature. Even the smallest potterhall therefore has at least two kilns. If a potterhall is using enamels to decorate their pottery, then an enamelling kiln will also be needed, and calcining kilns for burning flint or bone are likely too. Terracotta firing needs a kiln that can reach 1250°C in order to make the product water and frost resistant. The main Pottercraft hall and other large potterhalls will, of course, have many, many kilns.

Glazes are added between the biscuit firing and the glaze firing. Wares can be dipped into glaze solutions, or glaze can be brushed on by hand. Underglaze decoration is painted on by hand and may need a low temperature 'hardening on' firing, before the glaze is applied and the actual glazing firing takes place.

Lacking electricity and mechanisation, Pernese kilns will be of the bottle oven (updraught) or beehive (downdraught) type, the latter allowing a better control of air flow. Wares are placed in saggars (earthenware tubs made for the purpose) on a bed of flint and stacked in the central oven.

Firing is the most critical part of the whole production process, and a bad firing can result in catastrophic losses of wares. Mere apprentices and journeymen will never have control of a large hall's main kiln. A pottermaster will take the job of firing, using years of experience to bring the oven up to temperature by monitoring the colour of the flames, checking the porosity of test pieces and adjusting ventilation and fuel accordingly. Even the most experienced master could expect wastage of 20 to 30 percent for a typical firing. Potterhalls traditionally have large spoil heaps of discards (shraff) nearby!

The main biscuit firing for a large potterhall's kilns takes about three days – it takes about two thirds of that time to reach peak temperature and one third to cool. Bricks may take 3 to 5 days to fire. The master may stay awake for this whole period, or two pottermasters may work together so that spells of rest are possible.

Glazes and Colours

Adding colour to a ware can be as simple a matter as dipping in a slip made of a clay with different properties to the main vessel, or as complex as grinding and mixing a whole host of mineral pigments to provide a coloured glaze. Many colours and glazes will be produced to traditional recipes, although journeymen will also be encouraged to experiment and test the colours and properties of new glaze mixtures. Senior apprentices may be set to grinding some of these pigments, although expensive or toxic ones may be the purview of journeymen and masters.

Decoration can be applied before the glaze or after. Enamels are particularly common for the latter. Skilled china decorators are much sought after by the pottercraft, and any apprentice or journeyman who showed talent in that direction would be steered towards the production of tableware and decorative ware.

The brilliant whites and vibrant colours of modern Earth pottery glazes and decoration may present problems to the Pernese. Some of these colours require industrial chemistry to create. Others can be produced by grinding various minerals, but often these are toxic when in dust form, so the pottercraft may restrict their use to special or expensive items. Hold craft pottery and common or garden table and ovenware from the pottercraft is likely to come in various shades of buff, terracotta, grey, yellow-green or yellow-grey. Find some pictures of Medieval, Anglo-Saxon or Roman pottery if you want to see the sort of colours produced.

Getting the Wares to Market

Bricks are heavy. Pottery is both heavy and fragile. Transport of the pottercraft's wares therefore presents a problem. A horse and cart can transport a load of 350 bricks, so you'll need a lot of cartloads to construct anything bigger than the proverbial brick outhouse. Pottery is transported in special 'crates': large open cages made of (on Earth) hazel or willow, packed with straw to protect the wares on their journey. A cart could carry two or three of these.

Water transport by barge or ship is more efficient for long-distance transport – unless there is a very, very bored and unusually helpful dragonrider around. Ships may use products like tiles or bricks for ballast, and thus add an extra trade item to their cargo for what would otherwise be an unprofitable run. The Pottercraft may also ask the Seacraft to assist in the disposal of waste material from unsuccessful firings by dumping this at sea.

Pottery-making as a Hold Craft

People without Pottercraft training will still be able to produce very basic pottery from local clays, if available and suitable. They don't even require a kiln or a potter's wheel. One type of handmade pot is the coil-built, where a long sausage of clay is coiled into a pot shape, and the bumps then smoothed out with a wet spatula. Slab-built pots are constructed of wedges of clay added on top of each other, and again the joins smoothed over before drying. The dry pot can be burnished with a smooth piece of wood or stone if a smooth finish is required, or left rough, or decorated by incising the clay. A pie dish, for instance, would have a smooth inner surface to make it 'non-stick' and a rough or incised rim for a better grip.

The firing itself can be done in a bonfire or a clamp (a pit bonfire covered in turf). Pots fired in this way will be yellow-brown or reddish-brown with black streaks and smudges or – if the fire is kept deliberately smoky or air flow restricted – be black all over. As the temperatures in bonfires and clamps are quite low (about 600 to 650^{o}C), the clay is often baked rather than truly fired. The fire containing the pots is usually left overnight, often unattended. These pots will remain somewhat porous and are often unevenly fired. This reduces their lifespan, especially if they are being used for cooking. The small kiln a cothold might boast can reach higher temperatures (maybe up to 1000°C), but will have to be continuously fed with wood throughout the 12 to 24 hour firing process.

There is always a lot of wastage when firing pottery, and a holder would routinely expect to find that several of the pots in his bonfire or kiln have fractured, broken or become misshapen during firing.

Women in the Pottercraft

The Pottercraft has long acknowledged that the skills that enable women to make dyes for cloth or create beautiful pictures in embroidery or tapestry are well suited to the artistic needs of a glaze maker or decorator. As such, the craft takes on female apprentices, albeit not nearly in equal numbers to male apprentices. By far the majority of these girls will be born in the crafthall. Female apprentices can be taken from outside the halls, but it is not a common event.

However, once apprenticed, women do not receive a fast track to the production of fine tableware and decorative ware. A girl has to hold her own with the boys in all the heavy work and tedious chores that clay processing and ceramic manufacture entails. If the potterhall at which she is apprenticed specialises in bricks and quarry tiles, she may spend all her days stamping out clay in the brick pits or stacking tiles for drying. If a female potter marries, there is strong pressure for her to give up a great portion if not all of her craft and concentrate on family and domestic matters instead. Nevertheless, the Pottercraft is one of the most liberal crafts on Kadanzer's Pern. As such, female potters may be viewed with prejudice by other crafters or by holders.

The Health Hazards of Being a Potter

People arrived on Pern with the knowledge that minerals containing arsenic, lead, tin or copper are dangerous, and that breathing in powered flint is bad for your lungs. Thus many of the life-threatening or debilitating industrial illnesses and ailments associated with pre-mechanised potteries on Earth will be reduced in degree or absent altogether on Pern. That said, however, much of the work that goes on in a potterhall is arduous or hazardous to health.

Clay is heavy stuff – it is after all, powdered rock! Kneading and moulding often involves throwing large balls of clay repeatedly onto a hard surface, which can cause chest or heart injuries. Loading a potterhall's main kiln involves carrying saggars full of wares from the drying area to the kiln and stacking them. As a loaded saggar can weigh some 22 to 25 kilograms (50 to 56 lbs), injuries from heavy lifting will occur.

Apprentices will experience extremes of temperatures as they carry wares to and from the moulding rooms and drying ovens. The potters may take precautions to avoid breathing in flint dust and metal oxide dust (from various enamels and pigments), but Pern has no reliable extractor fans, so some contamination is unavoidable. The healers attached to a potterhall may specialise in treating various lung diseases and metal poisoning.

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And the main websites:

Clay roof tiles:
http://www.clayroof.co.uk/benefits/benefits_cw.html

http://pubs.usgs.gov/info/clays/

Environmental Characteristics of Clays and Clay Mineral Deposits (see print outs)
http://www.tulane.edu/~sanelson/geol211/clayminerals.htm

Clay minerals -- properties and uses (see print outs)