# CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 2017

DateRun: 10/05/2017

Experimenters:

ClientType:

ProjectNumber: Project #1

Substrates:

PartType: Coupon

Contaminants:

Cleaning Methods:

Analytical Methods:

Purpose: The purpose of the experiment is to determine the relative rate of contaminant removal from the cloths by the detergent. This test method stimulates a uniform mechanical standard to properly utilize the solution.

Experimental Procedure: White Cotton, White Cotton Polyester, and Purple Nylon fabric were soiled with the sebum, ink, mustard, and tomato sauce. Each contaminant was soiled on three pieces of each type of cloth. Every piece of 4x5 in cloth was spread over a glass beaker and the soil was applied manually. Sample clothes were allowed to dry for a day and dirty gloss readings were taken. They were washed at 85 F for 12 min in the Terg-O-meter at an RPM of 90. One milliliter of detergent was added for 3.5 L of water. After washing, the cloths were rinsed in water and dried for a day. Color readings were taken at the end of the day. The second part of the experiment was to study the effect of the detergent on the color fastness of orange, blue and purple fabric. Each piece of cloth was washed for 15 cycles and color fastness was recorded in terms of gloss values. Final assessment was to look at the fabric texture and rate according to the table listed below.

| Grade | Observations |
|---|---|
| SA·5 | Very smooth, pressed, finished appearance. |
| SA·4 | Smooth, finished appearance. |
| SA·3.5 | Fairly smooth but nonpressed appearance. |
| SA·3 | Mussed, nonpressed appearance. |
| SA·2 | Rumpled, obviously wrinkled appearance. |
| SA·1 | Crumpled, creased and severely wrinkled appearance. |

The cleaning analysis was done by calculating the stain removal index using the equation below:

SRI = 100 – ((Lc-Lw)2 +(ac –aw)2 + (bc-bw)2)1/2

where: L = reflectance, a = redness/greenness, b = yellowness/blueness, c = unstained fabric, washed in the treatment conditions, w = stained fabric, washed in the treatment conditions.

Results: Change in L value denotes the change in concentration of stain while a and b values denote the spectrum on blue and green shades in the sample. Thus these values denote the amount of stain that the detergent was capable of removing.

**The SRI for all the materials when the test was performed is presented below:**

Table 2: Results from Cloths soiled with Sebum

| Cleaner | Cloth | Initial | | | Cleaned | | | SRI | Avg. SRI |
|---|---|---|---|---|---|---|---|---|---|
| | | L* | a* | b* | L* | a* | b* | | |
| Pak-It All Clear Laundry | White Cotton | 85.09 | -0.29 | 6.74 | 84.01 | -0.13 | 8.24 | 98.28 | 98.11 |
| | | 84.54 | 0.07 | 6.84 | 83.37 | -0.09 | 8.59 | 97.77 | |
| | | 85.26 | -0.26 | 6.80 | 84.13 | -0.12 | 8.27 | 98.27 | |
| | White Cotton Polyester | 88.20 | -0.37 | 0.89 | 86.41 | -0.24 | 1.22 | 98.34 | 98.25 |
| | | 88.12 | -0.14 | 0.83 | 86.56 | -0.33 | 1.18 | 98.70 | |
| | | 88.28 | -0.39 | 0.78 | 86.16 | -0.36 | 1.02 | 97.72 | |
| | Purple Nylon | 39.24 | 16.99 | -28.66 | 36.46 | 17.68 | -28.57 | 95.89 | 97.91 |
| | | 33.39 | 17.19 | -28.42 | 33.62 | 16.79 | -27.22 | 99.17 | |
| | | 34.86 | 17.99 | -29.41 | 34.34 | 17.57 | -27.92 | 98.67 | |
| | White Cotton | 85.57 | -0.38 | 6.79 | 83.71 | -0.32 | 8.08 | 97.44 | 98.27 |

# CLEANING LABORATORY EVALUATION SUMMARY

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Aqua ChemPac Laundry | | 85.62 | -0.41 | 6.98 | 84.83 | -0.13 | 7.76 | 99.34 | |
| | | 85.45 | -0.35 | 6.83 | 84.23 | -0.12 | 8.37 | 98.04 | |
| | White Cotton Polyester | 88.08 | -0.36 | 0.71 | 86.73 | -0.16 | 1.52 | 98.74 | 99.05 |
| | | 88.15 | -0.37 | 0.76 | 86.92 | -0.23 | 1.26 | 99.11 | |
| | | 88.03 | -0.37 | 0.68 | 87.10 | -0.23 | 1.39 | 99.31 | |
| | Purple Nylon | 38.67 | 17.04 | -28.52 | 34.01 | 18.79 | -29.35 | 87.27 | 87.62 |
| | | 39.34 | 16.43 | -28.07 | 34.07 | 18.74 | -29.48 | 82.45 | |
| | | 39.22 | 16.68 | -28.31 | 35.65 | 17.66 | -28.27 | 93.15 | |

Both products were effective at removing sebum from cotton and polyester. Pak-It All Clear Laundry was more effective at removing sebum from nylon.

Table 3: Results from Cloths soiled with Ink

| Cleaner | Cloth | Initial | | | Cleaned | | | SRI | Avg. SRI |
|---|---|---|---|---|---|---|---|---|---|
| | | L* | a* | b* | L* | a* | b* | | |
| Pak-It All Clear Laundry | White Cotton | 85.33 | -0.21 | 6.84 | 78.67 | 4.77 | 32.22 | -256.65 | -223.58 |
| | | 85.17 | -0.2 | 6.86 | 77.31 | 6.46 | 32.38 | -278.70 | |
| | | 85.57 | -0.34 | 6.96 | 80.60 | 2.42 | 27.9 | -135.40 | |
| | White Cotton Polyester | 87.97 | -0.40 | 0.68 | 84.65 | -0.74 | 21.94 | -131.56 | -123.18 |
| | | 87.99 | -0.38 | 0.71 | 84.61 | -0.79 | 21.26 | -116.95 | |
| | | 88.08 | -0.39 | 0.70 | 84.78 | -0.83 | 21.46 | -121.03 | |
| | Purple Nylon | 38.93 | 16.66 | -28.43 | 33.65 | 15.56 | -21.61 | 62.20 | 66.77 |
| | | 38.35 | 16.98 | -28.65 | 33.66 | 15.62 | -22.15 | 66.95 | |
| | | 39.34 | 16.89 | -28.78 | 33.99 | 16.16 | -23.44 | 71.16 | |
| Aqua Chempac Laundry | White Cotton | 85.49 | -0.34 | 6.90 | 80.60 | 3.67 | 24.05 | -67.06 | -186.20 |
| | | 84.84 | -0.47 | 6.91 | 77.69 | 6.08 | 34.28 | -321.57 | |
| | | 85.57 | -0.37 | 6.61 | 79.62 | 4.49 | 28.54 | -169.97 | |
| | White Cotton Polyester | 88.21 | -0.38 | 0.69 | 84.78 | -0.36 | 20.27 | -97.57 | -86.47 |
| | | 88.01 | -0.36 | 0.68 | 85.61 | -0.71 | 16.29 | -24.78 | |
| | | 88.14 | -0.38 | 0.69 | 84.29 | -0.13 | 22.12 | -137.06 | |
| | Purple Nylon | 39.09 | 16.50 | -28.44 | 35.55 | 16.51 | -25.36 | 88.99 | 86.85 |
| | | 39.08 | 16.26 | -27.63 | 36.11 | 16.73 | -26.02 | 94.18 | |
| | | 39.37 | 16.67 | -28.42 | 34.53 | 15.71 | -23.85 | 77.38 | |

Pak-it All Clear cleaner was not as effective at removing tomato sauce as Aqua Chempac Laundry. Both cleaners resulted in negative values for white cotton and polyester. However, Aqua Chempac was successful at removing 86% of the stain in comparison to Pak-it which only removed 66%.

Table 4: Results from Cloths soiled with Mustard

| Cleaner | Cloth | Initial | | | Cleaned | | | SRI | Avg. SRI |
|---|---|---|---|---|---|---|---|---|---|
| | | L* | a* | b* | L* | a* | b* | | |
| Pak-It All Clear Laundry | White Cotton | 84.67 | -0.05 | 7.65 | 86.34 | 0.93 | 15.87 | 64.34 | 72.69 |
| | | 85.49 | -0.03 | 7.98 | 87.13 | 0.76 | 14.32 | 78.25 | |
| | | 86.22 | 0 | 7.82 | 86.70 | 1.03 | 14.73 | 75.48 | |
| | White Cotton Polyester | 88.81 | -0.01 | 2.75 | 89.28 | 0.39 | 10.68 | 68.37 | 45.86 |
| | | 88.95 | -0.01 | 2.75 | 89.88 | 0.05 | 10.12 | 72.41 | |
| | | 89.11 | -0.07 | 2.71 | 87.93 | 0.66 | 17.01 | -3.21 | |
| | Purple Nylon | 34.92 | 15.92 | -26.59 | 38.96 | 15.63 | -24.44 | 89.49 | 85.94 |
| | | 34.12 | 18.70 | -29.28 | 34.63 | 16.61 | -23.88 | 83.11 | |
| | | 38.10 | 17.05 | -27.83 | 37.38 | 15.15 | -22.79 | 85.24 | |
| Aqua Chempac Laundry | White Cotton | 83.20 | 0.18 | 7.87 | 83.73 | 2.25 | 24.25 | -36.44 | 5.73 |
| | | 84.94 | -1.19 | 10.35 | 84.59 | -1.16 | 22.73 | 23.31 | |
| | | 85.83 | -0.15 | 8.86 | 85.37 | 0.78 | 20.62 | 30.31 | |
| | White Cotton Polyester | 83.00 | -0.26 | 2.37 | 86.76 | -0.11 | 15.94 | 0.85 | -9.17 |
| | | 88.11 | -0.34 | 1.96 | 87.81 | -0.51 | 14.13 | 25.89 | |
| | | 87.28 | -0.32 | 2.94 | 84.21 | 2.19 | 20.05 | -54.24 | |
| | Purple Nylon | 39.52 | 16.38 | -27.51 | 39.02 | 16.14 | -25.03 | 96.77 | 94.45 |
| | | 39.23 | 16.16 | -27.16 | 38.61 | 15.38 | -24.06 | 94.70 | |
| | | 39.23 | 16.57 | -27.73 | 38.70 | 15.39 | -23.91 | 91.87 | |

# CLEANING LABORATORY EVALUATION SUMMARY

The supplied cleaner, Pak-it All Clear Laundry Detergent was effective at removing mustard from the different fabrics. Overall Aqua Chempac Laundry Detergent was not as effective as the supplied cleaner. However, it was marginally more successful at removing mustard from nylon fabric.

Color Fastness Test

| | | Initial | | | Cleaned | | | Difference | | | Avg. % Difference | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cleaner | Cloth | L* | a* | b* | L* | a* | b* | ΔL | Δa | Δb | ΔL | Δa | Δb |
| Pak-It All Clear Laundry | Orange | 58.81 | 53.09 | 55.44 | 56.35 | 50.34 | 52.01 | 4.18 | 5.18 | 6.19 | 4.27 | 5.34 | 6.29 |
| | | 58.66 | 53.63 | 56.00 | 56.22 | 50.99 | 52.69 | 4.16 | 4.92 | 5.91 | | | |
| | | 59.00 | 53.90 | 56.29 | 56.36 | 50.71 | 52.47 | 4.47 | 5.92 | 6.79 | | | |
| | Blue | 54.98 | -4.12 | -27.67 | 54.44 | -3.71 | -27.74 | 0.98 | 9.95 | -0.25 | 0.54 | 8.47 | -0.23 |
| | | 55.18 | -3.98 | -27.72 | 54.67 | -3.66 | -27.76 | 0.92 | 8.04 | -0.14 | | | |
| | | 53.85 | -4.45 | -27.77 | 54.00 | -4.12 | -27.85 | -0.28 | 7.42 | -0.29 | | | |
| | Purple | 39.29 | 17.67 | -28.21 | 38.18 | 16.79 | -27.33 | 2.83 | 4.98 | 3.12 | 2.79 | 4.06 | 1.78 |
| | | 40.23 | 17.24 | -27.84 | 39.41 | 16.47 | -27.31 | 2.04 | 4.47 | 1.90 | | | |
| | | 40.13 | 17.49 | -27.90 | 38.72 | 17.01 | -27.81 | 3.51 | 2.74 | 0.32 | | | |

.

| | | Initial | | | Cleaned | | | Difference | | | Avg. % Difference | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cleaner | Cloth | L* | a* | b* | L* | a* | b* | ΔL | Δa | Δb | ΔL | Δa | Δb |
| Aqua Chempac Laundry | Orange | 58.97 | 53.90 | 56.28 | 55.82 | 50.10 | 51.45 | 5.34 | 7.05 | 8.58 | 4.25 | 5.91 | 7.05 |
| | | 56.39 | 51.43 | 51.76 | 54.95 | 48.96 | 49.11 | 2.55 | 4.80 | 5.12 | | | |
| | | 58.93 | 53.32 | 55.63 | 56.07 | 50.19 | 51.49 | 4.85 | 5.87 | 7.44 | | | |
| | Blue | 54.42 | -4.31 | -27.73 | 54.41 | -3.66 | -28.13 | 0.02 | 15.08 | -1.44 | 0.57 | 13.22 | -1.51 |
| | | 54.63 | -4.00 | -27.99 | 54.14 | -3.48 | -28.39 | 0.90 | 13.00 | -1.43 | | | |
| | | 54.92 | -3.97 | -27.94 | 54.48 | -3.51 | -28.40 | 0.80 | 11.59 | -1.65 | | | |
| | Purple | 40.13 | 17.68 | -28.30 | 39.67 | 16.60 | -27.60 | 1.15 | 6.11 | 2.47 | 2.44 | 5.85 | 2.72 |
| | | 39.92 | 17.46 | -27.97 | 38.36 | 16.32 | -26.95 | 3.91 | 6.53 | 3.65 | | | |
| | | 39.85 | 17.33 | -27.65 | 38.95 | 16.48 | -27.09 | 2.26 | 4.90 | 2.03 | | | |

Aqua Chempac Laundry caused more of a change in color than the Pak-It All Clear Laundry

Visual and Texture Results after Cleaning:

| Cloth Type | Pak-it All Clear Laundry Detergent | Aqua Chempac Laundry Detergent |
|---|---|---|
| Orange | 3.50 | 3.33 |
| Blue | 4.10 | 3.94 |
| Purple | 3.50 | 3.05 |

Summary of Stain Removal Index (SRI) Results:

| Cleaner | Cloth | Soil | SRI | Avg. SRI |
|---|---|---|---|---|
| Pak It All Clear Laundry | White Cotton | Mustard | 72.69 | -61.81 |
| | | Tomato Sauce | -223.585 | |
| | | Ink | -194.46 | |
| | | Sebum | 98.11 | |
| | White Cotton Polyester | Mustard | 45.86 | -67.65 |
| | | Tomato Sauce | -123.18 | |
| | | Ink | -291.52 | |
| | | Sebum | 98.25 | |

# CLEANING LABORATORY EVALUATION SUMMARY

| | | | | |
|---|---|---|---|---|
| | Purple Nylon | Mustard | 85.94 | 75.24 |
| | | Tomato Sauce | 66.77 | |
| | | Ink | 50.35 | |
| | | Sebum | 97.91 | |

.

| Cleaner | Cloth | Soil | SRI | Avg. SRI |
|---|---|---|---|---|
| Aqua Chempac Laundry | White Cotton | Mustard | 5.73 | -229.47 |
| | | Tomato Sauce | -186.20 | |
| | | Ink | -835.68 | |
| | | Sebum | 98.27 | |
| | White Cotton Polyester | Mustard | -9.17 | -93.88 |
| | | Tomato Sauce | -86.47 | |
| | | Ink | -378.95 | |
| | | Sebum | 99.05 | |
| | Purple Nylon | Mustard | 94.45 | 73.52 |
| | | Tomato Sauce | 86.85 | |
| | | Ink | 25.18 | |
| | | Sebum | 87.62 | |

Summary:

Conclusion: In comparison to Aqua Chempacs, Pak-it All Clear Laundry Detergent was more effective in removing sebum and mustard from the three different types of fabrics. Both cleaners were unable to clean tomato sauce and ink from white cotton and white cotton polyester fabrics, but were slightly effective in cleaning the soils from purple nylon cloths. Pak-it All Clear Laundry caused less of a change in color and produced better texture ratings than the comparative cleaner.