1175-7-12-3

Final Rpt

FACULTY RESEARCH GRANT

AN INVESTIGATION INTO TECHNIQUES OF SALT GLAZING CERAMICS EMPLOYING NON-TOXIC ENVIRONMENTALLY SAFE SUBSTANCES.

submitted by:

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AN INVESTIGATION INTO TECHNIQUES OF SALT GLAZING CERAMICS EMPLOYING NON-TOXIC ENVIRONMENTALLY SAFE SUBSTANCES.

It is possible to form a glaze on the surface of a piece of ceramic ware by introducing common salt(sodium chloride) into the kiln when the ware reaches its vitrification temperature. Unfortunately, besides producing a glaze coating on the ware, this method also results in emissions that are harmful to the environment. Upon entering the heated kiln the sodium chloride vaporizes into a fine mist. The sodium oxide chemically reacts with the silica contained in the clay to form a glaze and the chloride is released into the atmosphere in the form of hydrochloric acid and chlorine gases. These gases will cause metal and kiln bricks to deteriorate rapidly and are harmful to breath.

Because of the unique and attractive appearance of salt glazed ware, its lower fuel consumption(work can be fired only once, eliminating the bisque firing) and its use of fewer costly glaze chemicals it is a popular method used to finish ceramic ware. In order to eliminate the toxic by-products caused by the use of sodium chloride and still retain the other positive qualities of the process the introduction of the carbonate forms of alkaline substances is a possible alternative.

To find out if similar results in glaze appearance could be achieved three different operating temperatures were chosen, cone 04 (1950°F), cone 5 (2201°F) and cone 10 (2450°F) Three different carbonates were chosen, sodium, potassium and lithium, and three different clay bodies were used.

Each different clay body was fired at its designated vitrification temperature and exposed to each of the three different carbonate formulars. This proceedure was used in nine seperate firings and the amount of glazed produced by each variation in types of material was compared. The results of these tests show that it is possible to produce a glaze appearance that is close to the sodium chloride glazing. More importantly it will enable students to experience the entire salt glazing process in a classroom/studio environment without the exposure to hazardous materials.

CLAY BODY FORMULARS:

FIRED TO PYROMETRIC CONE o4

	number 1	number 2	number 3
silica	33.5	38.5	40.5
K.B.	32.5	30.5	29.5
kaolin	20.0	17.0	15.5
spar	14.0	14.0	10.0
bento	1.0	1.0	1.0

FIRED TO PYROMETRIC CONE 5

	number 1	number 2	number 3
EPK	35.0	30.0	25.0
silica	20.0	25.0	30.0
K.B.	12.0	12.0	12.0
Tenn. Ball	8.0	8.0	8.0
talc	15.0	10.0	5.0
Vitrox	5.0	7.5	10.0
Cornwall	5.0	7.5	10.0
bento	2.0	2.0	2.0

FIRED TO PYROMETRIC CONE 10

	number 1	number 2	number 3
fireclay	41.0	31.0	31.0
Tenn. Ball	12.0	12.0	9.5
K.B.	12.0	7.0	9.5
Red Clay	10.0	10.0	10.0
silica	10.0	15.0	20.0
feldspar	10.0	10.0	10.0
grog	15.0	15.0	15.0

CARBONATE FORMULAR (salt substitute)

	number 1	number 2	number 3
sodium carb	36.0	30.0	30.0
potassium carb	8.0	8.0	14.0
lithium carb	4.0	10.0	4.0
borax	3.0	3.0	3.0
whiting	48.0	48.0	48.0
bentonite	1.0	1.0	1.0

A thirty-three foot gas fired, sprung arch, downdraft soft brick kiln was constructed to conduct the research project. Two 500,000 BTU burners were made to produce the sufficient amount of heat required for a broad range of test firing. Liquid propane gas was hooked up to the burners as the fuel source of the kiln. Special silicon carbide shelves were used for durability and compatibility with this process. The use of a fuel burning kiln as opposed to an electric kiln was crucial to the project because traditional salt firings employed fuels to achieve the most attractive appearance in the finished glaze. It is important to control the firing atmosphere during the firing and with this type of kiln this is possible.

The test clay bodies in each temperature range (1,2,3) were exposed to one variation of the carbonate mixture in a single firing. When the kiln reached firing or clay vitrification temperature small packets of carbonate mixture were thrown into the kiln at the burner ports. The mixture began to volitilize almost immediately, turning into a fine white mist. Because of the design of the kiln the natural circulation of the burning fuel carried the carbonate mist throughout the kiln. Depending on how much mixture was thrown in the kiln the amount of chemical reaction that took place between the carbonate mist and the silica in the clay varied from firing to firing. The maximum amount of carbonate mixture was 20 lbs. and the minimum was 5 lbs. After each packet of carbonate mixture was introduced into the kiln 10 minutes was allowed to pass before a test ring was removed. A metal rod was inserted through a spy hole in the kiln and ring was removed. In this manner it was possible to determine how much glazing was taking place in the kiln while the firing was in process.