Chemical Analysis of Local Kansas Clay and Use in Ceramic Art

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Abstract:

Seeking to learn more about local materials and their potential use in ceramic art as well as investigating the possibility of replicating the effects of local clay using raw materials, a sample of locally harvested clay was sent to CoorsTek Analytical Laboratories. X-ray Diffraction (XRD) and X-ray Fluorescence (XRF) processes determined the chemical contents of the sample and the list of elements was converted into a clay body recipe via the Unity Molecular Formula to target specific desirable characteristics. Further experimentation over the course of more than a year has yielded highly promising results which prove to be both useful for my practice now, and have led to inspiring questions for future research.

Introduction:

The minerals in the earth beneath our feet determine the geomorphology of the environment, and the way we view and interact with the landscape. The use of local materials in my artistic work involves a significant amount of primary research looking for new and 'interesting' resources. Through these expeditions I have discovered a hillside with 3 distinctly different clay beds laid on top of each other, see **Fig. 1**. One of the clays has highly unique and desirable properties I became interested in its chemistry as it can be used directly out of the ground, and withstand the hottest temperatures I fire to with beautiful color response to atmospheric firing.

Analysis Procedure and Selected results:

•**Table 1** provides the XRF analysis results. In addition to the major and minor elements listed, the sample also contains trace levels (< 0.05 wt%) of 12 additional elements.

•Preliminary tests led to focused efforts on approximating the silica and the iron content in the body due to an appealing response to soda vapors and ash accumulation as may be see **Fig.2**.

•Additional research yielded a 3 ingredient body of Tile#6 Kaolin, Plastic Vitrox Clay (P.V. Clay), and Silicon Dioxide (Quartz) with Yellow Ochre as the iron source. This recipe, WC-UMF A and alterations are listed in **Table 2.**

•WC-UMF A was found to be unfavorable as the P.V. Clay was not enough flux to bond with the silica resulting in dunting during some firings prompting flux substitution tests.

•Both WC-Alt 3 B and WC-Alt 4 B develop a satin-like sheen and rich chocolaty brown color of the raw clay and the working properties of all 4 bodies are excellent.

Table 1: Results from X-Ray Fluorescence Analysis

Element	Amount (wt%)	Standard Deviation
Silicon (Si)	30.12	0.68
Iron (Fe)	3.24	0.01
Calcium (Ca)	0.17	0.01
Magnesium (Mg)	0.55	0.01
Titanium (Ti)	0.55	0.01
Potassium (K)	2.01	0.02
Sodium (Na)	0.1	0.01
Aluminum (Al)	11.62	0.08
Oxygen (O) By Difference	51.64	N/A

Fig. 1: Hillside showing three strata of clay. The yellow clay visible in the lowest level is the focus of this research.

Table 2: Table 2: Test Recipes Derived from a Unity Molecular Treatment of the X-Ray Fluorescence Analysis Results and Subsequent Alterations.

	Coded Clay Recipe Tests				
Material	WC-UMF A	WC-Alt 1 A	WC-Alt 2 A	WC-Alt 3 A	WC-Alt 4 A
Tile #6 Kaolin	44.75	44.75	44.75	44.75	44.75
Silica (Quartz)	26.95	26.95	26.95	26.95	26.95
Plastic Vitrox Clay	28.3			14.15	14.15
Minspar 200 Feldspar		28.3		14.15	
Custer Feldspar			28.3		14.15
Batch Percentage	**100**	**100**	**100**	**100**	**100**
For 'B' Variant Add Yellow Ocher	4.9	4.9	4.9	4.9	4.9

Fig. 2: Tumbler made from local clay exhibiting heavy soda glazing and a reduced cooling atmosphere.

Conclusions:

The Western Kansas clays constitute a unique and valuable natural resource with intrinsic beauty as well as great usefulness in the ceramic arts. The X-Ray Diffraction and X-Ray Fluorescence tests have provided a means to understand the components of the clay. Clay body formulation and testing have provided an approximation of the desirable qualities of the natural clay from raw materials available nationally and internationally. However, there will forever endure a difference between the two; the manufactured product and the harvested material. The impurities of the natural clay lend an esoteric beauty to the work that, if an attempt were made to chemically emulate would risk appearing merely contrived. This duality encapsulates the draw to incorporate natural materials as much as possible in my own work as an artist. The product of this research, while inspired by a desire to capture the natural beauty of the local clay amounts to more than simple imitation but realizes an expansion upon the aesthetic properties discovered while working with the native materials.

References:

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