# Wood Ash Glaze

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**Thesis submitted to the**
**College of Creative Arts**
**At West Virginia University**
**In partial fulfillment of the requirements**
**For the degree of**

**Master of Fine Arts**
**In**
**Ceramics**

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**Division of Art**

**Morgantown, West Virginia**

**2006**

**Keywords: Wood Ash Glaze, Ceramic, Glazes, Pottery, Ash**

# Abstract


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My thesis is a documentation of my research with wood ash glaze. Specifics of the type of wood ash used, how it was prepared, where it was collected, and glaze formulas are discussed. I have included a brief history of ash glazes and the importance through their elemental structure. Contemporary potter's who have strongly influenced me through their use of ash glaze are referred to also. The type of clay, firing methods, and application are also briefly mentioned. My goal is to present the variety of surfaces using a small collection of glaze material and wood ash with several types of coloring oxides, creating an unlimited array of colors and depth. Formulation of fake ash glazes made for an alternative to the surface quality and saved time, by eliminating the involvement of collecting and processing wood ash.

# Acknowledgements

None of this experience would be possible if it was not for Bob Anderson. His patience with teaching and the material has demonstrated well for many. Bob, I came to you a young man and I leave you a young potter. Thanks for showing me how to make pots!

My committee gave me the insight, encouragement, and professionalism to be a student-artist. Thanks for letting me see and express my desires.

To my family, girlfriend Kim, friends, fellow graduate students, and the entire pot shop crew for showing me the love and support to keep going. Your pep talks and opinions on pots and life will stay with me forever. You guys rock!!!

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# Introduction

I have been drawn to the organic qualities of ash glaze throughout graduate school. These last few years have given me the opportunity to explore the possibilities with ash glaze and the depth, range of color, and texture you can achieve. Wood ash used as a glaze material was unexpectedly the first of its kind. The organic surface of ash glaze is as varied as the material itself. Wood ash is not a processed, mass produced material available in a clean, distributed bag. Much work is involved in getting to its usable form in a glaze. Wood ash is as diverse a material as the location and soil it was harvested from. A pine tree taken from Pennsylvania is going to have different surface qualities than a pine tree from Tennessee. An even closer example would be gathering a young tree verses an old tree. The change in composition of the tree will change overtime effecting percentages of the soluble alkalis that us potters are interested in. My relationship with the material is about having a gained knowledge of its unique and ever changing features. Discovering new surfaces and colors through experimentation with set materials and a full range of coloring oxides has been my path.

# Historical Reference

The first ash glazed pots are believed to be produced in the Shang period about 1500 B.C. At this time, kiln design allowed for higher temperatures and better movement of the flame path. Clay technology was also improving. The increased firing temperature gave pots a denser, more durable, vitrified surface. The surface of the ware also has a colored, glassy coating, usually on the shoulder and only on one side. Wood was the only fuel used. Accidentally, the hotter temperature, about 2140 F or cone 3 caused the ash to stick and melt on to the pots. The result was a smooth to rough, runny glaze. The molten ashes contained soluble alkali's (potassium and calcium), which chemically formed the glaze. Most of this early glaze that was created had a greenish yellow color from the iron and titanium oxides found in clay and ashes.

This new type of decoration to the pots surface took sometime to realize. During the end of the Shang period to the beginning of the Zhou dynasty (1066-221), actual glaze produced from wood ash was applied to the outside surface of the pots. This glaze was simply the combination of wood ash and the clay body or other types of clays. Glaze was applied through brushing or dipping. A few hundred years later, the beautiful jars from the

Western Han period (1 B.C. - 1 A.D.) had the wood ash and clay mixture sifted onto a wet surface. Also notably, during this time, was how the surface decoration of the pot was affected by the ash glaze. You start to see more incised lines, combed patterns, and bands of raised decoration. These decorations served a function to collect the glaze and stop it from running down to the kiln shelf.

# Contemporary Potters

Potters today still use wood ash and other types of plant ash to decorate and complete their pots. Two contemporary potters who have influenced me, use wood ash glazes extensively, and make great pots are Phil Rogers and Tom Turner. Phil's wood ash glaze is primarily described as a celadon ash glaze. He is drawn to the ancient characteristics of wood ash glaze and its timeless beauty. His experimentation on many kinds of plant ashes and local materials has served many potters and students valuable information. Pine ash tends to give his ash glaze a cleaner, green color and pure surface. The majority of his work is influenced by the late potter's Bernard Leach and Shoji Hamada, Korean, Chinese, and Japanese ceramics.

Tom Turners work has a remarkable craftsmanship and strong presence. Using ash glaze to finish his porcelain pots because of the visual and physical textures common with the fired ash glaze serves him well. The control with the application of the ash glaze and knowledge of his material, gives Tom a finished piece of perfection and beauty. His ash glazes are typical made from apple ash, mixed hardwoods, and even fake ash combinations. The Chinese's highest level of ceramics, during the Song Dynasty, is his major influence.

# Makeup of Wood Ash

Determining why wood ash is so useful in glazes, one most have knowledge of the makeup of the material. The organic elements found in wood ash, from trees that potters are concerned with, are calcium, potassium, magnesium, and sodium. The highest concentration of elements with the greatest importance in the glaze is calcium and potassium. These materials intensify the wood ash in the glaze and encourage it to run, pool, and have many layers. This chart represents the makeup of certain ashes. Its main object is giving us the percentages of the fluxes and hardeners. It lets us know what ashes will move more on their own, verses which ones will be stable and not run. For example, apple ash has more fluxing capabilities than pine ash. Apple has 63.6% calcium, will pine only has 25. We can state that apple ash is soft and pine is medium in the surface movement. This chart only represents the ash tested in the area it was taken from. We can use it as a rough guide when testing different types of ashes in glazes.

| | Apple | Beech | Oak | Pine | Spruce | Willow |
|---|---|---|---|---|---|---|
| Silica $SiO_2$ | 1.31 | 3.01 | 15.30 | 10.00 | 2.73 | 4.44 |
| Alumina $Al_2O_3$ | — | — | 0.13 | 0.43 | — | 0.05 |
| Phosphorus $P_2O_5$ | 4.9 | 6.2 | 13.8 | 8.8 | 2.12 | 10.00 |
| Iron $Fe_2O_3$ | 1.66 | 0.62 | 2.40 | 4.00 | 1.42 | 1.25 |
| Calcium CaO | 63.60 | 42.00 | 30.02 | 25.00 | 33.97 | 20.21 |
| Potash $K_2O$ | 19.24 | 24.29 | 14.00 | 26.50 | 19.66 | 49.80 |
| Magnesia MgO | 7.46 | 8.20 | 12.01 | 6.32 | 11.27 | 8.26 |
| Soda $Na_2O$ | 10.45 | 8.34 | 9.12 | 8.65 | 1.37 | 2.50 |
| Manganese MnO | — | 4.52 | 0.10 | 5.06 | 22.96 | 0.18 |
| Sulphates $SO_3$ | 0.93 | 2.10 | 2.61 | 4.63 | 2.64 | 1.22 |
| Copper Ox CuO | — | — | 0.05 | — | — | — |
| Chlorine Cl | 0.45 | 0.72 | 1.18 | 0.52 | 0.07 | 0.08 |

These elements have great variability in concentration due to the type of tree, region where it was grown, age, season it was harvested, and part of the tree used (trunk, branch, bark, leaves, and needles). Usually the trunk, bark, and leaves have the highest

level of organic elements and the branches have the lowest. Preparation of the wood ash is also a factor in the percentages of organic elements and will be discussed later.

# Collection and Preparation of Wood Ash

Wood ash is a material that can not be purchased at the ceramic supply company. It is an organic material of greater value through its raw characteristics and historical worth. Living in Morgantown, WV as a ceramic student made my experience of gather wood and ash a little easier. Surrounded by forests and people who fuel their homes with wood was perfect. An understanding was needed of the other materials (paper, cardboard, etc.) people might use to burn in their wood burning stoves. Trying to duplicate a certain ash twice with this type of variable is very frustrating. You can not just go into the forest and pick the pine or poplar tree you like. Much of the wood ash that I obtained was from friends and businesses that burned wood for heat. This is very ideal because I know what type of wood was burned, that it was protected from the elements, and that it was not contaminated. I will elaborate on the importance of these issues later on. All of this ash gathered was from the fireplace or wood burning stove, which usually contains finer particles of ash ands less chunks of wood.

Harvesting wood ash from others is the easiest way to stockpile your material. It takes all of the labor-intensive work out of the experience. It also limits the type of wood ash you can test. The second best way for me to collect wood ash was to find dump piles of trees and shrubs. Driving around town and getting lost on country roads finding small "gold mines" was an adventure. Almost all of these piles consisted of dried branches and trunks of trees and full shrubs. Filling up my truck with this free material was the best. Overall, I probably had 12-15 truck loads of free wood ready to be processed.

Preparation of my wood ash was handled in a clean consistent manner. Special care was taken not to contaminate the ash with any material (iron, dirt, gravel, etc) or mix

different types of wood ash. To produce ash from the piles of wood I had gathered, I needed to build a wood burning kiln. In Phil Rogers *Ash Glaze* book, I followed directions on building a "mock" wood burning kiln he had obtained from other ash glaze users. The main function of the stove was to burn the wood thoroughly to create a fine usable ash. It should also protect the ash from the elements. I found the kiln to work very efficiently, burning the wood fast and evenly. Using lentil bricks, old bricks and shelves, expanded steel, metal shelving, and a metal tube worked wonderfully.

One thing to mention is not to overload the kiln with wood. Only so much wood can combust due to the size. The most discovering factor of all this was the amount of ash collected. From the 12-15 truck loads of wood, I collected 4 gallons of pine and spruce and only 1.5 gallons of evergreen. This was very disappointing, but humbling. Nature only lets you

have what she wants to give. Emil Wolff and his work with ash analysis were right. He estimated you will only obtain one pound of ash from two hundred pounds of most dry wood. How wild is that!

Further preparation of the ash was to first get it into a dry place before it was to be mixed with the other glaze material. Many potters' at this point would wash their ash and set aside to dry for many days. But I do not care to. The reasoning is because of the visual change of the final glaze. Washing robs the "soul" of the wood ash, depleting the soluble fluxes. Washing is also labor-intensive and time consuming. Some benefits of washing are to lesson the concentration of the soluble alkalis, which cause the glaze batch to deflocculate or flocculate and become unusable. The ash will also not be as acidic, which can cause your skin to burn and become irritated. Some agents added to help thicken the glaze will no longer be effected.

Finally, the last step of preparation would be to sieve the entire glaze batch. I would do this with all the materials mixed in water and pour them through an 80 mesh screen. Large particles of wood can be removed and discarded. Thus, it is important to account for large chunks of wood, nails, etc that might be discarded after the weighting process. By adding twenty-five percent to the glaze batch for the wood ash amount is critical. For example, if the glaze formula called for 50 grams of wood ash, you would add 62.5 grams of wood ash for an increase of 25 percent. If you try to screen your ash dry before you weight it, you risk losing the fine particles and make a big mess. These particles are the soluble alkali's that you want!

# Ash Glazes

## Ash #4

Pine, cherry, or mixed hardwood ash 50

| | |
|---|---|
| Albany clay | 30 |
| Strontium carbonates | 10 |
| Dolomite | 10 |
| | 100 |

## Aerni Ash

Spruce, cherry, or mixed hardwood ash 50

| | |
|---|---|
| KY ball | 12.5 |
| Dolomite | 12.5 |
| G-200 | 12.5 |
| Silica | 12.5 |
| | 100 |

## Nuka Ash

Cherry or mixed hardwood ash 50

| | |
|---|---|
| G-200 feldspar | 60 |
| Silica | 40 |
| | 100 |

add:

| | |
|---|---|
| Vee gum t | 1 |

The ash glazes listed above are the standard glazes that I use. Substituting several materials for others gives me many subtle differences in surface and color. I believe the possibilities to be endless with any glaze; you just need to focus on the characteristics

you want. Texture, movement, color, and depth are the surface qualities that I am interested in with the ash glazes.

Ash #4 is an ash glaze originally formulated by Val Cushing. When first using the glaze I immediately was drawn to the matted, runny, textural surface. I did not like the fact it had barium carbonate at 10 %, which is a very poisonous material. I first changed barium carbonate to strontium carbonate, which is safer to use and is similar in composition. Interchanging dolomite with whiting to give more magnesium to the glaze and a more mottled surface, which can be nice depending on the coloring oxides used.

Using pine ash will give this glaze a lighter background and a cleaner, translucent glaze. Using dolomite instead of whiting tends to blend the color in better and mottles the surface. The added magnesium in dolomite gives these characteristics and is the main difference between it and whiting. Coloring oxides I use with the pine ash are cobalt (.25%), rutile (6%), ochre (3%), and red iron oxide (3%). Cobalt yields a strong, semi-matte blue as seen on the teapot on the right.

Rutile is a soft tan matte, with darker runs and pools as seen on the teapot on the left.

Ochre and red iron are similar in color and surface. The main difference is ochre tends to be more of a yellowish-brown color, with bluish- green runs as seen on the pitcher on the right.

Red iron is a reddish-brown color for the runs and a yellowish-tan for the background as seen on the oval casserole on the left. The depth from the back, middle, and foreground made through the color intensity is the same throughout these oxides; light matte to a darker semi-gloss.

When using mixed hardwood, you will get the opposite effects because the iron content is higher. The background will become darker and the glaze will be murky. I also like to substitute whiting for dolomite. The whiting seems to move the glaze more and does not have the mottling effects, so it is more on top of the glaze than mixing in it. Just using the base glaze, with no coloring oxides, sprayed over other glazes gives me great variety.

This large jar is first sprayed with fake ash 2 glaze with red iron oxide and titanium, and then sprayed with #4 ash base with hardwood ash. Multiple glazes sprayed over each other give many different surfaces and colors, which can be very beautiful.

The chopstick holder on the right has both red iron oxide (2%) and rutile (6%), which combines to a dry, matte surface with a pale brown to light brown color, with pools

of dark brownish-red.

The second base glaze that I use often is Aerni Ash. There are a few revised versions, but this one has more silica, giving it a stronger, shinier surface. I also use dolomite verses whiting to help blend and soften the coloring oxides.

Spruce ash has the same characteristics as pine; clean with some iron content and transparent. An addition of ochre (2%) to the base glaze will produce a glassy, soft green color. It is more of a bold green than just the base glaze alone. The dolomite and ochre produce thicker, bolder running lines, which can look beautiful on larger pots like the one on the left.

The teapot on the right has both cobalt (.25%) and rutile (6%), which produces a mottled grayish-blue with pulls of glossy black. The background color is a light tan from the soluble alkali's coloring the clay.

A further combination of cobalt, rutile, and ochre, with the same amounts as listed above, seen here on the creamer and sugar set, yields a much greyer-blue. Colors also range from matte to gloss in surface.

Hardwood mixed with the same coloring oxides and exact combinations, surprisingly displays the same results. The main difference is the background color. When it shows through with the hardwood it is a light brown color verse a tan color with the spruce. This is from the higher iron content in the hardwood verses the spruce. This large casserole has red iron oxide

added, but combined with the hardwood, will produce a much deeper reddish –brown color.

Nuka Ash is on the opposite end of the spectrum of ash glazes compared to the earlier two. Nuka ash typically has a thick, chun-like surface, usually white to ginger in color (see platter below). Rice husk ash was first used with this glaze in China and Japan, which is high in silica. I have found here in WV that cherry and mixed hardwood ash work best, with a high amount of silica added. To my surprise, pine and spruce did not work at all. Mixed hardwood has the look or a more traditional nuka ash; thick and white with high lights of blue. I have only been able to test cherry on my porcelain clay and do not have anymore to test on the white stoneware clay I use now. The characteristics with cherry ash gave a softer, more even glaze surface, with hints of purplish-blue. I have found that G-200 feldspar works much better than custer feldspar. This can be because G-200 contains a small percentage more of calcium and also produces a more translucent glass than custer spar. This would both make a difference with the high content of feldspar and the nature of the glaze. Small additions of a cleaner red iron oxide can give a subtle ginger color. Taking 1-2% of redart clay would be a good test to help the glaze adhere better and give a soft ginger color. I like to put 1% of vee gum t to aid in the suspension of the glaze materials, even the glaze surface, and give more dry strength.

# Fake Ash Glazes

## Fake Ash 1

| | |
|---|---|
| Dolomite | 32 |
| Albany | 52 |
| KY ball | 16 |
| | 100 |

## Fake Ash 2

| | |
|---|---|
| Albany | 53 |
| Silica | 12 |
| Whiting | 35 |
| | 100 |

My experimentation with fake ash glazes has been lead similar to the real ash glaze. The material difference is that there is not any wood ash in the fake ash glaze. The iron bearing clays and high percentages of whiting and dolomite fuse together to form a glaze. Whiting and dolomite help to achieve the ash like characteristics of a textural, runny skin through the added fluxing power of the calcium.

Fake Ash 1 has a matte mottled surface with less texture and rivulets when using dolomite. I have used whiting and you can produce wood ash qualities of texture and depth. I wanted something different from the wood ash and choose to tighten the movement of the glaze surface with dolomite. Using just the base glaze produces a light to dark olive green color (see pitcher on the right).

Adding cobalt (.25%) will give a greenish background, lighter green-blue foreground, with glossy blue pools, seen here on the oval casserole on the left.

This casserole on the right has yellow iron oxide (4%) added, which creates a yellowish tan background and yellowish green runs. Overall, the yellow iron has higher fluxing qualities producing more texture and runs in the glaze.

A further substitution of redart clay to the albany clay is worth consideration. It is very close to the base glaze surface and color, but showing pulls of yellowish-brown. This particular casserole was fired in the soda kiln and will darken the glaze and cause it to run more.

Fake Ash 2 is by far the least like an ash glaze. The qualities are more like a traditional Chinese celadon ash. The addition of silica in replace of the KY ball clay gives the strong, green transparent surface. The Albany likes to matte the surface or just parts, with a flat brown crystalline surface. This glaze has beautiful variations, from piece to piece, even when dipped, as seen on the right with the stacking casseroles.

When adding red iron oxide (3%) and titanium dioxide (1%) you get a wood ash glaze surface, as seen below on the mugs. The red iron and titanium really flux the surface and cause much movement. You should apply thin or only one dip. The glaze is very much like an amber celadon that was lightly salted or soda fired.

# Clay, Firing, and Application

It should be noted that these glazes will look different depending on the clay used, firing temperature and atmosphere, type of firing(reduction or soda), and glaze application. The following will explain these issues briefly through the materials and processes I use.

You can achieve different characteristics, mainly in color and some in surface depending on the type of clay used. Through experimentation, the more iron present in the clay will produce a darker glaze and sometimes more murky, mottled surfaces. The clay body that I use is:

**White Stoneware** (cone 10 -11)

| | |
|---|---|
| EPK | 20 |
| 6 Tile | 15 |
| KY ball | 15 |
| Goldart | 12 |
| Hawthorne | 13 |
| G-200 feldspar | 13 |
| Silica | 12 |
| | 100 |
| Add: | |
| Silica sand | 2 |
| Bentonite | 1-2 |

My ash glazes used on porcelain clay are lighter in color because of little to no iron content. My porcelain clay is:

## BB Porcelain

| | |
|---|---|
| Rogers Kaolin | 25 |
| Kaolex | 5 |
| Calcined Kaolin | 5 |
| Champion ball | 15 |
| Custer Feldspar | 20 |
| Silica | 15 |
| Pyrax | 10 |
| | 95 |

Firing atmosphere and temperature is also a large factor when trying to produce the same results time after time. I have found with my white stoneware that a light reduction firing serves the glaze the best. I do not do a body reduction because to much of the iron oxide will come to the surface of the body and change my ash glaze, especially with the fake ash glazes.

My porcelain clay will be fired opposite to the white stoneware. A body reduction will be done, following a light reducing atmosphere till the end of the firing. Bring the little iron present in the clay to the surface helps promote more intense colors.

A second way I fire my pots is in the soda kiln. The added fluxing from the soda will cause many surprises to any surface. Usually, with ash glazes, it will make the glaze

move, lighten, and become mottled. The added variation from the soda on the clay and glaze makes the pots more unique by its uncontrollable effects.

Most importantly, one must consider the firing temperature. 2340*F (cone ^10) is ideal. Any hotter and you will have a pot stuck to the kiln shelf. The characteristic of my ash glazes is to run and they will!

Thickness is also a determining factor with ash glaze. To thin of an application with my glazes will not give the color, texture, or depth that is beautiful of them. I mainly spray my glazes because of limited material I have on hand. Since I do not wash my ash, as previously stated, making smaller batches allows me to use the glaze quickly without having deflocculation or flocculation occur. It also lends me to more layering of different glazes and some interesting results. The fake ash glaze has no wood ash present, so making a large batch and dipping the glaze twice is my preference.

# Conclusion

Given the variability of ash glazes and the materials associated with them, I feel I was able to create a pallet of colors and surfaces with a limited range of materials. Analyzing how the materials influenced each other through their integration with the wood ash was necessary. Researching and developing other ways to create similar surfaces, without the use of ash, was needed. The time saved and the addition of new glazes was an added bonus.

I was also able to unify my surfaces with my forms. This completely different issue was resolved through my new understanding of the characteristics of ash glazes. As these glazes developed, I was able to realize what I wanted as a "skin" on my pots.

This research gives anyone a journey to take in the mysteries of wood ash glazes. Not many potters take this road or appreciate the subtleties and work involved with these glazes. For me, the connection is obvious in the materials themselves and the fired results. It is an organic fusion, not just in the materials, but in the maker through the process. These processes are natural and right for me as a young potter.

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