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October 13, 2022

Professor Don J. DeGroot
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Re: Results for Grain Size Analysis and Atterberg Limits and USCS

Dear Professor DeGroot:

As per your request, two labs were performed on the soils given using standard ASTM D422. The particle size analysis was completed on RS104 sand using sieve analysis and hydrometer analysis. Atterberg limit tests on kaolin prestige clay were conducted in compliance with ASTM D4318 standard test method for *Liquid Limit, Plastic Limit, and Plasticity Index of Soils.* Both tests for labs 3 and 4 were performed at the Geotechnical Engineering Laboratories, University of Massachusetts Amherst, September 2022. These tests create grain distribution curves and a plasticity chart (Figures 1-3) that help classify the soils using USCS.

The particle size analysis was conducted by placing the soil in a sieve shaker, where the weight of soil in each sieve size was recorded to calculate percent finer. Also, a hydrometer was used to calculate the density of a soil slurry after specific time intervals. The Atterberg Limits used a clay soil placed in a Casagrande cup and dropped at 2 blows per second until the groove closed ½ inch. The test was repeated four times after drying the soil between each. The soil classification was determined using ASTM D2487 *Classification of Soils for Engineering Purposes.*

The RS104 sand was determined to be a SP classification (Table A1) or poorly graded sand. This is because the majority of particles that fell were sand. The value of Cc for the tested RS104 Sand was a bit higher than the common value, and the Cu number was much higher than the common value. The RS104 Sand's tested value for % fines was slightly lower than the common value. The Prestige Kaolin clay was determined to be CH classification (Table A1) or a non organic clay with high plasticity. High plasticity generally indicates a high percentage of clay particles, which matches our value for percentage of clay. This data is much greater than the typical percentage of Prestige Kaolin, same with the liquid limit.

These numbers were different from the common values for RS104 Sand and Prestige Kaolin due to errors encountered, affecting the data. Determining when the ½ inch groove occurred was challenging to judge, thus affecting the liquid limit. Also, when determining the plastic limit, due to inexperience in performing the test, the water content was lower than expected. The hydrometer readings also may have been slightly off as the initial value reading had bubbles around the meniscus making it difficult to accurately gauge. Values may have been affected during the sieve analysis test, one of the sieves was empty, leading to our soil being graded improperly. This altered Figure 1 to have a plateau at 11 to 12 percent passing and most likely threw off our D for RS104 sand.

This completes the work for the project. If any questions arise feel free to contact us as needed.

Sincerely,

Nicholas Valianti, Kai Grocki, Andrew Spokis, Jonathan Jordan

Civil Engineering Students

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Appendix

Table A1: Calculated values of each soil's properties

Soil	D10	D30	D60	Cu	Cc	Gravel	Sand	Fines	Silt	Clay	LL	PL	PI	USCS
	mm	mm	mm	-	-	%	%	%	%	%	%	%	%	-
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
RS104 Sand	0.142	0.363	0.71	5.00	1.31	0	99.55	0.45	0	0	N/A	N/A	N/A	**SP**
Filter Pack Sand	2.03	2.46	3.25	1.60	0.92	0	100	0	0	0	N/A	N/A	N/A	**SP**
Prestige Kaolin	N/A	N/A	N/A	N/A	N/A	0	0	100	12	88	56	23.62	32.38	**CH**
Pure Gold Gel	N/A	N/A	N/A	N/A	N/A	0	0	100	.1	99.9	435	52.27	382.7	**MH**

Table A2: Table of % Passing vs Grain Diameter for all soils

RS104 Sand		Filter Pack Sand		Pure Gold Gel		Prestige Kaolin	
Grain Diameter	% Passing	Grain Diameter	% Passing	Grain Diameter	% Passing	Grain Diameter	% Passing
4.75	100	9.5	100	7.65E-02	100	5.01E-02	96
2	85.64	4.75	100	3.71E-02	100	2.50E-02	97
0.85	67.87	2	8.2403	1.79E-02	99.92	1.27E-02	96
0.425	37.99	0.85	0.1155	5.20E-03	95.75	3.52E-03	92
0.25	11.91	0.425	3.93E-15	2.69E-03	93.67	1.83E-03	88
0.15	11.53	0.25	3.93E-15	1.36E-03	89.51	8.83E-04	82
0.106	1.22	0.15	3.85E-02	6.85E-04	87.43	5.46E-04	75
0.075	0.45	0.106	3.93E-15	3.47E-04	83.26	6.69E-05	54
		0.075	3.93E-15	1.73E-04	81.18		
				5.83E-05	77.02		

Calc A1: Pure gold Gel hydrometer test at T = 240 minutes

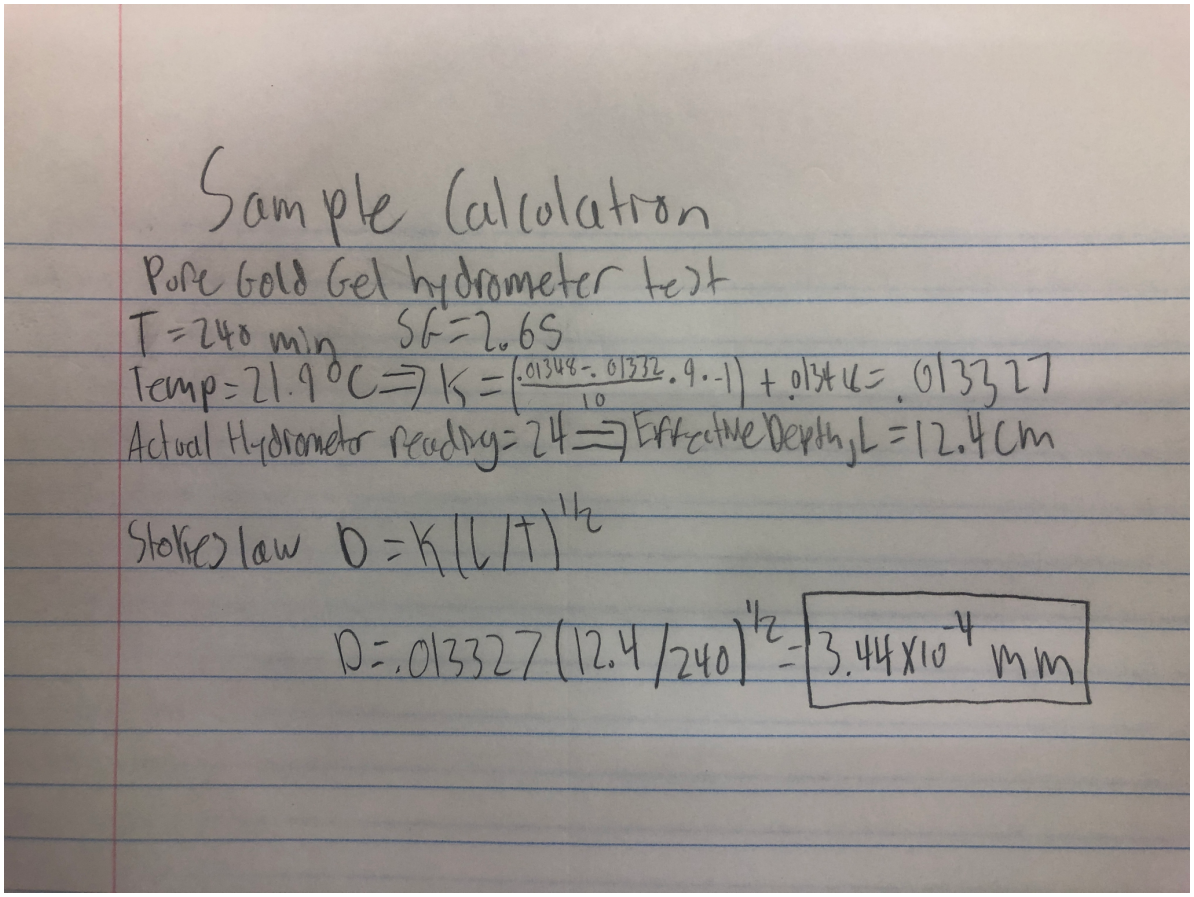


Figure 1. Grain-size distribution curves for all 4 soils

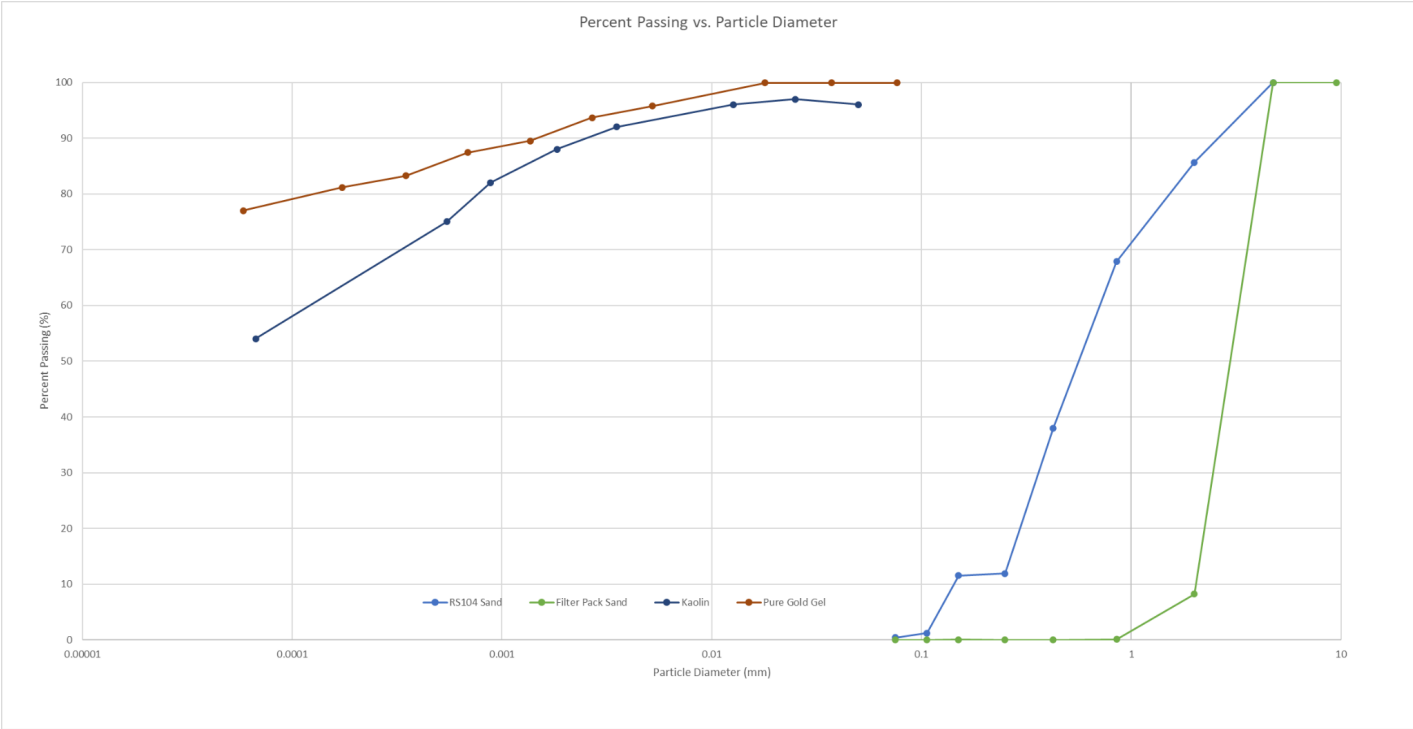


Figure 2 A/B: Liquid Limit Flow curves with line of best fit equation and R^2 value.

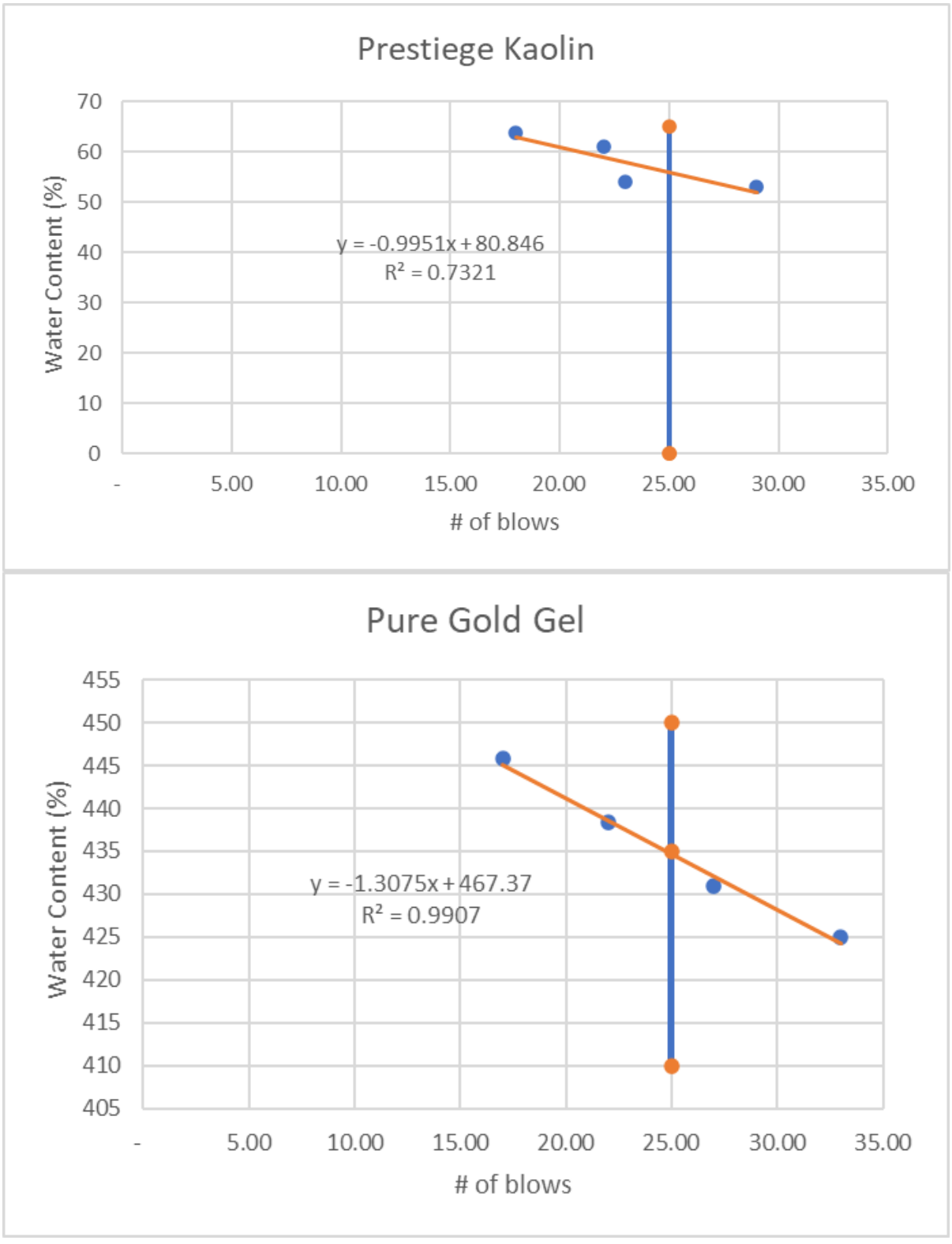
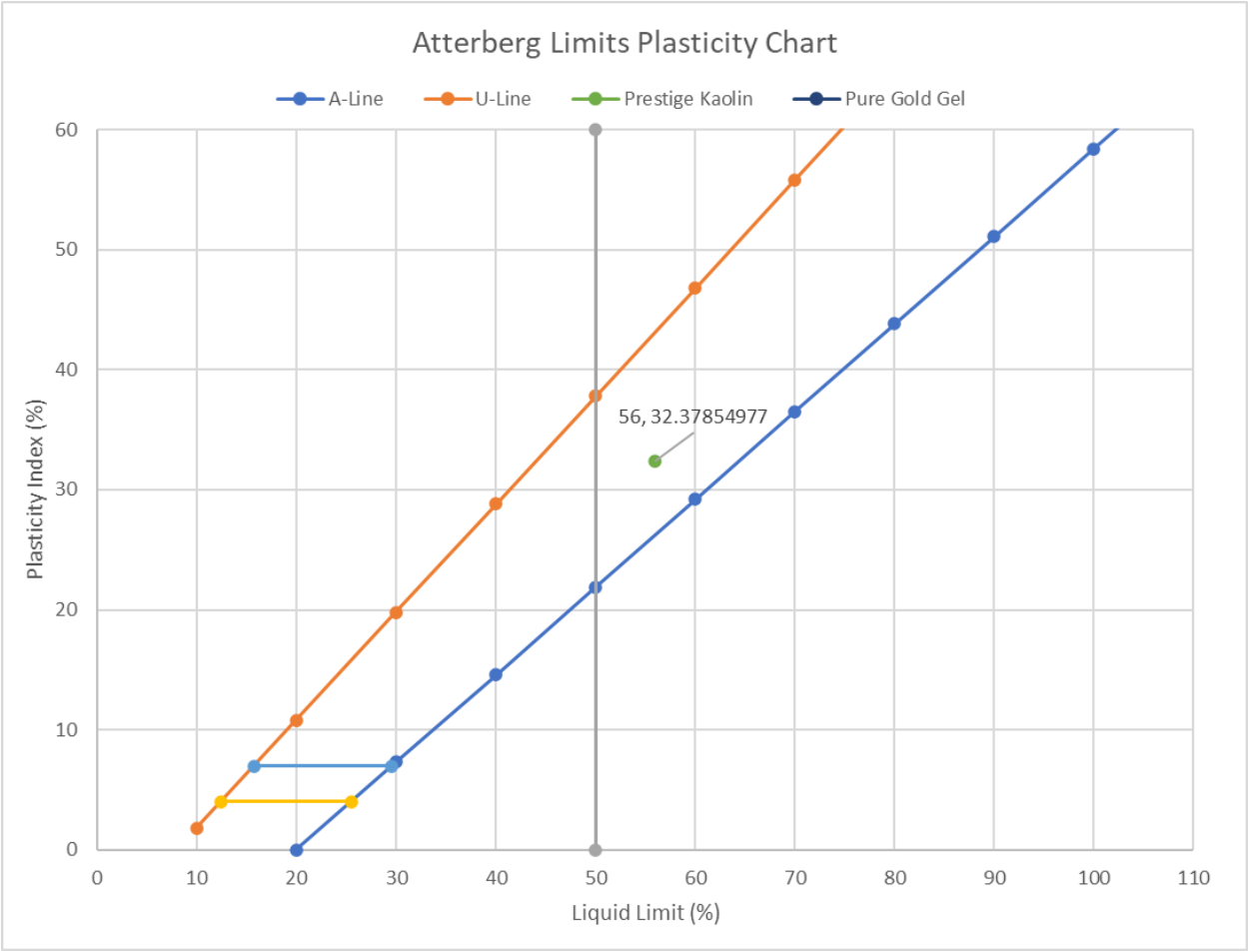


Figure 3: Plasticity Chart for Prestige Kaolin and Pure Gold Gel.



References

Holtz, R.D., Kovacs, W.D. and Sheahan, T.C. (2023). An Introduction to Geotechnical Engineering. 3rd Edition, Pearson.

DeGroot, D.J. and Jones, C.D. (2022) Laboratory manual CEE320 Soil Mechanics, 2nd Edition. Department of Civil and Environmental Engineering, University of Massachusetts Amherst, Amherst, MA.