

LA MERIDIANA

INTERNATIONAL SCHOOL OF CERAMIC IN TUSCANY



VAPOUR GLAZING

notes by Pietro Elia Maddalena

Introduction

The choice of a particular way of firing can influence dramatically the expressive options of the ceramic artist. In vapour firing the essential transformation brought about by heat and vapours is seen as part of the creative process. This chemically energetic activity can produce varied and exceptional graduations of colour, texture, pattering and flashing in the clays, slips and glazes. It has been the appreciation of such effects that has inspired renewed interest in this firing methods.



Gay Smith



Gay Nichols

Historical notes

Vapour glazed stoneware, generally once-fired, develops glazes and colours by introducing common salt or soda carbonates in the kiln at a temperature when the clay is maturing. Both salt and soda carbonates at those temperatures will decompose and the sodium, as a vapour on its way to the chimney, will react with the silica and alumina of the clay to form a thin, slightly orange-peel textured glaze which is very hard and resistant to corrosion.

Salt glazing developed in Germany and it went out of favour for tableware in the second part of the 18th century, its use confined to cheap jars, bottles, and drainage materials. Several craftsmen potters since the 1960's have revived this technique, which produces a very integrated and interesting variable finish.

Vapour glazing using sodium carbonates is a relatively new approach to vapour glazing, having first emerged among studio potters in the 1970s . It has since proven to have far more potential than the reproduction of “salt glaze imitation ”, offering new direction for ceramic work.

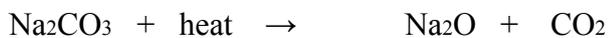
The chemical process

The process of **salt vapour glazing** (NaCl, sodium chloride), assisted with water, consists in the following:



The soda (Na₂O) combining with the clay will form a glaze while the hydrochloric acid HCl will escape through the chimney. This vapour is hazardous and produces pollution in the form of white clouds. Hence the need for a more environmentally friendly alternative which was found with the use of soda carbonates (soda ash and baking soda).

Soda vapour glazing, done on a variety of ways, has the following scheme:



For vapour glazing to be effective, the salt or soda carbonates must be quickly decomposed to create volatile soda. The easiest way to achieve quick decomposition is to dissolve either salt or soda carbonates in water and to introduce it in the kiln either by spraying or drip-feeding it. The high temperature in the kiln will instantly create steam thus breaking down the compounds. In wood firing kilns the wood can be soaked with the dilutions.



Jane Hamlyn



Ruthanne Tudball

Clays

Most clays may be vapour glazed with a various degree of success. As a basic principle the more silica in the clay the smoother the glaze will be, but with less silica and more alumina, the more distinctive “orange peel” texture will result.

The colour of the clay after firing is governed by the nature of the firing and by the iron content. From pale gold (1%) to pale tan (1.5%) to medium brown (1.8 -2 %). More than 3% of iron will cause the glaze to be progressively duller.

Not all clays are well fluxed by the soda because many contain insufficient free silica, e.g. china clays, ball clays and stoneware clays with alumina/silica molecular ratios between 1 to 2 and 1 to 4. The best clays for vapour glazing are fireclays which are high in silica. These have alumina/silica ratio of 1 to 5 or higher.

Extra silica is sometimes added to clay as quartz sand but silica in isolation does not make a glaze, some alumina is necessary. Small amounts of calcia and magnesia help to stabilise the glaze.

When the kiln is soaking at high temperatures, various forms of quartz develop in the body of the pots: some of this quartz is very unstable, the most unstable form being cristobalite.

As already mentioned, the more silica in the body, the better it will salt. However, the more silica in the body the higher the danger of cristobalite to develop in quantity and pots to shatter unless due care is taken.

The most stable of quartz forms is mullite which forms if the kiln is cooled very rapidly. Therefore fast cooling down to around 1000 °C has developed thus stabilising the pernicious effects of excessive silica.

Slips

The sodium glaze itself has no colour, and it takes various shades from the clay beneath. Many potters use slips and/or oxides and stains to introduce colour on to the surface of their work, and depending on the diversities of the firing and cooling processes, colour responses will vary greatly. When using slips the same basic principles of interaction between clays and soda apply. The ratio of alumina to silica will affect the glaze finish. The higher the proportion of silica to alumina, the more sodium is attracted to the slip, and thicker the glaze formed. If the slip covering the body is high in alumina, the sodium is resisted and a more matt, flashed surface tends to result.

In a vapour glazing slip normally a high percentage of kaolin is used and additions of a variety of fluxes and oxides makes for a big choice of colour.

Soda glaze quality is highly reliant on materials used, especially clay. It is important to become familiar with locally available clays and their responses to soda vapour. Developing and working with slips is a good start for such research.



Walter Keeler



Hayne Bayless



Terry Gees

Glazes

If glazes are used, they will be affected by the fluxing action of the soda and the colour and texture of a glaze can change quite dramatically. The extra fluxing action can make some glazes run down the walls, but some, such as magnesia matts and some barium matt glazes, will crystallise and can form dry, rough patches.

Because salt glazing relies upon vapour to form the glaze on the clay, the insides of all but the shallowest bowls remain unglazed. Insides of pots may be glazed with slip glazes prior to firing in the normal way. Slip glazes are popular because the whole process of soda firing can be a once-fired process.

Techniques

There are many different ways of using vapour glazing techniques. From the choice of the clay, slips and glazes, through the making and decoration processes, to the final glazing and firing alternatives. All of these choices are important for a personal statement and therefore the spectrum of possibilities is again limitless.

In order to have some basic view of the process I have restricted my exposition to three main ways of interpretation:

- a) **Soda firing.** Basically derived from salt firing and its typical aesthetics.
- b) **Soda, Clay and Fire.** A new intriguing and revolutionary approach.
- c) **Variations through soda.** A much practiced way of using soda with glazed surfaces.

SODA FIRING

Soda firing is done in a conventional way, often eliminating the biscuit stage. It makes the process slightly longer but it saves in time and fuel.

Soda can be introduced in a variety of ways: spraying it dissolved in hot water, drip-feeding the solution, as small blocks of various compositions, etc.

The drip feeding is an excellent method since it only requires a short length of angled iron and achieves a good and even distribution of soda. Heavy build ups of soda obliterate colour in the yellow/orange variety and make some slips run.

As the solution breaks down in the heat of the flame, water vapour is released along with the vaporizing soda. Water vapour helps to carry the soda through the kiln chamber, enabling good glaze distribution and evidence of flame movement on the work. Water vapour also appears to assist with soda dissociation and glaze formation.



Ruthanne Tudball



Jane Hamlyn



Walter Keeler

Firing cycle

The typical technique would be raw firing with pre-heating and slow raising temperature to take the clay through its biscuit process. If the work is already biscuit fired then, of course, the initial stage can be quite fast.

After soaking the kiln for about one hour at around 900°C, to burn out any carbonaceous matter to avoid any possible bloating, a reducing atmosphere is necessary to convert the ferric oxide

compounds in the body and in slips to the ferrous state. Depending on the clay, often around 1150°C, it could be good practice to oxidise for a few minutes in order to avoid any carbon trapping when sodium already present in the kiln is beginning to vaporise and seal the body. Then maintain only a light reduction or neutral atmosphere throughout the rest of the firing.

Soda starts to be introduced into the kiln at cone 8 through cone 10.

The use of test rings is necessary to understand how the glaze is building up.

An oxidation soak of about an hour at the end of the firing will give warmer oranges from iron bearing bodies and slips.

The kiln is then crash cooled down to about 950°C.

Ruthanne Tudball is one of the foremost ceramic artist investigating and using soda vapour glazing. She has written a book **“Soda Glazing”** edited by A&C Black . London and first published in 1995.

SODA, CLAYS AND FIRE

Gail Nichols is a potter whose technical research and artistic approach to soda firing has literally opened up new aesthetics in the world of ceramics.

In contrast with the general rule of using high contents of silica in the clay, she uses high alumina clay bodies which reacts to soda vapour to create a generous opaque glaze, dimpled and frosty matt, giving the impression of glacially flowing ice.

It bears little resemblance to traditional salt glaze, or to the bright glassier styles of soda glaze.

Unlike slips or detailed surface marking of much salt and soda glaze work, this very special technique tries to focus toward another aesthetic in which the thickly formed glaze flows over, interacts with and softens the form.

Fairly slow cooling is required to create frosty mattness (two hours to 1100 °C and three more to 800 °C). It was also discovered that water vapour in the kiln can alter the glaze colour and increase the crystalline mattness. Compounds like calcia, magnesia, silica, iron or wood ash are to be avoided.



Gail Nichols



Gail Nichols



Gail Nichols

Firing cycle

After reaching 900°C start reducing and fire up with light to medium reduction.

Soda introductions begins at cone 8 with intervals of about 15 minutes with temperature raising up to cone 9 and 10 down.

At cone 10 maintain temperature for two hours (cone 11 down) then fire down to 1000 °C in two hours and again cool down normally to 800 °C in three hours.

Results and conclusions

In Gail Nichols experiments, the soda “ice” glaze formed most successfully in oxidation. Its maturity and colour were enhanced by reducing during the first cooling stage. When reduced cooling below 1000 °C, the colours became muted, producing dull browns instead of reds and oranges.

Reduction during the high temperature glaze forming stages produced some strong colours with close resemblance to traditional salt glaze. Shino style slips and glazes also developed much stronger colour when exposed to this reduction.

It seems that for colour enhancement during cooling, water vapour is most effective between 1000 °C and 800 °C. Water during cooling can also be used to create matt glazes from otherwise glassy surfaces.

Copper and manganese pigments blend well with soda “ice” glaze.

Strong red colours are assisted by a reducing atmosphere and water introduction during glaze forming stages, as well as by reduction during the early stage of cooling.

The “ice” glaze owes its opacity and mattness to a complex mixture of surface distortion and crystallisation. Its icy character is caused by its high soda content, the complete absence of other fluxes, its low silica/alumina ratio, and the absence of crystallised iron. The best ice glaze seems to be obtained in oxidation.

Gail Nichols has written a book, “**Soda, Clay and Fire**” on her distinctive approach to soda vapour glazing published by *The American Ceramic Society* in 2006.

VARIATIONS THROUGH SODA

Soda is a flux and on its way to the chimney will attack and change both in texture and colour any ceramic surface, clay, slip or glaze. Many potters exploit this fact and choose to benefit from it at different temperatures and intensities.

One very good use of the process, altering also temperature and firing schedule, is to soda fire lightly over a selection of otherwise normal stoneware glazes. This firing technique will give the work that extra richness of surface and colour that can enhance further the making process.



Peter Meanley



Pietro Maddalena



John Chalke

TESTING

Vapour glazing with its characteristic of clay interaction with volatile sodium offers a variation of alternatives and possibilities that go from temperature, clay body components and kiln design to firing and cooling schedules, vapour sources, wadding materials and applied surfaces, all areas of limitless investigation and potential discoveries for ideas and aesthetics qualities. The relevant question to ask, as Gail Nichols write, is not “How is it done ?” but rather, “How is it not being done ?” Serious studies of materials and processes will lead to intuitive understanding and to that critical link between science and art.

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