A Spectroscopic Analysis of a Multiglaze Blend

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Objective

To gain further understanding of the different components present in ceramic glazes to control qualities such as color, opacity, and texture. Using a Spectrophotometer, differences in light absorption in chosen glazes will be analyzed.

Background

Main Materials Used in Glazes:

- Bases/Fluxes: Lowers melting point of glaze
- Amphoterics: Stiffens glaze (Alumina/Clay); Opacifiers
- Acids: Glass-formers (Silica); Matting agents
- Colorants: Pigments

In-Campus Ceramic Studio

- Downdraft Gas Kiln
- Δ10, Reduction
  - Kiln atmosphere with oxygen deficit
  - Increase by 287.5ºF/hr until 2350ºF is reached

Glaze Defects Caused By:

- Over firing
- Cooling Conditions
- Thick or improper glaze application

Crawling: Application conditions

Blistering: Application or overfiring

Crazing: Cooling time, Glaze match

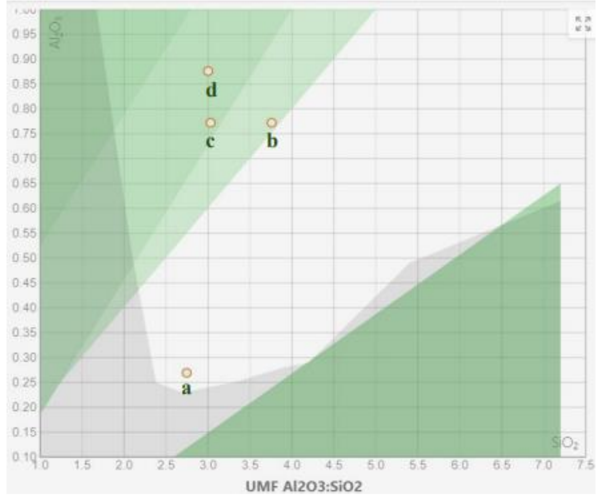
Changing the Ratio of Silica & Alumina from Base Glaze

- **Test #1 :Colorant Line Blend**

  Increasing Cobalt Carbonate by 0.5 g increments to observe change in pigmentation

- **Test #2: Silica and Alumina Variations**

  Controlling amounts of Silica and Alumina ratio to reach textures such as glossy, matte, and semi-matte



a. 20 g silica/ 2.5 g EPK
b. 20 g silica/50 g EPK
c. 5 g silica/ 50 g EPK
d. 0 g silica/ 60 g EPK

References

Hopper, R. (2001). *The Ceramic Spectrum: A Simplified Approach to Glaze & Color Development*. Krause Publications.

Knowles, K.M., & Freeman, F.S.H.B. (2004, February 24). Microscopy and microanalysis of crystalline glazes. *Journal of Microscopy, 215*.

Multiglaze Development

- In the first two tests, the original recipes were adjusted by increasing or decreasing the colorants, amphoterics, and the glass-formers to analyze color and control textures.
- For this section, the two chosen glazes are premade; the recipes were not adjusted. To prepare the samples, Glaze A is decreased by 25% increments from 100% to 0% and Glaze B is increased by 25% from 0% to 100%.

Test Tile Label	Seafoam Blue		Cherry Blossom	
	Percent (%)	Qty. (g)	Percent (%)	Qty. (g)
01	100%	200 g	0%	0 g
02	75%	150 g	25%	50 g
03	50%	100 g	50%	100 g
04	25%	50 g	75%	150 g
05	0%	0 g	100%	200 g

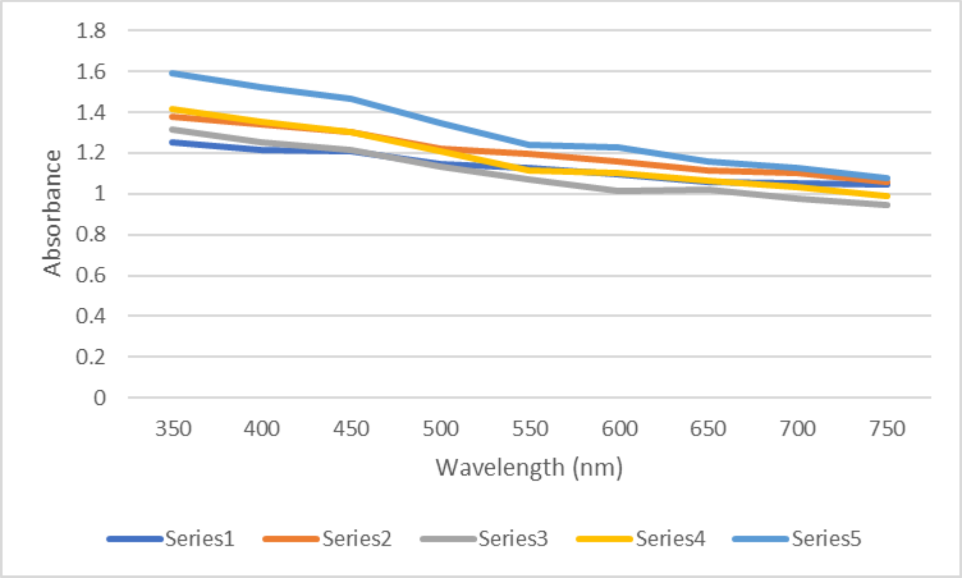
- In this test, a range of purple hues were expected. However, it is observed that two sets of green glazes are produced from ratios 75/25 and 50/50. Furthermore, in the third test tile, the texture changed from glossy to semi-matte.
- As the increments are changed by 25%, smaller increments of 5% was implemented to analyze at which ratio of Glaze A and B switches from green to purple to white, and from glossy to semi-matte.

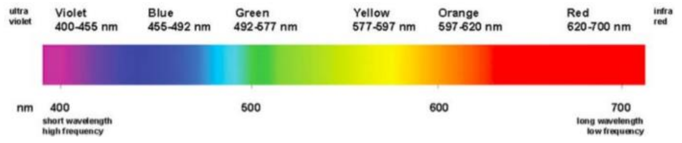
50/50 | 45/55 | 40/60 | 35/65 | 30/70 | 25/75 | 20/80 | 15/85 | 10/90 | 05/95 | 0/100

Spectroscopic Results

- The maximum absorption of all sample glazes occurs at the wavelength of 350 nm, which falls in the violet region of the visible light spectrum.
- In the table, as Glaze B intensifies by 25% in the mixture, the absorbance values increase for each wavelength. As it gets thicker, the light absorbed is higher in comparison to the glazes with less amount of Glaze B. Furthermore, as the wavelength increases, the absorbance decreases for each individual glaze.

Wavelength (nm)	Absorbance				
	1	2	3	4	5
350	1.254	1.381	1.318	1.419	1.592
400	1.218	1.338	1.256	1.353	1.52
450	1.208	1.303	1.218	1.303	1.468
500	1.146	1.221	1.131	1.211	1.348
550	1.129	1.194	1.074	1.117	1.241
600	1.093	1.157	1.017	1.105	1.227
650	1.061	1.118	1.02	1.067	1.161
700	1.054	1.104	0.978	1.031	1.125
750	1.046	1.058	0.948	0.989	1.079





Results and Limitations

- In using the Spec 20, the glazes should be diluted to 1-part glaze and 499-part water (1:499). Any glaze to water dilution part less than 1:499 will not lead to any reading in the machine.
- To sample all glazes, longer access to a lab is needed in order to test around 20 glazes. As each test varies in focus from colorant to silica and alumina ratio, relations between absorbance and texture could also be explored.
- Limited access to machines that could further analyze the glazes. Machines such as X-Ray Diffraction, Optical Microscopy, Scanning Electron Microscopy could have been used to better present differences in the components or structure of the glazes.
- Time constraint in further developing the fourth sample in the multiglaze blend to adjust its texture and consistent layering of the pigmentation.

Future Work

- Adjust Alumina and Silica values to smaller increments to showcase gradual change in texture.
- Test for light absorbance for all samples to further understand how variations of glaze components affect the data.
- Produce a glaze based on 75% Seafoam Green and 25% Cherry Blossom to achieve the following characteristics:
  - Same shade of green
  - Consistent pigment layering
  - Less crazing and runs

Conclusions

- Application process drastically changes the composition of the final piece. In ceramics, a piece can be dipped into more than one type of glaze, resulting in unique patterns and colors. However, the same result cannot be expected if the two glazes are mixed into the same container as the overall recipe changes.
- Although the spectroscopic results show consistent patterns between the five glazes, it was expected that the max absorption values would differ throughout as each glaze present different pigments. This result may have been due to the samples being unfired. Meaning the pigments that show after firing is not currently present for the spectrophotometer to measure.

Acknowledgements

This work was supported by the New Jersey Space Grant Consortium and Brookdale Community College. I would like to thank Prof. Thomas Riley, Prof. Jennifer Riley, Prof. Lori Uffer, Prof. Ed Stein, Prof. Ana Teodorescu, and Prof. Karina Ochs.

New Jersey Space Grant Consortium