8 Kilns

Any serious kiln-building project involves a considerable investment of time and money, and before embarking on building a new kiln it is advisable to consult specialist books on the subject, and gather first-hand information by visiting and talking to other potters. The following section offers some help and advice on ways to approach building the kiln for vapour firings. The vapour agent, salt or soda, and the way in which it is introduced into the kiln, have a bearing on the choice of building materials and other aspects of kiln design. There are a number of specific questions to be addressed during the planning stage, and the answers to these are interdependent and will be specific to each situation.

Making Plans

The Location of the Kiln

Assuming that any necessary permissions and approvals have been granted, both the safety and practical aspects of the site must be considered together. If the kiln is built outside there will certainly be plenty of air circulating around it, but adequate shelter will need to be constructed to protect it, and those working around it, from the elements. Packing and firing a kiln while being battered by inclement weather is not an essential ingredient of salt glaze. Outside there will be plenty of space in which to work, but all the kiln furniture will need to be stored dry and reasonably close to the kiln.

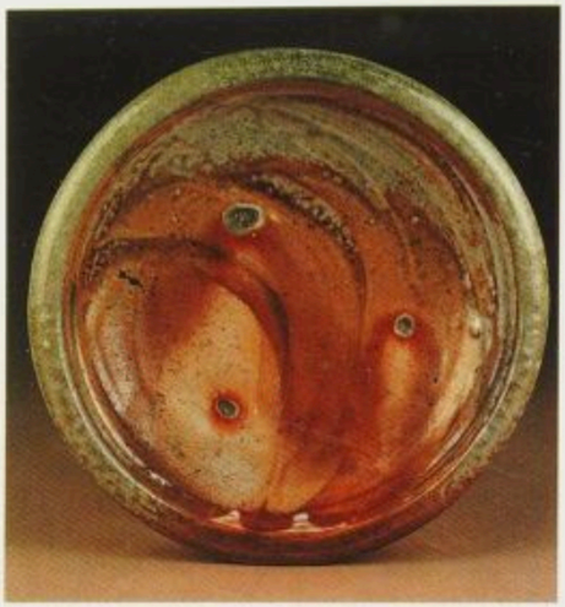
Outbuildings serve well as kiln sheds, but there must be ample ventilation through open windows and doors to ensure that any fumes from the kiln cannot accumulate. Avoid siting the kiln too close to the inner walls, or in a corner with inadequate space to move easily around it. As the firing progresses, the outer walls of the kiln give off considerable heat, and it can become very difficult to manoeuvre in a hot tight space, especially around the flue, to check the spy-holes, adjust the damper or attend to the burners. Awkward situations can be avoided in the initial planning stages.

Additional space is needed around the kiln not only to store the kiln furniture and 'wicket' bricks, but also to bring the pots and to prepare for the firing. The bigger the kiln, the more space is required. How the fuel will be delivered, stored and how it will reach the kiln, needs to be worked out at the same time as determining the site.

Fuels

Any high temperature vapour firing needs a live flame from a combustible fuel, the options today being wood, oil or gas. Each has its

The salt kiln at Rosemary Cochrane's pottery was built in a redundant chicken shed.



Deep plate by Jeremy Steward. 10½in. Wood-fired soda glaze.

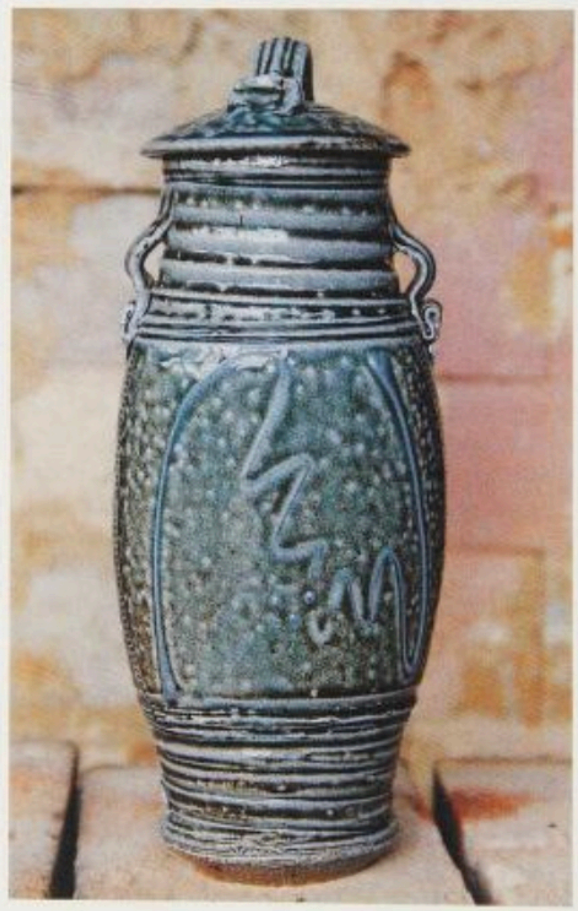
advantages, disadvantages, and different aesthetic merits. In Britain, approximately half the potters engaged in vapour firings are using gas, and the remainder use oil and wood, in roughly equal numbers.

The glaze qualities from a successful wood-fired salt or soda kiln can be the richest and most exciting of all. The combination of the flames and ash deposits produce both subtle and dramatic surfaces that no other firing can. Undoubtedly any wood-fired kiln is best suited to a rural location, as smoke is an unavoidable part of the process. Readily available timber supplies, adequate space for delivery, and covered storage for seasoning and drying the timber all have to be organized. Furthermore a wood firing can be a long and exhausting event and is best undertaken with a small team of willing helpers.

Oil burns with a long, hot flame that favours the distribution of the salt vapour and an even control of the kiln atmosphere. Colours in salt glaze can be enriched by traces of impurities in oil. But it is also possible that oil will contain small amounts of sulphur, and this can be the cause of unpleasant deposits on the surface of the pots. The cheapest source of oil is to recycle waste sump or drain oil, but it is certainly the dirtiest to handle and burn. Heavy fuel oil, such as for a domestic central heating system, is generally the choice for firing a kiln. Oil needs to be stored in a large capacity tank and gravity-fed to the burners.

All burners work on the same principle, using a supply of forced air to produce a fine spray of oil. They range from home-made fittings, to those that are sophisticated and expensive. Electricity is needed to power the source of pressurized air that atomizes the oil, and in a rural area where the power supply may not always be

(RIGHT) Tall, lidded jar by Barry Huggett. Gas-fired salt glaze.



(BELOW) Teapot and two tea bowls by Richard Dewar. Oil-fired salt glaze.

reliable, it is advisable to have a generator standing by. There is only one way to fire with oil without using a source of forced air and that is with a system of plates onto which the fuel drips, vaporizes and burns.

Gas may be either propane, or natural/mains: as the majority of vapour kilns will preferably be sited in rural areas, the most likely gas supply will be propane, either bottled or from a large storage tank. Gas bottles are heavy and need safe storage. Once the choice of building materials and the size of the kiln have been decided, the manufacturers will be able to advise on the number and size of suitable burners. The fittings, pipes, regulators and burners must be assembled in consultation with a qualified person. Gas is relatively easy to control for oxidation and reduction, although depending on the kiln design and number of burners, some potters find that the generally shorter flame length can inhibit vapour distribution. Introducing suitable-sized lengths of wood into the firebox at stages during salting can help to enliven the flame-path. Oil can also be used to the same effect, by setting up a pipe above the gas burner to drip-feed oil onto the gas flame.

Costs

In terms of the comparative fuel costs, it is not possible to be precise. Those of oil and gas fluctuate from year to year and according to the world market. The source and price of wood supplies, including delivery, will be specific to any one area. The size of the kiln, and the type of brick used to construct it, will obviously affect fuel consumption, and good insulation will undoubtedly conserve heat.

The Size of the Kiln

For those who wish to try vapour firing on an experimental scale, the solution is a small, simply constructed kiln. Ideas for a test kiln are given later in the chapter. Such a kiln can also be useful for firing small batches of work, and a portable version useful for demonstration firings. But if the fascination with salt glaze leads to a serious commitment to the whole process, then deciding how big or how small a kiln to build will involve thinking about the way you like to work.

Unless the plan is to fire large sculptural forms, a kiln with a large capacity means that a considerable volume of work must be produced to fill it. Predictably firings will be less frequent. This may suit some potters and can be a spur to making, but to others it can seem a daunting task, and a struggle to maintain the momentum of a comfortable cycle of making and firing. A large kiln also means that each firing will represent a big investment of work. The chance to experiment with the kiln atmosphere, and other variables during the firing, will risk everything. On the other hand, too small a kiln could become a frustration and may not be an economical use of fuel.

Inevitably, any maker's level of production is going to vary throughout the year, and a good compromise would be to build the first vapour kiln to a size that will allow an average of a firing every six to eight weeks. It is invaluable to be able to fire again with the experience of the previous firing still fresh. For this reason, it can also be useful to have the firings back to back. Furthermore, if the kiln is outside, firings in quick succession are a good way to take advantage of better weather, and to avoid wet and cold winter firings.

Building Materials

In the years of the salt-glaze revival, many salt kilns were built from scavenged refractory materials not best suited to salt firings. Understandably, students who build kilns at colleges do not have much interest in their long-term survival, and it can be assumed that the life of the salt kiln is short. Moreover, there is rarely any money to spend on new bricks. Many salt kilns lie abandoned after perhaps only twenty firings, poorly maintained and flawed in their design and structure.

Nevertheless, although the vapour does attack the interior of the kiln, it is certainly possible to maintain the fabric of the kiln so that it will last for a very long time. There are salt kilns built of the better kind of heavy brick which are still in use after over 200 firings. Such a kiln will have been regularly repaired, and some sections rebuilt. Opting for the least destructive method of introducing the vapour agent will also help to preserve the kiln. The alternative ways are discussed in Chapter 9.

Interior of salt kiln. Build-up of salt glaze on 'scavenged' high-silica bricks. Deterioration of unsuitable mortar running down brickwork around the salt port. Bag wall collapsed into firebox.

Choice

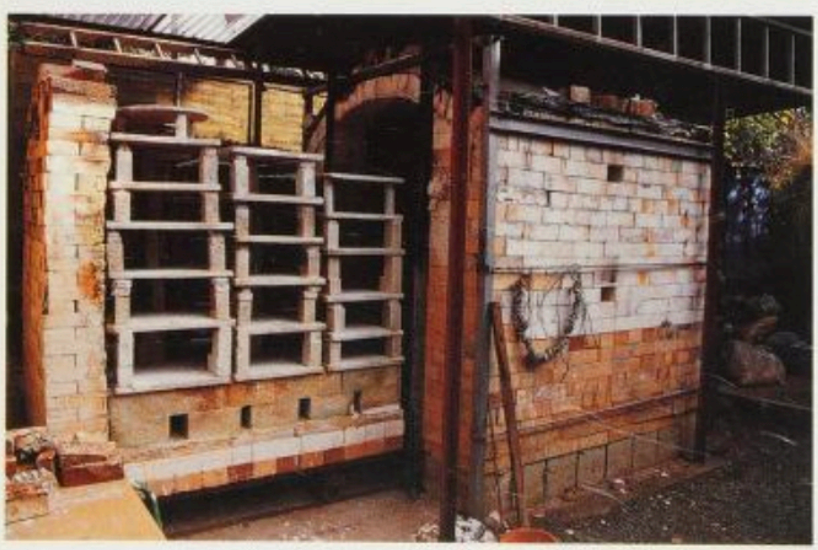
For a long time it was generally agreed unwise and a waste of time and money to use any type of lightweight insulating bricks for the interior of a salt kiln. It was thought they would be less able to withstand the vapour attack, and would deteriorate very quickly. In some cases this proved to be correct, but in others the opposite was also found to be true. Vapour kilns built of lightweight bricks are still standing after years of constant use, and there are also examples of trolley kilns, built for vapour glaze firings with high temperature insulation bricks, which are still in reasonable repair.

Today it is considered practical to have the choice of either heavy firebricks or lightweight insulating bricks for either a salt or a soda kiln. The over-riding difference is in the initial cost of building materials – but even if funds are limited, it is still worth considering both the options, as considerable fuel savings can be made with the right choice of insulating brick. Whatever the final choice of brick for the main structure of the kiln, it is always recommended that the best grade high-alumina heavies be used for the fireboxes and the most vulnerable parts of the kiln around the salt and soda ports.

Lisa Hammond's 90cu ft trolly kiln used for soda firings. The walls and arch are built of insulating bricks; heavy bricks for the base and fireboxes.

Heavy Firebrick

Many free bricks from second-hand sources, such as the dismantled kilns of brick works and the lining bricks of furnaces, may still look to be in excellent condition. However, one serious



drawback is that they will almost certainly have a high silica content. They are designed for industrial kilns and furnaces, and are less able to withstand the relatively rapid heating and cooling and repeated firings of the studio pottery. They will also attract the salt vapour, become heavily coated in glaze, and deteriorate rapidly. The brickwork will slag, and the lower structure of the kiln will weaken quickly.

Heavy firebricks, or 'heavies', come in different categories and grades. Manufacturers normally classify them as super, high, intermediate and low duty, and within these classes there are different basic types, each made of a different composition. Either of the middle-duty ones should prove suitable for high stoneware or porcelain temperatures. If you are able to purchase new 'heavies', the ones recommended for the interior of a salt kiln should have a high alumina content of at least 40 per cent, or better still, 60–63 per cent; but any higher, and the percentage of alumina makes the brick more porous and prone to deterioration. Within that choice, there will be several grades at different prices.

The two usual methods of manufacture are dry press, or stiff mud, and they produce bricks of differing qualities. Dry-press bricks are the most uniform, and will expand and contract with the least spalling. The stiff mud process produces a brick that is described as dense, and able to withstand slagging. Note that all heavies are extremely hard, and difficult to cut and shape without machinery. They take up a lot of heat, have a high rate of heat conductivity, and will need a backup layer of insulating bricks on the outer face of the kiln. Many potters still choose to use hard bricks for the inner construction of their salt kilns, and dense firebricks are unquestionably the only choice for the fireboxes.

Insulating Firebrick

There are several different types of lightweight insulating brick. Hot-face insulating bricks withstand high temperatures and are used for the interior of a kiln. High temperature insulation bricks, or HTIs, can also be used, but are slightly different in that they are not necessarily load-bearing. IFB is another abbreviation for 'insulating firebricks'. All insulating bricks are manufactured with a mix of refractory clay, and a filler which burns out, or a specially structured aggregate. Either method produces a brick that is easily cut and is up to 85 per cent lighter than a dense, heavy firebrick. They neither store nor absorb much heat, and having a low conductivity, the heat loss is considerably reduced.

Insulating firebrick is categorized by temperature, so the number relates to the maximum service temperature: the higher the service temperature, the denser the brick and the lower the insulation properties. A 26 grade has a maximum service temperature of 2,600°F – that is, 1,427°C. This would be suitable for the hot face of the vapour kiln, and is a valid option for salting methods using dry salt or sprayed solutions. However, it is strongly advisable that samples be tested over several firings in another salt kiln, before the final purchase is made. This should confirm that they are not prone to spalling or melting, and are likely to be a satisfactory choice. Investigations continue into the suitability of different insulating bricks for salt and soda kilns.

Peter Meanley's three-year, post-doctoral research is underway, funded under the Arts and Humanities Research Board of UK Universities. His aim is to try to identify the conditions, materials and appropriate application of resists to give salt and soda firers the confidence to build their next kilns with insulation materials. So far the research indicates that there is unlikely to be a definitive formula for success. However, the nature of the bricks and the methods of applying the resist are both critical, and maintaining a watchful repair and renewal system will always remain important.

Mortars

Even if the kiln is to be a permanent structure the bricks can be laid dry, but any mortar mix that is required in building the salt kiln should be made with a high alumina fireclay, as opposed to one that is high in silica. The wicket is dismantled and rebuilt for each firing, and although this, too, can be dry-laid, it needs to be sealed. Two parts sand to one part fireclay makes a suitable mix, and remains friable and easy to clean off. This is also used to seal gaps that appear during the firing, and for clamming up at the end. May Ling Beadsmoore's experience of air-setting cements in the construction of her kiln is described in later pages.

The Wicket and Outer Insulation

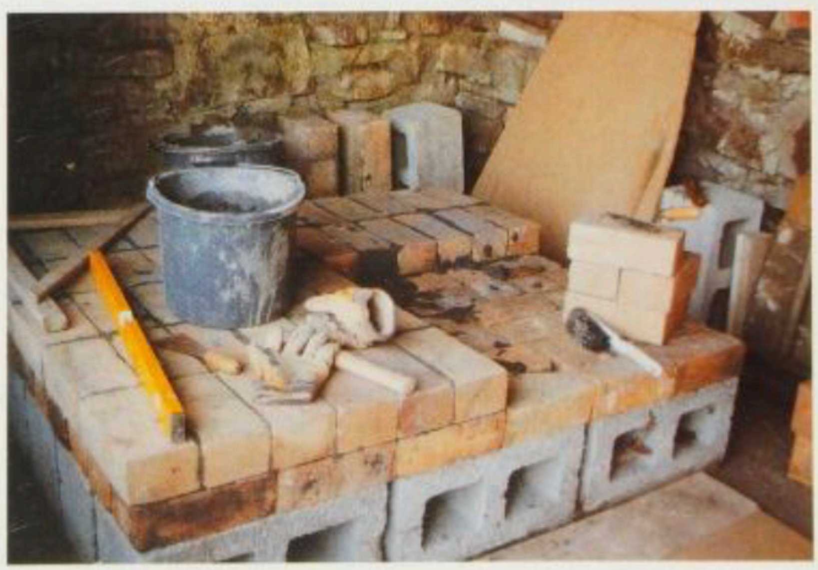
The lightweight lower grades, 16 or 20, are useful as a back-up brick. Diatomaceous bricks can also be used as an outer insulating brick. The 'wicket' is the entry into the kiln chamber through which the pots are introduced, and is bricked up during firing. There is some benefit in using hot-face insulation bricks for the wicket, as they are lighter and easier to handle.

The refractory industry is continually updating and revising its list of products. The cost varies according to quality, and the suppliers can provide manufactures' technical data sheets, and advise on your requirements. Superior quality insulation bricks from both Europe and America can be a good investment for the ultimate high-tech kiln.

Arch Insulation

The vapour-glaze process prolongs the firing, and a good layer of insulating material is essential to reduce heat loss and conserve fuel. The

Laying the base of a salt kiln using the minimum of mortar. Catenary arch former in background.



Firebox castable lining in need of repair.

arch can be covered with sheets of fibre blanket or extra coatings of an insulating mix made up with sand, vermiculite, sawdust and fire clay. The proportions for such a mix vary widely, but in principle the sand and fireclay, with a small amount of water, comprise the binding agent and make up the smaller part of the mix.

It is important to protect any timbers in the ceiling or roof from the heat, and additional insulation board should be used to shield and safeguard the vulnerable area above the kiln. Heat loss from the kiln continues long after a firing is complete, and could ignite dry timbers when the kiln is left unattended.

Ceramic Fibre

A European directive now classifies most refractory ceramic fibres as category 2 carcinogens, and also as an irritation to the skin. With these potential risks and hazards to health, every precaution must be taken when it is handled and used. There is no ban on its use, but the British Health and Safety Executive have published their recommendations in an information document. There are alternative products available that can be used, but as a sensible precaution, protective gloves and a facemask should be used when handling any fibrous material.

Castables

Castables are made up of alumina and aluminium-silica coarse aggregates which, when mixed with water in the correct proportion, will harden in thirty minutes and set to a very hard and resilient cement. These refractory products are invaluable when building the salt kiln, and for repairing various sections. As the fireboxes are the hottest part, and also sustain the most attack from the salt, a lining of high-alumina castable will protect this area.

In time, and particularly if heavy, damp salt is introduced over the firebox, even the castable will break down under the salt attack. An accumulation of glaze liquefies and runs into any porous or jointed surface in each firing. However, before the bricks themselves have been subjected to the salt-glaze penetration, the castable can be chipped out and replaced with a new lining.

Castables can also be used to construct the arch of the kiln, but the experience of using castables ranges from highly successful to disastrous. An arch cast as one piece will have great strength and good insulating properties and, in principle, no joints through which the vapour can penetrate and erode the structure. But problems start if stress cracks develop, or if there are large interlocking sections and construction joints open up during the firings. In these circumstances not only do the vapours enter the casting through the cracks, but bits of castable fall onto the pots.

A further drawback is the porosity of high-alumina castable. This makes it susceptible to the salt-vapour attack, more so as the calcium in the cementing agent acts as a strong flux, causing the surface to melt and peel off. A denser, high alumina refractory is called for, but also one that will not crack with the relatively quick heating and cooling of the studio potter's firings.

The choice of castable is therefore critical. As there are many products available it is advisable to consult with the manufacturers or suppliers. All castables have specific instructions on how they should be mixed and applied, and the product's performance depends on this.

Refractory Suppliers

Refractory materials are those that are resistant to high temperatures and suitable for kiln building, for kiln shelves and for other kiln furniture. At the start of the twentieth century the manufacture of refractory bricks had virtually ceased in Britain, and they are now imported from various other countries. The main regional suppliers of refractory products can be found in local directories. Some overseas manufacturers have regular agents in Britain.

Kiln Design

Down-draught kilns are generally easy to control, and give the best circulation of heat and vapour for a salt firing. They are often designed with burners that are diametrically opposed, in order to achieve a good overall flame path and even distribution of heat. A catenary arch kiln, or a box-shaped kiln roofed with either a sprung or catenary arch, are both suitable designs for the salt kiln. The chimney must be high enough to take the salt vapour emissions away from the area immediately around the kiln. Air and damper controls must be able to produce extremes of oxidation and reduction.

SIGNIFICANT POINTS FOR KILN DESIGN AND BUILDING

Specific considerations for building a vapour kiln:

- Refractory materials available
- Budgets for building
- Fuel and fuel costs
- Intended life-span of the kiln
- Salt and or soda

Considerations to incorporate into the structure:

- Salt ports
- Soda ports
- Salt drip system
- Reinforcement around the vapour ports
- Repairable combustion area from where the salt can be distributed
- Protection of the firebox
- Ways to repair or reconstruct the fireboxes
- Repair and support of the bag walls

Factors to favour the long life of the kiln

- Choice of appropriate materials
- Good brickwork
- Hard firebrick fireboxes lined with castable
- Sufficient substantial steel bracing
- Routine repair
- Least damaging method of introducing the salt
- Efficient and economical use of salt

Salt Ports

Salt ports are incorporated at the building stage as loose bricks in the kiln walls. Traditionally they are sited over the fireboxes, either above the burner ports or through the side of the kiln, but the final decision will depend on how the vapour agent is to be introduced. It is a good idea to leave the options open, and to make provision for salting or soda glazing in more than one way. A greater number of loose bricks will be needed for spraying soda, but whether the spray is a salt or soda solution, the best location for the ports may be a matter of trial and error, and will depend on the kiln itself. Insulation bricks are lighter and easier to handle during the process.

Bracing

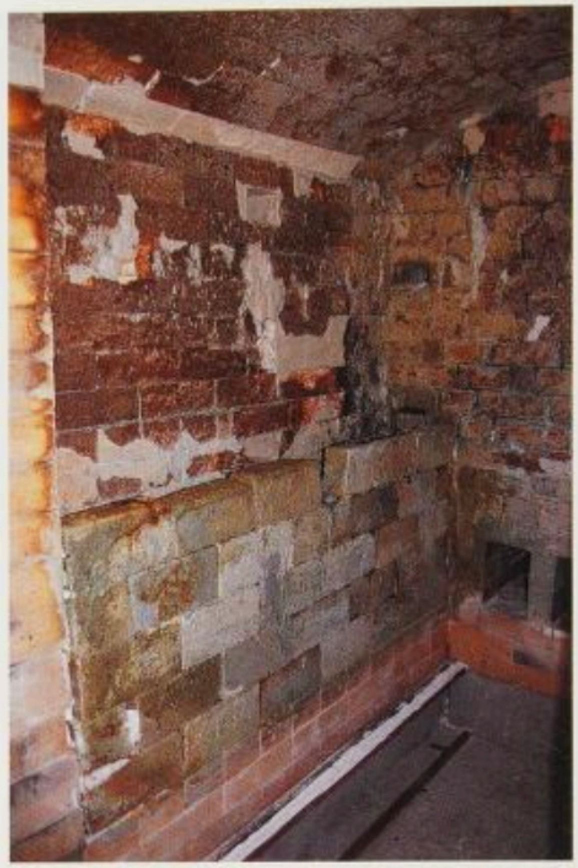
The base of a kiln will tend to move as it expands and contracts on firing and cooling. In the case of the vapour kiln, the sodium will penetrate any crevices and cracks and cause further deterioration of the fabric. It is especially important to brace the base of the kiln with a substantial metal frame, as well as restricting any likely movement of the arch, front to back. The sodium vapour will attack any metalwork, which should be treated with aluminium paint to keep it from corroding.

Protecting the Kiln Interior

Although many potters would advocate that it is best not to coat the inside of the kiln with anything, there are various remedies that can be adopted to reduce the attack of the salt or soda vapour on the kiln. The first is to apply a proprietary zirconium-based resist that is marketed in Britain under the name of 'Furnascote'. It is

(RIGHT) Deterioration of protective coating in gas-fired salt kiln.

(FAR RIGHT) Deterioration of protective coating on insulation bricks in gas-fired soda kiln.



impossible to either recommend or condemn this, as the experience of potters varies hugely whether they use salt or soda: some have found there is a high risk of the resist flaking off and falling onto the pots during subsequent firings; others have had few problems and are convinced of the advantages the protection has given to the interior of their own kiln. It is certainly important to use it in exact accordance with the manufacturer's directions.

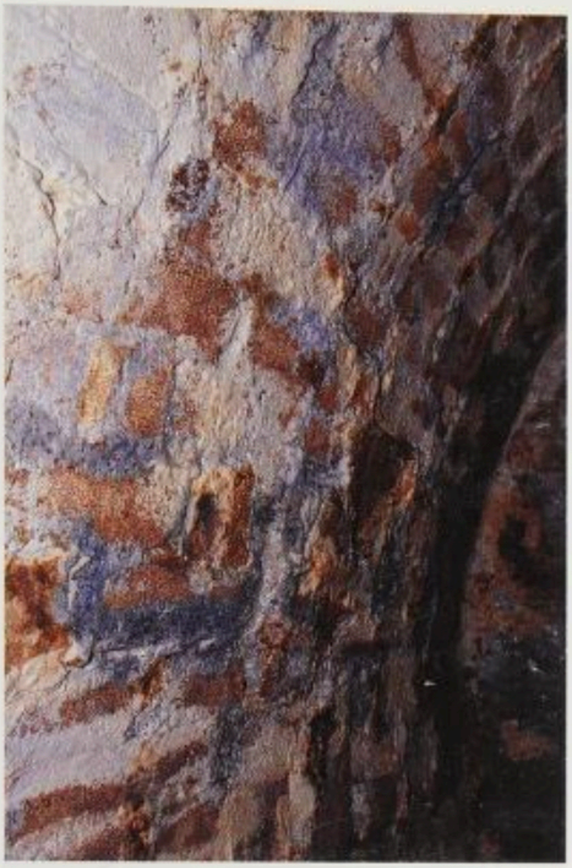
Any resist that is high in alumina will repel the salt vapour. Peter Meanley has used a fine-grained mix of 5 parts calcined alumina, 2.5 parts molochite 130s grade, 2.5 parts china clay and 1 part silicon carbide 220s grade; this is mixed with water and applied in a thin wash before any firing. By dipping the brick in the wash, the coating will cover all the hot face edges of the brick. A series of successive coatings should be applied in following firings, and as the layers accumulate, the areas where it begins to loosen can be tapped off and the coating reapplied.

In Peter's small kiln, 0.4cu m (14cu ft), two coats were worked into the hot face of HTI bricks. Although after successive firings there is some shelling from the walls, it has been considered successful in protecting the bricks from the penetration of vapour attack for over seventy firings. The kiln interior had become very irregular, and kiln cement mixed with alumina hydrate has since been applied to the entire surface. The 'bubble alumina 34' bricks in the firebox are the only ones apparently untouched by the salt.

Another remedy is to spray or paint the inside of the kiln with a coating of a simple stoneware glaze mix before the first salt firing. This will seal the surface of the bricks and help to prevent the direct attack from the salt. The build-up of salt glaze on top of the applied glaze can cause drips to run off the top of the arch onto the pots, although in fact this can be a problem with heavy bricks that are not high in alumina, whether they have been painted or not.

Care and Repair

Emphasis has been placed on the need to look after the structure of the salt kiln, and it pays to heed the early signs of deterioration and to



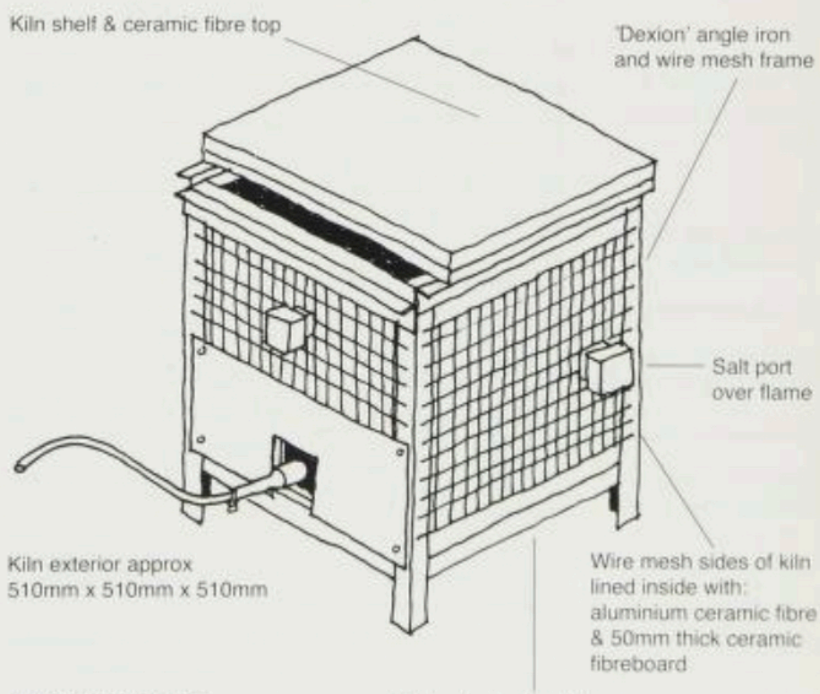
versions have been constructed and fired, and have survived the salt. This type of kiln is suggested for experimental and occasional use – although every care should be taken when handling ceramic fibre, particularly in the construction stages. Steve Harrison has built a test fibre kiln that he uses for demonstrations and workshop days, and for the occasional urgent order.

(FAR LEFT) A well repaired arch of a salt kiln built of heavy bricks.

(ABOVE) Steve Harrison's fibre salt kiln in action.

patch, repair or rebuild as soon as possible. The bag walls may start to lean and need to be supported in some way. If they are dry-laid, with bricks dipped in an alumina resist, they will be relatively easy to separate, and can be turned around to reduce the effects of excessive heat on the firebox side. Less frequent repairs will include replacing the refractory castable lining of the fireboxes.

There is a variety of patching materials based on alumina and kiln cement to repair a salt kiln. Ted Hamlyn has developed one that has been used to maintain the Hamlyn's kiln for over 200 firings. It is made up of a mix of high alumina cement available from any builders' merchant, with the addition of unmeasured amounts of molochite, crushed-up hard brick, and 'T' material, a clay with a high molochite content.



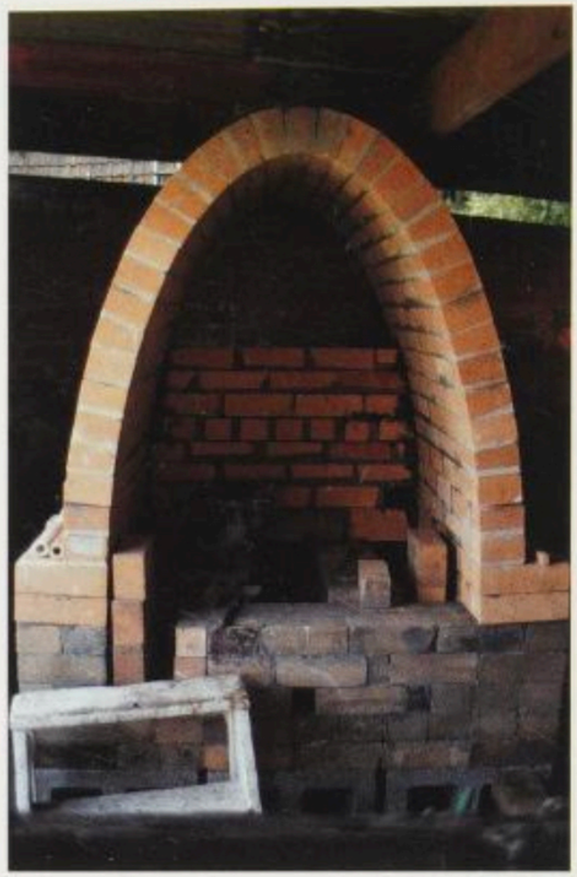
▲ *Drawings for the small fibre kiln.*

First Salt Kilns

Small Fibre Kiln

Salt glaze is not often associated with small, lightweight, portable fibre kilns, but several

(RIGHT) Catenary arch kiln under construction. High-alumina heavy bricks.



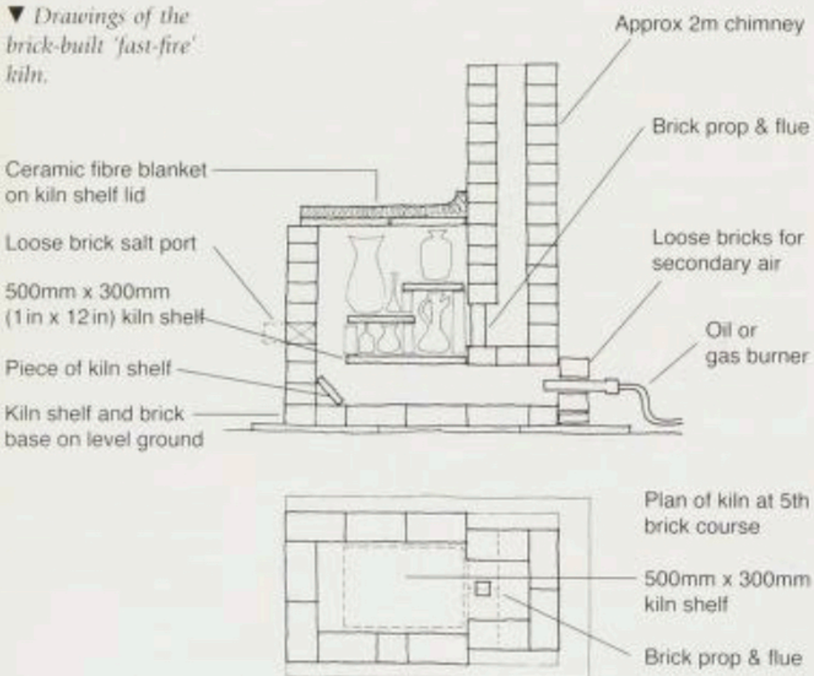
A cube is built with angle-iron and an iron-mesh frame, and is then lined with ceramic fibreboard, ceramic fibre blanket and aluminium foil on the outside. The base of the kiln is made of high alumina bricks. 'Furnascote' should be applied thinly to the inside of the kiln before it is first used. Good maintenance is essential to preserve the lining. 'Furnascote' and 'Higlaze' should be applied as necessary and in response to each firing. Steve has not yet had to re-line his kiln after forty firings. The appropriate BTU rating of the burner will depend on whether it is for natural or propane gas.

For a more permanent site, a similar-sized kiln can be constructed using insulating bricks contained within a simple cube of angle iron, but without the need for the wire mesh.

'Fast-Fire' Salt Kiln

Plans for this kiln from New Zealand have been circulating for some years. Jane Hamlyn was impressed when she saw it in action at George Halliday's salt-glaze workshop near Christchurch. It can be fired with gas or oil, requires a total of 250 bricks, and claims to have been fired in four hours using 20ltr of oil.

▼ *Drawings of the brick-built 'fast-fire' kiln.*

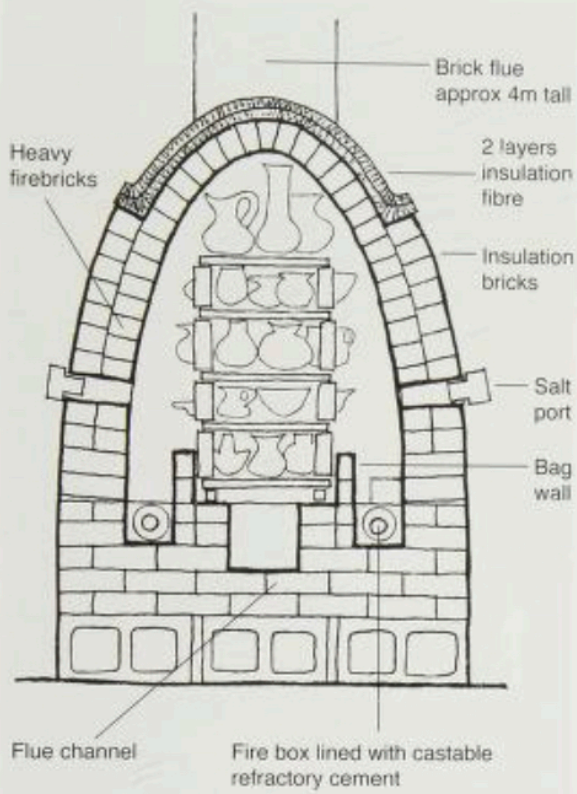


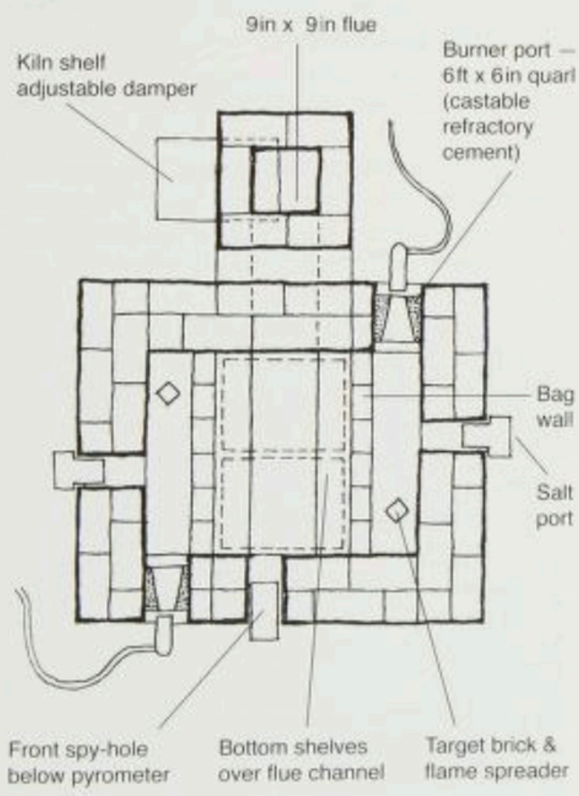
Catenary Arch Salt Kiln

A catenary arch is derived from the curve made by suspending a chain between two fixed points, the inverted curve becoming the arch. It is a particularly strong structure, although for a salt kiln the arch must be braced from front to back; also, because the front and back walls are not tied into the arch brickwork, there is a tendency for a gap between to open out. It has the further disadvantage of being awkward to pack, since the curve reduces the height available at the sides of the shelves, and the diminishing width makes it difficult to place pots on the top shelves.

Small Wood-Fired Salt Kiln

The 'Stubbs-Schloessingk' prototype kiln was built and fired at the 1977 International Potters Festival at Aberystwyth. Micki Schloessingk wanted to develop a kiln that was easy to fire single-handed and would be efficient in its use of fuel and energy. Paul Stubbs helped with the design of a kiln that was fairly simple to build





(FAR LEFT) Drawings of the catenary arch kiln used by Rosemary Cochrane.

and would be easy on the stoker. A full account and plans of the kiln appeared in *Ceramic Review* No. 170, 1998.

Production Pottery Salt Kilns

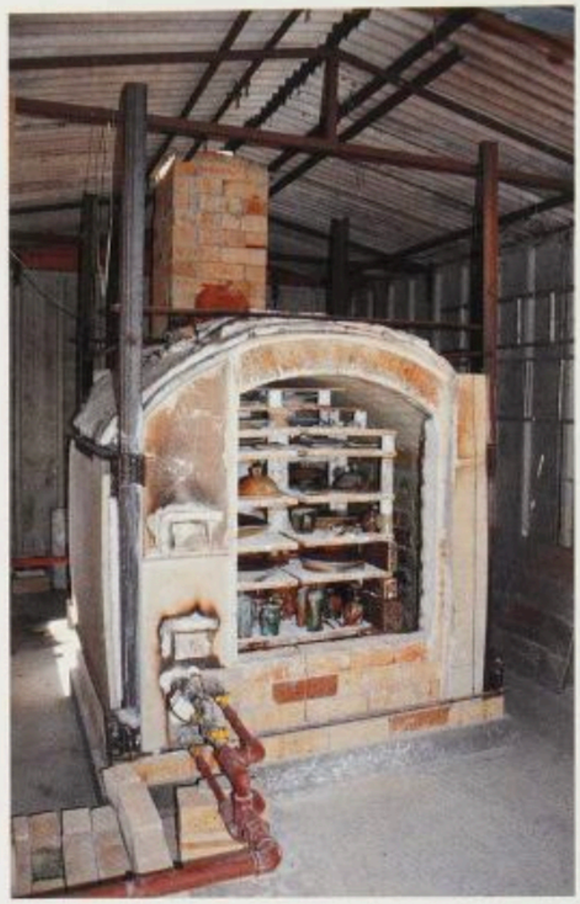
Toff Milway

Toff has been a production salt-glaze potter for nearly two decades, and his experience is of particular interest to those who hope to build a salt kiln that will have a long life. Generally he is seeking a smooth salted surface, but he is also mindful of the damage that the salt has on the kiln fabric. He uses relatively low levels of salt in the firing process, and because of this he finds that the maturity of the kiln and the residual salt it holds is all-important. He says: 'Re-bricking the bag wall or replacing old shelves with new is enough to throw out the balance and can give rather dry effects. Unfortunately, the destructive effects of the salt necessitate regular replacement of shelves.'

The kiln is of a sprung-arch, down-draught design with salt pits beneath the burners. It is fired on liquid petroleum gas with three burners rated at 69,000BTU each, and operated at a maximum of two bar. The first kiln, built in 1986, was rebuilt in 1998 after 150 firings. The chamber is 1.53cu m (54cu ft), and the packing space about 0.85cu m (30cu ft). Originally a 26-grade, soft hot face insulation brick was used for the main body of the kiln, with 28-grade for the firebacks in the bag wall area, super-duty heavy bricks in the firebox area and hearths, and a back-up of 25-grade overall on the outside. Although the interior bricks were affected with a glaze from the salt, it was the 28 higher-grade bricks in the firebacks that had creviced, cracked and spalled the worst. The effect of the salt had also penetrated between the walls in the area around the burner ports, and they were near to collapse.

All the bricks had originally been coated with a glaze wash that survived about ten firings before the outer layer of the bricks began to peel off. This protective treatment was not repeated in the rebuild, and instead the proprietary kiln wash 'Furnascote Non-Vit' and 'Higlaze' was

(ABOVE) Toff Milway's gas-fired salt kiln showing heavy brick reinforcement around the salt and burner ports. Salt pits are beneath the burners.



(RIGHT) May Ling Beadsmoore's down-draught, gas-fired soda kiln. Approximately 1cu m, fired with eight Aeromatic Barter burners.

tried. It fell off in sticky sheets after fifteen firings. The 26-grade insulation bricks have been replaced throughout the chamber, and high alumina heavy bricks used to strengthen the areas around the salt and burner ports. Although a kiln shelf is used to protect the top of the stack during the firing, up to 10 per cent of the kiln contents are spoilt by pieces that flick off the walls and roof and land on the pots.

Interior of Toff Milway's salt kiln.

May Ling Beadsmoore

May Ling's 0.76cu m (27cu ft) soda kiln was built from single-skin firebricks with air-setting mortar, and insulated with 25mm (1in) ceramic fibre blanket and 25mm (1in) 1,260°C ceramic fibreboard; 2mm (1/10 in) ceramic fibre paper was pushed into the expansion joints, but has since dissolved. Firebricks were chosen for their longevity and low maintenance, even thought they soak up a lot of heat and firings are relatively expensive.

Two different types of firebrick and mortar were used: for the walls, 42 per cent alumina firebricks with 'wet air-set cement' were used, and after thirty firings this adhesive has melted and run, and there is a crusty build-up on the bricks. For the arch, 60 per cent alumina firebricks with 'BR5 Sairset Ready Mixed' were used, and after thirty firings the bricks and adhesive are almost as new, with no soda build-up. The bricks have spalled slightly, but the adhesive has shrunk very little and has resisted the soda. The air-setting mortar develops a strong bond throughout the entire brick joint.

'Low Tech' to 'High Tech': Suzy and Nigel Atkins

Interior of May Ling Beadsmoore's soda kiln showing bag wall built into the shelf stacks each firing.

A number of salt-glaze potters in America and Europe have built their recent kilns using the very latest refractory materials, incorporating sophisticated features and firing with high-tech equipment. At present no one in Britain has such experience.

Suzy and Nigel Atkins give a straightforward comparison between producing salt glaze using a traditional kiln, and their more recent experience using a high-tech kiln. Suzy originally trained at Harrow during the 1970s. She set up a pottery in France, with her husband Nigel, making functional salt-glaze ware.

The old kiln was a 3cu m (106cu ft) down-draught kiln with two Swirlamizer induced-air gas burners. The kiln was built with nine spy-holes, plus one usually set in the wicket. The inner walls were built of 43 per cent alumina heavy bricks, with an outer coating of insulation bricks and Rockwool insulation held in place with chicken wire. The useful volume of the kiln was 2cu m (70.6cu ft). Salting took 18kg (40lb) of coarse wet sea salt, manually loaded onto angle irons and thrown into the fireboxes. Suzy and Nigel appreciate that this was a very cheap, medium-sized kiln that served them well once they got to know it; in the end it became increasingly erratic, capable of superb firings, or neatly destroying all the decorated ware in the kiln.

The advantages of the old kiln were its initial cheapness, and its occasional capacity to produce quite astonishing results. The disadvantages were that it was impossible to control in the face of changing meteorological conditions. Salt distribution was uneven, with two areas being so over-salted that they were finally abandoned, losing a tenth of the kiln volume. It was also labour intensive: building and dismantling the wicket alone took seven days each year. Bad firings resulted in seconds and worse; and lastly, the gas consumption was uneconomic.

Serving dish on feet by Suzy Atkins, 1990. Fired in the old kiln.

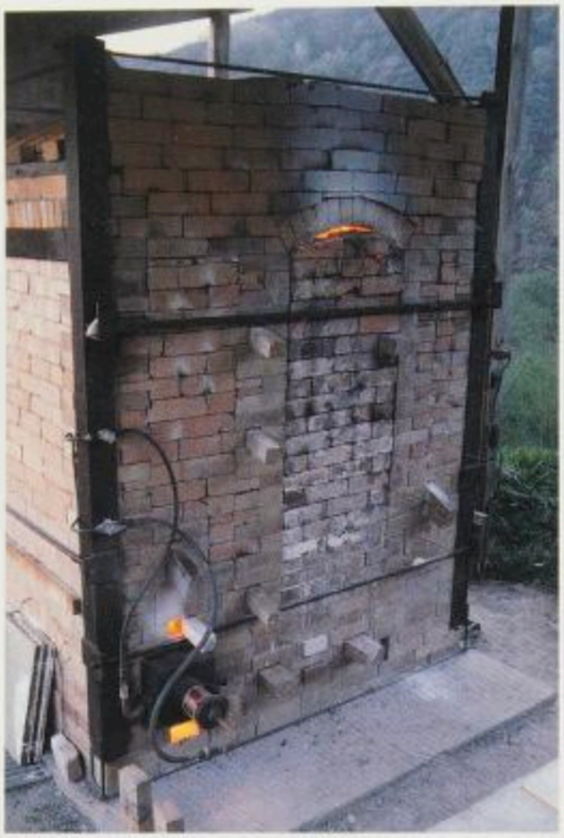
The new high-tech kiln has 1cu m (35cu ft) of useful volume heated by four North American forced-air burners. There is no chimney, but down-draught gas evacuation occurs as the kiln fires under positive pressure, expelling exhaust gases into a hood and an exhaust duct above the rear vent. The kiln is built of 60 per cent alumina bricks coated with Polybond zircon-based wash, backed by two layers of insulation bricks and insulation felt. There is a full-width door on the front of the kiln, and one spy. The damper in the rear duct is left permanently open.

The new kiln uses 8.5kg (18.7lb) of fine sea salt, blown into the kiln through refractory steel tubes set just above the flames of the burners. In principle this kiln is a very expensive, reliable, controllable production tool, with normally a long life and thus eventually a low cost per cubic metre fired. It is nevertheless a complicated piece of delicate technology, which requires constant attention and very precise adjustments in order to produce constantly fine results.

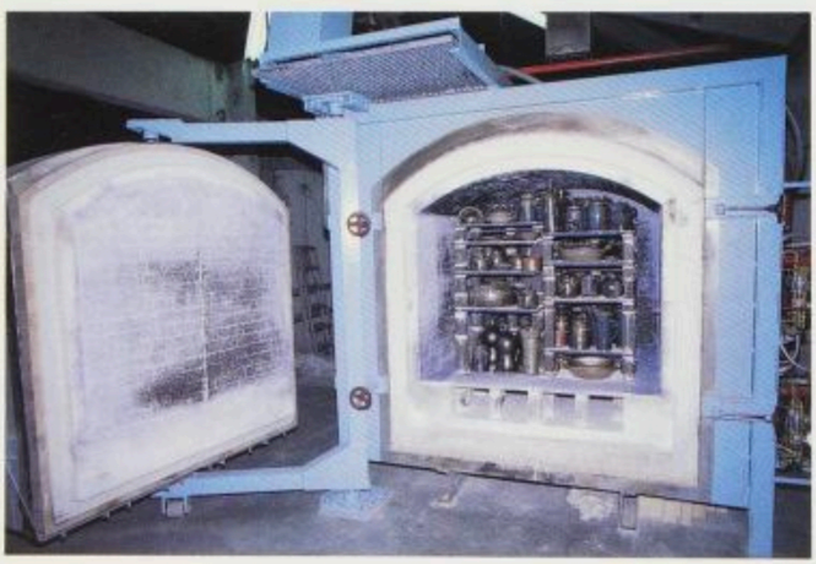
Its advantages are listed as easy to load and unload, very reliable automatic control, tiny production of seconds, remarkable glaze results

(RIGHT) Dish with handles by Suzy Atkins, 2000. Fired in the new kiln.

Atkins' old oil-fired kiln.



Atkins' new high-tech, gas-fired kiln.



on all slips and excellent salt distribution. The disadvantages are its vast initial expense, it is very sensitive to regulate, and there is complicated technology to master.

It is unlikely that anyone would invest in a high-tech salt kiln before building a more conventional, cheaper kiln. However, some of the materials and a simplified technology could be useful for a smaller-scale operation.

In Conclusion

The problems that are intrinsic to any high-fired vapour kiln revolve around the detrimental effect of the sodium and its inevitable attack on the kiln structure. The perceived difference to the wear and tear of salt and soda kilns is well founded. Soda firings may seem to be less destructive on the soda kiln's fabric because the fireboxes are spared a concentrated attack of an accumulation of sodium. Soda is nearly always introduced as a sprayed solution. When salt is introduced as a brine solution, instead of as damp salt dumped into the fireboxes, the deterioration of the salt kiln is considerably reduced.

Apart from agreement on the use of heavy firebricks for the fireboxes, it is difficult to be categorical about building a salt or soda kiln, and this is borne out by the wide variety of successful vapour kilns. The experiences and views of vapour-glaze potters can vary as widely as the materials they have used, and as the combination of factors at work. Trials continue on the effect that salting has on different insulation bricks and coatings. In one sense they can never be entirely conclusive because of the many variables that are always involved in the way that a salt firing is conducted.