

CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 2025
 DateRun: 03/24/2025
 Experimenters: Amelia Wagner
 ClientType: Cleaner Manufacturer
 ProjectNumber: Project #1
 Substrates: Textile
 PartType: Coupon
 Contaminants: Inks, Food, Blood
 Cleaning Methods: Mechanical Agitation
 Analytical Methods: Colorimeter
 Purpose: To test the efficacy of various reformulations in removing the blood/milk/ink stain from cotton (the stain the original detergent performed the worst on in the past trial).

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:

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

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

Where:

L=reflectance (0 black - 100 White)

Reformulations tested:

- 1- Original (2% enzyme mix)
- 2- Reformulation (4% enzyme mix)
- 3- Reformulation (2.4% enzyme mix with double the amount of Cellulase)
 - 0.4% Amylase, 0.4% Lipase, 0.4% Protease, 0.4% Mannanase, 0.8% Cellulase
 - The concentration of Cellulase was doubled because this enzyme is expected to target the compressed charcoal and ash of the india ink (breaks down starches)
- 4- Reformulation (4.8% enzyme mix)
 - 0.8% Amylase, 0.8% Lipase, 0.8% Protease, 0.8% Mannanase, 1.6% Cellulase
 - The concentration of Cellulase was doubled because this enzyme is expected to target the compressed charcoal and ash of the india ink (breaks down starches)

Results:

Reformulation	L initial	L dirty	L clean	% DET
Original 2% enzyme mix	84.95	44.16	72.84	70%
Reformulation 4% enzyme mix	84.88	44.05	78.34	84%
Reformulation 2.4% enzyme mix	84.89	43.90	65.35	52.32%

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Reformulation 4.8% enzyme mix	85.07	43.98	68.22	58.99%
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Summary:

Conclusion: The Reformulation using the 4% enzyme mixture, with equal amounts of each enzyme performed the best. The addition of extra Cellulase in both the 2.4% enzyme mix reformulation and the 4.8% enzyme mix reformulation caused the efficacy to decrease below that of the original formulation. This could be due to the extra cellulase deactivating the other enzymes or other ingredients in some way.