CLEANING LABORATORY EVALUATION SUMMARY

SCL #:	2024
DateRun:	12/21/2024
Experimenters:	Amelia Wagner
ClientType:	Cleaner Manufacturer
ProjectNumber:	Project #1
Substrates:	Textile
PartType:	Coupon
Contaminants:	Dirt, Clay, Food, Blood
Cleaning Methods:	Mechanical Agitation
Analytical Methods:	Colorimeter, Visual
Purpose:	

Experimental Procedure:

Testing:

Prep: 5x5 inch white cotton and blue polyester fabric swatches were used for testing. Each fabric swatch was measured for reflectance, redness/greenness, and yellowness/blueness with a colorimeter 5 times in 3 separate areas (0.5x0.5) where the fabric would eventually be stained. The three areas were treated as individual coupons. The 5 measurements for each area were averaged together and used as the representative measurements of the specified area/coupon. Each area was stained with the correct soil type and left to air dry for 24 hours. Colorimeter measurements of each stain was ten recorded.

Washing procedure: The fabric swatches were washed in a washing machine with 45 mL of Liquid Laundry Detergent and 6.5 gallons of water on a normal washing cycle set for a medium load. The water used has a water hardness level of 63 PPM mg/L. The washing cycle consisted of a wash step (~12 mins), a rinse step (~14 mins), and a spin step (~5 mins). Half of the fabric swatches were washed unheated with a temperature range of 60F-85F, while the other half was washed heated with a temperature range of 105F-125F. The fabric swatches were dried in the drying machine on a heated gentle/tumble setting for 30 mins. After drying, the colorimeter was used to re measure the 3 staining areas on each fabric swatch.

Analysis:

Where:

L=reflectance (0 black - 100 White)

Detergency: Unadjusted measure of the percentage the cleaned fabric was returned to its original state (uses only L values/measures of lightness)

$$\% \text{ Detergency} = 100X((L_{clean}-L_{dirty})/(L_{initial}-L_{dirty}))$$

Where:

L=Reflectance

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Results:

Temp	Stain	Fabric	L Initial	L Dirty	L Clean	% DET	AVG % DET	AVG Visual
Unheated 60-85F	Dust + Sebum	Cotton	88.91	81.77	90.96	128.71	115.49	1
			90.47	82.87	90.83	104.74		
			90.22	85.15	90.88	113.02		
		Polyester	51.83	41.65	51.05	92.34	82.76	1.8
			53.06	41.25	50.33	76.88		
			3.27	41.04	50.71	-25.60		
	Clay	Cotton	90.49	90.3	90.49	100.00	126.81	1
			90.87	90.04	90.71	80.72		
			90.07	88.94	90.69	154.87		
		Polyester	52.99	87.37	53.37	98.89	97.01	1
			52.82	86.1	53.61	97.63		
			52.35	87.05	53.31	97.23		
	Grass	Cotton	90.31	83.17	84.98	25.35	56.99	2.5
			90.41	82.35	87.89	68.73		
			90.04	81	87.95	76.88		
		Polyester	51.49	49.43	53.34	189.81	133	1.5
			53.04	48.1	53.2	103.24		
			52.92	48.06	53.21	105.97		
	Cocoa	Cotton	90.13	56.82	81.47	74.00	76.4	1.5
			89.17	55.84	82.24	79.21		
			90.65	55.16	82.13	75.99		
	Blood + Milk + Ink	Cotton	90.01	18.4	66.56	67.25	54.82	3.5
			90.45	17.85	57.16	54.15		
			90.51	20.31	50.54	43.06		
Heated 105-125F	Dust + Sebum	Cotton	90.69	80.5	90.71	100.20	99.59	1
			90.43	84.43	90.43	100.00		
			90.4	82.73	90.29	98.57		
		Polyester	53.2	42.6	50.77	77.08	79.04	1.5
			53.15	41.34	50.74	79.59		
			52.87	41.26	50.6	80.45		
	Clay	Cotton	90.46	89.08	90.69	116.67	105.14	1
			90.64	89.19	90.64	100.00		
			90.38	88.94	90.35	97.92		
		Polyester	53	85.31	53.33	98.98	98.33	1
			52.94	85.88	53.42	98.54		
			52.75	86.24	53.6	97.46		
	Grass	Cotton	90.34	80.97	89.64	92.53	94.99	1.5
			90.51	84.59	90.03	91.89		
			90.45	83.02	90.49	100.54		
		Polyester	52.85	47.91	53.14	105.87	104.08	1.5
			53.09	49.26	53.1	100.26		
			52.9	47.98	53.2	106.10		
	Cocoa	Cotton	90.75	64.35	86.9	85.42	82.46	1.5
			90.15	61.92	83.33	75.84		
			90.69	52.64	85.41	86.12		
	Blood + Milk + Ink	Cotton	90.67	27.85	48.21	32.41	45.73	3.5
			90.3	22.28	52.13	43.88		
			89.99	17.86	61.78	60.89		

Summary:

Conclusion:

Unheated 60-85F:
The laundry detergent performs effectively on all soils on cotton except for Blood + Milk + Ink, where only 68% of the stain was removed. All other stains on cotton were removed at rates 90% and above. After the cleaning process, the cotton was left slightly greener and slightly bluer than its original state.

The laundry detergent struggled to remove staining from polyester, with a consistent removal rate around <40%. After the cleaning process, the polyester was consistently left slightly greener and slightly more yellow.

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Heated 105-125F: The laundry detergent performs very effectively on all soils on cotton except for Blood + Milk + Ink where 63% of the stain was removed. The addition of heat did not improve the performance in removing Blood + Milk + Ink. All other stains on cotton were removed at rates of 95% and above. The addition of heat did improve the performance of the laundry detergent in removing grass and cocoa. After the cleaning process, the cotton left slightly greener and slightly bluer than its original state. The laundry detergent struggled to remove staining from polyester, with a consistent removal rate around <40%. The addition of heat did not improve the performance in removing any of the soils. After the cleaning process, the polyester was left slightly greener and slightly more yellow.

Although residual staining was detected by the colorimeter on the polyester fabric swatches, visually the staining was largely undetectable earning the polyester swatches visual rankings of 1 to 1.5 (for slight discoloration)