electric wood ash

by Ryan Coppage, PhD

Many, many potters are eventually seduced by wood-fired ceramics and the beautiful, subtle colors, patterns, blushes, and unpredictable depths found, therein. For those of us that cannot manage the significant time or effort that a wood kiln demands, there are other options.

Defining the Terms

Bottom Ash: Ash particles that are too large to be carried up with the flame.

Flashing: The deposition of gaseous vapor metals (typically sodium and sodium-oxide layers) on the surface of low-iron and low flux-content clay that creates color bursts, typically in oranges, yellows, and browns. Flashing can also refer to reduced red iron patterns on wood-fired surfaces that are fired down in reduction.

Fly Ash: Light ash with incredibly small particle sizes, created when wood burns.

Wadding: A mixture of half EPK kaolin and half alumina hydrate used to elevate ceramics off of shelves during atmospheric firings.

Wood Ash: The mineral byproduct of burning wood, which is primarily whiting, silica, and metal, alkaline, and alkaline earth oxides.

Wood Firing: The process of firing ceramics solely with wood, such that the ash produced creates patterns on the surface of the works.

Wood Ash Byproduct vs. Wood-Fired Ceramics

Many of us keep day jobs and dream of that week we can pour into an anagama firing, only to emerge utterly exhausted and back at the daily grind. The goal here is to make "wood-fired" pottery at home, on a realistic schedule, and in realistic parameters.

Wood has been used throughout history as a fuel source. It fuels campfires; it heats homes; it is used as a fuel source in steam engines and steam turbines, and of course, in wood-fired kilns. Wood, in addition to providing the heat energy to fire pottery, also produces the resulting wood ash that creates the surfaces that you admire. The problem with this multi-purpose, regenerating, and easily accessible fuel is that its heating byproduct, wood ash, is caustic. Yes, small amounts of it are good for your garden as a potassium source, but wood ash is created in such large amounts on a global scale that significant efforts have been made to find creative uses for the caustic waste product, most successfully including additive properties in concretes.[1, 2]

This is an opportunist's dream: A waste product, wood ash, is responsible for creating some of the nicest ceramic art surfaces in history. Several logic jumps down the road and one can envision the creation of a wood fire-emulated surface from a cone 6, electric firing (1, 2). With the caretaking and use of a wood kiln existing as one of the most time- and labor-intensive practices out there, we have room for better living through chemistry for potters who are obsessed with wood-ash surfaces.

Wood ash can be categorized into two divisions: fly ash and bottom ash. These vary slightly in chemical composition depending on the wood type burned, the bark/fiber component used, and the location and mineral profile surroundings of the wood harvested. What is rarely up for debate is the weight or density of the ash and ash particle size. Fly ash is light with incredibly small particle sizes, as it is created when wood burns and is carried and deposited onto ceramic surfaces. The ash particles that are too large to be carried up with the flame are retained as bottom ash and are roughly similar in chemical composition. These are found in the bottom of your wood-kiln's fire box, fireplace, fire pit, etc. A larger particle size means a higher melting temperature, as more heat must be applied to a smaller surface-area-to-volume ratio. With that in mind, we know that to use this bottom ash we must add some flux to the ash and put it in a stable glaze application system.

There are two of these recipes already developed by Michael Frasca and Val Cushing (shown on page 99). Based on these, you can test and develop your own, as most ash chemical analysis profiles will be different.

1

2

Cone 6 Electric Wood-Ash Ceramics

Unfortunately, you can't realistically go about creating a sodium-vapor deposition atmosphere for flashing in an electric kiln or create a side draft to make those gorgeous wadding-directed flame patterns without destroying your elements and making the process horribly destructive and costly; however, you can easily load a "wood-ash glaze" into a spray gun and spray the patterns across your pottery (already mounted on wadding and shells) from one direction. The glaze will be easily blocked and directed by wadding, akin to results from a side-draft or anagama kiln. To match the palette of colors achieved from firing in a wood-fire kiln, red iron oxide can be added to the glaze. The adapted recipe (shown below), uses a very small quantity of soda ash to promote flashing of the surface of Standard's 182G clay body, which was recently labeled as vitrified at cone 6. Additionally, you may have noticed that this clay flashes with the use of sodium feldspars in oxidation. Some amount of sodium likely gasses out of the glaze during firing, creating a subtle orange blush halo on bare clay where the glaze line terminates.

It is somewhat traditional to place ceramics on shells with wadding supports when firing in wood kilns, as very different pattern orientations are obtainable and the shells help catch any glaze that starts to drip in their direction, which is sometimes good and sometimes bad. Additionally, shells are mostly calcium carbonate with some salt impurities, or whiting. Upon being fired, even to cone 6, they will give off CO_2 which will carry any volatilized sodium/salt content in the shell to the ceramic surface above it and create shell flashes in the work, as seen in figures 1 and 2. After being fired, the remaining shell will be CaO that will slowly pick up water vapor from the air, form $Ca(OH)_2$, and crumble away.

There are numerous parameters and variations to change here and develop your own style of electric "wood ash" ceramics. To warn fellow potters, unwashed wood ash is caustic and gloves are needed when working with it. Be mindful to avoid breathing the dust in; wearing a dust mask or properly fitted respirator is good practice here. Wood ash must be sieved to a manageable particle size. Test your wood ash with various fluxes, clays, and minimal amounts of colorants, as copper, iron, and manganese are already there in trace amounts that will contribute to color! As a hint, it is easy to add 2% increments of Gerstley borate to flux your glaze more and 2% increments of silica to reduce your flux.

Saving Time and the Environment

Ultimately, the chemical profile of a wood-fired pottery surface can be reproduced, even going beyond current methods and characteristics in color and color variety, on a realistic schedule, and in realistic parameters. Additionally, by using this recipe and not one of pure materials content for similar effects, you have begun to reduce your ceramic carbon footprint and both reduced/reused in the process. With roughly half of your glaze by weight consisting of waste wood-ash byproduct and no precious/expensive metals needed for producing color, material mining footprints can be reduced while creating surfaces that look far more difficult and time-consuming to make than they really are (3).

MICHAEL FRASCA'S WOOD ASH
Cone 6 Oxidation

Whiting	11.36%
Wood Ash	54.56
Potash Feldspar	11.36
Ball Clay	11.36
Silica	11.36
	100.00 %

Note: Unwashed wood ash is caustic, always wear gloves when working with it.

VAL CUSHING'S WOOD ASH
Cone 6 Oxidation

Wood Ash	50 %
Gerstley Borate	20
Whiting	12
EPK Kaolin	8
Silica	10
	100 %

Note: Unwashed wood ash is caustic, always wear gloves when working with it.

FLASHING WOOD ASH
Cone 6–10 Oxidation and Reduction

Gerstley Borate Substitute	5.21 %
Soda Ash	1.04
Whiting	9.38
Wood Ash	54.17
Potassium Feldspar	9.38
Ball Clay	10.41
Silica	10.41
	100.00 %
Add: Red Iron Oxide	4.00 %

1 Chawan, 182G clay body, Flashing Wood-Ash Glaze, placed on shells, fired to cone 6 in oxidation. **2** Yunomi, 182G clay body, Flashing Wood-Ash Glaze, placed on a shell, refired from a dry wood firing to cone 6 in oxidation. **3** Ochoko, 621 Troy Woodfire clay body, Flashing Wood-Ash Glaze, placed on a shell, fired in cone 10 reduction.

the author *Ryan Coppage is currently Chemistry Faculty at the University of Richmond. He teaches a Japanese Ceramics and Glaze Design class at the Visual Arts Center of Richmond and still makes far too many pots. Check out www.ryancoppage.com.*

References:
1.Tarun R. Naik and Rudolf N. Kraus. A New Source of Pozzolanic Material. Concr. Int. 25, (2003).
2.Chowdhury, S., Maniar, A. & Suganya, O. M. Strength development in concrete with wood ash blended cement and use of soft computing models to predict strength parameters. J. Adv. Res. 6, 907–913 (2015).

Have a technical ceramics question? Have an idea for a technical article? Send your topic ideas to Ceramics Monthly *at editorial@ceramicsmonthly.org.*