

# CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 2025

DateRun: 07/15/2025

Experimenters: Amelia Wagner

ClientType: Cleaner Manufacturer

ProjectNumber: Project #2

Substrates: Textile

PartType: Coupon

Contaminants: Inks, Dirt, Clay, Food, Blood

Cleaning Methods: Mechanical Agitation

Analytical Methods: Colorimeter

Purpose: To test the efficacy of two lower cost reformulations of the Chemtrax liquid laundry detergent containing the 4% enzyme mix identified from previous testing.

Experimental Procedure: Prep: 5x5 inch white cotton and blue polyester fabric swatches were used for testing. Each fabric swatch was measured for reflectance 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 were then 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)

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

Where:

L=reflectance (0 black - 100 White)

Results:

| Formulation                    | Temp     | Soil/<br>Stain     | Fabric                   | L<br>Initial | L<br>Dirty | L<br>Clean | % DET   |
|--------------------------------|----------|--------------------|--------------------------|--------------|------------|------------|---------|
| MS LLD                         | Unheated | Dust<br>+<br>Sebum | Cotton                   | 85.88        | 73.43      | 85.6       | 97.75%  |
|                                |          |                    | Polyester                | 60.26        | 54.76      | 59.95      | 94.36%  |
|                                |          | Clay               | Cotton                   | 85.89        | 78.34      | 85.76      | 98.28%  |
|                                |          |                    | Polyester                | 60.52        | 79.13      | 61.26      | 96.02%  |
|                                |          | Grass              | Cotton                   | 85.74        | 79.63      | 85.53      | 96.56%  |
|                                |          |                    | Polyester                | 60.43        | 58.88      | 60.43      | 100.00% |
|                                |          | Cocoa              | Cotton                   | 85.69        | 49.68      | 85.61      | 99.78%  |
|                                |          |                    | Blood<br>+ Milk<br>+ Ink | 85.71        | 44.68      | 84.5       | 97.05%  |
|                                | Heated   | Dust<br>+<br>Sebum | Cotton                   | 85.86        | 82.95      | 85.68      | 93.81%  |
|                                |          |                    | Polyester                | 60.48        | 55.39      | 59.62      | 83.10%  |
|                                |          | Clay               | Cotton                   | 85.9         | 79.65      | 85.84      | 99.04%  |
|                                |          |                    | Polyester                | 60.79        | 76.07      | 60.85      | 99.61%  |
|                                |          | Grass              | Cotton                   | 85.72        | 78.19      | 85.28      | 94.16%  |
|                                |          |                    | Polyester                | 61.22        | 59.67      | 61.15      | 95.48%  |
|                                |          | Cocoa              | Cotton                   | 85.86        | 48.67      | 85.57      | 99.22%  |
|                                |          |                    | Blood<br>+ Milk<br>+ Ink | 85.58        | 44.24      | 84.63      | 97.70%  |
| Chemtrax<br>Reformulation<br>1 | Unheated | Dust<br>+<br>Sebum | Cotton                   | 85.84        | 75.59      | 85.72      | 98.83%  |

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|                    |                          |                    |              |        |       |       |         |
|--------------------|--------------------------|--------------------|--------------|--------|-------|-------|---------|
|                    |                          |                    | Polyester    | 60.5   | 52.82 | 60.09 | 94.66%  |
|                    |                          | Clay               | Cotton       | 86.13  | 77.51 | 86.12 | 99.88%  |
|                    |                          |                    | Polyester    | 60.24  | 77.64 | 61.04 | 95.40%  |
|                    |                          | Grass              | Cotton       | 85.72  | 73.34 | 85.71 | 99.92%  |
|                    |                          |                    | Polyester    | 61.2   | 59.3  | 61.18 | 98.95%  |
|                    |                          | Cocoa              | Cotton       | 85.62  | 49.07 | 85.2  | 98.85%  |
|                    |                          | Blood + Milk + Ink | Cotton       | 85.83  | 44.81 | 84.66 | 97.15%  |
|                    |                          | Heated             | Dust + Sebum | Cotton | 85.63 | 78.96 | 85.31   |
|                    | Polyester                |                    |              | 60.53  | 58.62 | 60.05 | 74.87%  |
|                    | Clay                     |                    | Cotton       | 85.88  | 80.2  | 85.87 | 99.82%  |
|                    |                          |                    | Polyester    | 60.87  | 79.28 | 60.64 | 101.25% |
|                    | Grass                    |                    | Cotton       | 85.7   | 77.38 | 85.1  | 92.79%  |
|                    |                          |                    | Polyester    | 60.51  | 58.67 | 60.48 | 98.37%  |
|                    | Cocoa                    |                    | Cotton       | 85.94  | 40.89 | 85.41 | 98.82%  |
|                    | Blood + Milk + Ink       |                    | Cotton       | 85.57  | 44.33 | 84.8  | 98.13%  |
|                    | Chemtrax Reformulation 2 | Unheated           | Dust + Sebum | Cotton | 85.66 | 80.35 | 85.6    |
| Polyester          |                          |                    |              | 60.35  | 56.18 | 59.97 | 90.89%  |
| Clay               |                          |                    | Cotton       | 86.03  | 77.17 | 85.97 | 99.32%  |
|                    |                          |                    | Polyester    | 60.21  | 78.99 | 61.12 | 95.15%  |
| Grass              |                          |                    | Cotton       | 86.14  | 83.6  | 86.11 | 98.82%  |
|                    |                          |                    | Polyester    | 61.22  | 59.44 | 60.99 | 87.08%  |
| Cocoa              |                          |                    | Cotton       | 85.64  | 49.7  | 85.54 | 99.72%  |
| Blood + Milk + Ink |                          |                    | Cotton       | 86.1   | 48.06 | 80.53 | 85.36%  |
| Heated             |                          | Dust + Sebum       | Cotton       | 85.87  | 80.57 | 85.81 | 98.87%  |
|                    |                          |                    | Polyester    | 60.93  | 55.69 | 59.65 | 75.57%  |
|                    |                          | Clay               | Cotton       | 85.88  | 79.55 | 85.79 | 98.58%  |
|                    |                          |                    | Polyester    | 60.66  | 77.61 | 60.54 | 100.71% |
|                    |                          | Grass              | Cotton       | 85.79  | 83.27 | 85.57 | 91.27%  |
|                    |                          |                    | Polyester    | 60.83  | 58.49 | 60.81 | 99.15%  |
|                    |                          | Cocoa              | Cotton       | 86.02  | 48.04 | 85.23 | 97.97%  |
|                    |                          | Blood + Milk + Ink | Cotton       | 85.76  | 43.61 | 75.68 | 76.09%  |

The tables below compare the measurements of the MS LLD baseline product tested, and the measurements of both reformulations.

Reformulation 1:

| Artificial Stain          | Stain Removal Index acceptable range | Cold Water      |                 |           | Hot Water       |                 |           |
|---------------------------|--------------------------------------|-----------------|-----------------|-----------|-----------------|-----------------|-----------|
|                           |                                      | MS LLD Original | Reformulation 1 | Pass/Fail | MS LLD Original | Reformulation 1 | Pass/Fail |
| Dust & Sebum on Cotton    | SRI within 10 points                 | 97.75           | 98.83           | Pass      | 93.81           | 95.2            | Pass      |
| Dust & Sebum on Polyester | SRI within 10 points                 | 94.36           | 94.66           | Pass      | 83.1            | 74.87           | Pass      |
| Clay on Cotton            | SRI within 11 points                 | 98.28           | 99.88           | Pass      | 99.04           | 99.82           | Pass      |
| Clay on Polyester         | SRI within 5 points                  | 96.02           | 95.4            | Pass      | 99.61           | 101.25          | Pass      |

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|                                       |                       |       |       |      |       |       |      |
|---------------------------------------|-----------------------|-------|-------|------|-------|-------|------|
| EMPA 112- Cocoa on Cotton             | SRI within 9 points   | 99.78 | 98.85 | Pass | 99.22 | 98.82 | Pass |
| EMPA 116- Blood, Milk & Ink on Cotton | SRI within 2.5 points | 97.05 | 97.15 | Pass | 97.7  | 98.13 | Pass |
| Grass on Cotton                       | SRI within 2 points   | 96.56 | 99.92 | Pass | 94.16 | 92.79 | Pass |
| Grass on Polyester                    | SRI within 2 points   | 100   | 98.95 | Pass | 95.48 | 98.37 | Pass |

## Reformulation 2:

|                                       |                                      | Cold Water      |                 |           | Hot Water       |                 |           |
|---------------------------------------|--------------------------------------|-----------------|-----------------|-----------|-----------------|-----------------|-----------|
| Artificial Stain                      | Stain Removal Index acceptable range | MS LLD Original | Reformulation 2 | Pass/Fail | MS LLD Original | Reformulation 2 | Pass/Fail |
| Dust & Sebum on Cotton                | SRI within 10 points                 | 97.75           | 98.87           | Pass      | 93.81           | 98.87           | Pass      |
| Dust & Sebum on Polyester             | SRI within 10 points                 | 94.36           | 90.89           | Pass      | 83.1            | 75.57           | Pass      |
| Clay on Cotton                        | SRI within 11 points                 | 98.28           | 99.32           | Pass      | 99.04           | 98.58           | Pass      |
| Clay on Polyester                     | SRI within 5 points                  | 96.02           | 95.15           | Pass      | 99.61           | 100.71          | Pass      |
| EMPA 112- Cocoa on Cotton             | SRI within 9 points                  | 99.78           | 99.72           | Pass      | 99.22           | 97.97           | Pass      |
| EMPA 116- Blood, Milk & Ink on Cotton | SRI within 2.5 points                | 97.05           | 85.36           | Fail      | 97.7            | 76.09           | Fail      |
| Grass on Cotton                       | SRI within 2 points                  | 96.56           | 98.82           | Pass      | 94.16           | 91.27           | Fail      |
| Grass on Polyester                    | SRI within 2 points                  | 100             | 87.08           | Fail      | 95.48           | 99.15           | Pass      |

Summary:

| Substrates:   |   | Textile                       |                               |             |                                     |                |
|---------------|---|-------------------------------|-------------------------------|-------------|-------------------------------------|----------------|
| Contaminants: |   | Inks, Dirt, Clay, Food, Blood |                               |             |                                     |                |
| Company Name: | Product Name:                                       |                               | Conc.:                        | Efficiency: | Effective:                          | Observations:  |
| Chemtrax      | MS LLD  |                               | 45ml per 6.5 gallons of water | 97.48       | <input checked="" type="checkbox"/> | Temp: 60-85F   |
| Chemtrax      | Chemtrax liquid laundry detergent (reformulation 1) |                               |                               | 97.96       | <input checked="" type="checkbox"/> | Temp: 60-85F   |
| Chemtrax      | Chemtrax liquid laundry detergent (reformulation 2) |                               |                               | 94.40       | <input checked="" type="checkbox"/> | Temp: 60-85F   |
| Chemtrax      | MS LLD  |                               |                               | 95.27       | <input checked="" type="checkbox"/> | Temp: 105-125F |

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|          |   |  |       |                                     |                |
|----------|---|--|-------|-------------------------------------|----------------|
| Chemtrax | Chemtrax liquid laundry detergent (reformulation 1) |  | 94.91 | <input checked="" type="checkbox"/> | Temp: 105-125F |
| Chemtrax | Chemtrax liquid laundry detergent (reformulation 2) |  | 92.28 | <input checked="" type="checkbox"/> | Temp: 105-125F |

Conclusion:

Reformulation 1 was able to pass the comparison criteria across all stains, fabric types, and temperatures. Reformulation 2 was not able to pass the comparison criteria for Blood/Milk/Ink stain on cotton or grass stains on both cotton and polyester. These fails were consistent when the testing was repeated for these stains and fabric combinations. Reformulation 1 is the best option for a lower cost reformulation.