Ash glazes, local slip glazes and once fire process

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ASH GLAZES, LOCAL SLIP GLAZES
       and ONCE FIRE PROCESS

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Preface

My reasons for writing this thesis is to present my findings which have resulted from my explorations into the development of ash glazes, local slip glazes, once fire techniques and the production of an oriented ash glaze surface which will be consistent enough to be used on a steady line of functional dinnerware and accessories.

Investigation into these areas was stimulated by a striving to join myself with the closeness of ash and natural clay glazes to the relation of the clay-forming process itself. Also the investigation has led toward the development of the once fire method which has resulted in great savings economically, time-wise, and ecologically. This once fire process joins the raw clay and slip clay ash glaze without taking away the fresh raw quality of the clay by being fired from raw clay to finished product in a one step process.

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ASH GLAZES, LOCAL SLIP GLAZES
and ONCE FIRE PROCESS

Many glaze formulas are available today from the information provided in books and periodicals and from commercial glaze companies. The question may be asked as to why one should formulate glazes dealing with unknown clay slips when other proven obtainable glazes or glaze formulas are ready for instant use. To me making my own particular pottery comes from within. It is transmitted through the movement of my hands. So why should I go to the cupboard of commercially prepared chemicals and reproduce a glaze which has been developed by someone else to be used on my own individualized work? This would seem far removed from the spirit which I have put into the pottery that I have created. When I dig my own clay, slake it down, screen it, ball mill it, dry it, and then bag it, I have made my own slip glaze base for my glazes. This glaze surface and the formed pottery is united in a way which no one else can do. If I want to use another natural glaze, I may do so by using the ashes from burned wood which can be made into a glaze. I can also combine the slip glaze and the ash glaze to produce still another type of glaze.

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Ash glaze surface is often considered to have a varying texture which can only be produced once. This is not necessarily the case. The ash glazes which I wish to develop would maintain a steady textural quality either be it of smooth or rough gradation. In developing my ware to suit these glazes, a surface reflecting both qualities of rough and smooth variations are to be applied to the surface. In dinnerware, for example, the use of an accenting rough textural surface played against a smooth eating surface will use both inherent qualities of ash glazes. These glaze formulas when fully developed will produce consistent quality surfaces which may be reproduced for use in making production pottery.

Interest in natural glaze elements has stemmed from information gleaned from reading books and from personally observing the ways in which the glaze elements are used by other potters. Two authors whose books I have read and who have described slip and ash glazes and once fire techniques are Michael Cardew who wrote Pioneer Pottery and Daniel Rhodes who wrote Clay and Glazes for the Potter. One well known potter whom I observed during my first summer at Rochester Institute of Technology is Frans Wildenhain. He introduced me to a slip from the shore of Lake Ontario. This introduction led me to consider using natural slips and ashes separately or by combining them or by further combining them with other chemicals. It also led me in the direction of the varying surface textures available by using slips or ash alone, or by combining them for textural effects.
The purpose of my efforts has been to seek and develop ways in which natural glaze elements could be combined chemically to form a glaze over a once fire body; thus making it possible for a glaze to be applied over a clay body to be fired once which would eliminate the bisque firing stage, and, therefore, would cut down on time for loading, and on gas used for firing.

When seeking the clay from which slip glazes are made, one must look for a vein of sedimentary clay. The most visible spots of sedimentary clays are in banks where large clay deposits are located. These banks may be found along the shores of lakes or along river banks. They may also be found where road construction has made it necessary to cut through the sides of hills. The best clay to be used for slip glazes can be found in a noticeable vein in a large bank of clay. Usually the vein will be a color different from the rest of the clay in the bank. It will be fairly free from stones, sand, and other organic debris. Sometimes, however, there may be a whole bank of clay which is quite free from debris and can be used for slip glazing. Another place to look for slip clay is in a drainage ditch beside a road which cuts through a bank. This clay when found is particularly good because nature has washed it free of stones of debris thus leaving the smaller size particles of clay to settle in the ditch. It is well to observe excavations that are made for house foundations because good clay deposits may be found below the topsoil. After
4.

the slip clay has been located and dug, it is necessary to slake the clay down. After the clay becomes slurry, it should be run through a thirty to sixty mesh screen to free the slip from any remaining debris. The next step in the process is to ball mill the slip until the clay particles are totally ground into a creamy consistency. This makes the slip into particles of equal size. Now it is time to apply the slip for glaze testing in order to find the slip's firing range. The firing ranges of these natural slip glazes may vary widely depending upon the chemical composition of the clay. After the firing, the slip glaze surface may vary from a mat finish to a high gloss. To the mat finish may be added flint silica, or feldspar, or nepheline syenite, or frit to make a more glassy surface. If the results after firing are a glassy surface, and a mat surface is desired, it may be done by adding kaolin or super pax or zirkopax.

Another flux that could be added to the slip glaze is wood ash. The ash often carries with it a yellow hue which will contribute to the color of the slip. By varying the amount of ash added to the slip, the glaze can be made glassy, or it can result in a surface on which there are running streaks which add beauty to the surface texture. In the choice of the kind of ash, it will be found that the different kinds of wood ash will make a change in the glaze color and the chemical content. Fruit-wood ash such as apple, for example, will tend to give a yellow-brown hue to the glaze. Hard-wood
ash, such as maple, will give a darker brown color and possibly it will contain more iron than does the fruit-wood ash.

Any wood ash by itself when heated to cone ten will form a glassy surface. This is caused by the chemical content which consists of up to fifteen percent alumina, up to thirty to seventy percent silica, up to fifteen percent potash, up to thirty percent lime, and some traces of iron oxide, phosphorous and magnesia. The glaze surface may be altered to further flux the glaze by adding felspar, flint or whiting. Clay must also be added to make the ash better adhere to the surface of the pottery. By so doing the fluidity of the glaze can be controlled. By adding kaolin to the glaze to which the fluxes have been added a mat or opaque surface can be acquired. As a result of these additions, the firing range can be adjusted between cone eight to cone eleven.

The gloss of the ash glazes may be varied by the kind of ash itself. Hard-wood ash such as maple is made up of: SiO₂-14.08, Al₂O₃-3.69, Fe₂O₃-0.94, P₂O₅-2.14, CaO-35.90, MgO-5.44, MnO-0.14, K₂O-1.45, Na₂O-0.55.

This ash gives a dark green hue to the glaze color. Fruit-wood ash also has a different color hue. Apple ash when mixed into a glaze gives a yellow-green hue to the glaze. The apple ash chemically is made up of: SiO₂-2.7, P₂O₅-4.5, CaO-70.9, MgO-5.5, K₂O-11.8, Na₂O-1.9, S0₃-2.7 which leads to a yellowish cast of color.

Some other sources of ash are soft-woods (pine), straw,
grass cuttings and leaves. Any burnable substance will produce an ash and every different kind of ash will produce an individual color hue to a glaze.

Additional colorants may be added to any ash glaze. Most of these colorants are composed of metallic oxides. Most oxides have more than one characteristic. They may act as a flux, a bleaching agent, or as a color additive. Rutile, iron, cobalt and copper are all oxides which may be added to produce color changes in the glaze surface. Many slips may be added along with oxides to create certain color changes in glazes. Some of these may be Albany slip, Barnard slip, or any other clay slip such as red art or natural slip clay. The glaze formulas using oxides which I chose to produce were: iron saturate glazes, rutile crystal glazes, cobalt and manganese glazes and spodumene glazes.

To produce iron saturate ash glaze I started with the formula of:

Red art 70%
Apple ash 30%

To this I next added bone ash at 5% to induce an opalescent quality and to add additional flux. To this working glaze formula next add percentages from two to five percent iron oxide to increase the iron content of the glaze. This addition of iron I found to work best at 5%, causing iron saturate crystals to be formed in the glaze.

To produce rutile crystal glaze I started with:

Hard-wood ash 35%
Kingman feldspar 35%
In my testing of this formula, both apple wood ash and maple wood ash have been tried. In trying to develop rutile crystals, I have found that the maple ash which is a hard-wood ash is more effective than the fruit-wood ash. Kingman Feldspar has been added as a flux and glass former. The China Clay has been used as a source of alumina, silica in the glaze to act as glass formers. Talc has been added to contribute both magnesia and silica for additional flux. To add additional color to the glaze rutile and ilmenite have been added. The rutile is added to give a source of titanium and iron oxide to the glaze. This in turn gives a coloring of tan to brown and may form rutile glaze crystals. Ilmenite also further contributes titanium and iron to the glaze. This contributes a yellowish halo around the rutile crystals.

To produce cobalt and manganese glaze, I started with:

Apple ash 50%
Custer feldspar 30%
Albany slip 15%
Cobalt .05%
Manganese 1%
Chrome oxide 1%

To produce this glaze, apple ash is used as the major portion of the glaze. Apple ash contains a high percentage of potash feldspar, alumina, and some iron and magnesia. The ash is primarily used as a flux and glass former. Custer feldspar also is added to provide additional flux and glass former. The
Albany slip is added both as a clay and for glass forming. It has a high iron content which contributes to the color. As a colorant cobalt provides the color blue. The colorant manganese contributes a deep blue-purple color to the glaze. A greenish hue is caused by the chrome oxide. The cobalt manganese formula is:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple ash</td>
<td>50%</td>
</tr>
<tr>
<td>Custer feldspar</td>
<td>30%</td>
</tr>
<tr>
<td>Albany slip</td>
<td>15%</td>
</tr>
<tr>
<td>Cobalt oxide</td>
<td>.5%</td>
</tr>
<tr>
<td>Manganese</td>
<td>.1%</td>
</tr>
<tr>
<td>Iron oxide</td>
<td>1%</td>
</tr>
</tbody>
</table>

Spodumene may be added to a glaze to bring out the iron crystals in the mixture. This is a form of feldspar and contains lithium as a glaze surface healer. The formula for the spodumene glaze is:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple ash</td>
<td>30%</td>
</tr>
<tr>
<td>Custer feldspar</td>
<td>25%</td>
</tr>
<tr>
<td>Spodumene</td>
<td>20%</td>
</tr>
<tr>
<td>Dolomite</td>
<td>15%</td>
</tr>
<tr>
<td>Kaolin</td>
<td>20%</td>
</tr>
<tr>
<td>Iron</td>
<td>1%</td>
</tr>
<tr>
<td>Zercopax</td>
<td>10%</td>
</tr>
<tr>
<td>Lithium carb.</td>
<td>1%</td>
</tr>
<tr>
<td>Barium carb.</td>
<td>20%</td>
</tr>
</tbody>
</table>

These are a few color possibilities which use the combination of wood ashes and colorant oxides.

After formulating the ash glazes, still another problem faced me. It was to apply ash glazes to a once fire, green, clay body. The first consideration is that the glaze tends to easily powder or flake off the clay surface. Secondly, when glazing once fire ware, glazes are not pulled as deep into the clay body as when they are applied to bisque ware. This also will cause flaking. The third consideration is to prevent
stress cracks which result form uneven glazes.

To keep the glaze from powdering or flaking off the clay surface, it is necessary to add bentonite to the glaze mixture at 3-5%. When applying glaze to flat plates a percentage of 5-7% or higher may be needed in order to stop the flat surface from cracking or flaking.

The stress cracks can be prevented by glazing both sides of the piece of pottery at the same time or by glazing one side and then immediately glazing the other. If glazing only one surface of the piece is desired, water may be applied by spraying or dunking the surface which is not to be glazed. This will then allow the opposite side to be glazed without putting stress on the clay.

By using the once fire technique, glazing methods such as double dipping, wax resist, and slips may be applied.

Considerations for the clay body to be used for once firing are ones with high plasticity, low percentage of shrinkage in drying and strong green ware strength. I have and am still experimenting with many different kinds of clays from which I hope I can formulate a good once fire body. The clay body with which I am presently working is composed of:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A9 White stoneware</td>
<td>30%</td>
</tr>
<tr>
<td>EPK</td>
<td></td>
</tr>
<tr>
<td>Kyantitsue special</td>
<td>15%</td>
</tr>
<tr>
<td>Flint silica</td>
<td>5%</td>
</tr>
<tr>
<td>AP Green fire clay</td>
<td>30%</td>
</tr>
<tr>
<td>Custer feldspar</td>
<td>3 to 5%</td>
</tr>
<tr>
<td>Grog</td>
<td>5 to 8%</td>
</tr>
</tbody>
</table>
Some of the design elements to be reflected upon are: the way in which to handle the pieces while glazing and the stress that will be put upon the pieces during the once fire glaze process. When trimming the ware, leave a large enough foot or some surface to hold onto while applying the glaze. In developing the form try to avoid sharp angle changes or leave thicker walls where form alterations are to be done. This extra thickness will avoid the chances for stress cracks when the glaze is applied.

The procedures which have been described relate my development of ash glazes, local slip glazes, once fire techniques and the production of an oriented ash glaze surface to be used for functional dinnerware and accessories. In developing these techniques, I have tried to draw myself closer to the beauty which freshly thrown or green piece of pottery holds within the essence of its form. By combining the closeness of spirit and form with the technical abilities which I have found, I should be able to produce a highly spirited, but yet saleable line of production pottery.
Ash Clays Illustrations

1. Iron saturate glaze
2. Rutile crystal glaze
3. Cobalt and manganese glaze
4. Spodumene glaze
5. Formal dinnerware placesetting using ash glazes
6. Closeup of double dipping glazes