# CLEANING LABORATORY EVALUATION SUMMARY

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|---|---|
| SCL #: | 2024 |
| DateRun: | 09/16/2024 |
| Experimenters: | Amelia Wagner |
| ClientType: | Metal Finishing |
| ProjectNumber: | Project #1 |
| Substrates: | Carbon Steel |
| PartType: | Coupon |
| Contaminants: | Cutting/Tapping Fluids, Greases, Lubricating/Lapping Oils, Oil |
| Cleaning Methods: | Immersion/Soak |
| Analytical Methods: | Colorimeter, Gravimetric |
| Purpose: | To test the efficacy of modified alcohols on removing a variety of metal shop soils. Preliminary testing prior to using supplied parts. |

Experimental Procedure:

Carbon plated steel coupons were used as the testing substrate to represent that carbon steel surface of the provided parts. Three coupons were used per soil. The soils chosen were based on the client's description of typical soils encountered. These soils are Rust Veto (corrosion preventative), Lenox Synthetic Lubricant (silicon lubricant), Synergy 735 (water based machining oil), Supertech General Purpose Grease (greases). The initial weights of the coupons were recorded as well as the initial fluorescence measurement (RFU). The coupons were then soiled with their respective soils by applying them with a swab to the bottom third of the coupons. The dirty weights and fluorescence levels of the coupons were recorded.

A solvent, PnB Glycol Ether, was chosen as the cleaning agent as it is a main component of the modified alcohol Dowanol PnBG. The cleaning method parameters used were based on the client's current vapor degreasing application process. The coupons were cleaned using heated immersion for 10 minutes at 180F. Stir bars were set to 300 rpm to introduce mild agitation. Immersion was used in place of vapor degreasing, as the chemistry will work similarly.

Once removed the coupons were dried using a heat gun for about 1.5 minutes each to speed to process of evaporating the solvent. Once dried, the coupons final weights and fluorescence levels were recorded.

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The RFU values from the Cleanospector represent the difference in fluorescence, or the amount of light that is reflected from a surface. Percent detergency demonstrates the amount of restoration to the original that has occurred after the cleaning test has been performed. A higher average percent detergency indicates that the cleaner has been effective and has restored the dirty substrate and cleaned it so that it now is much closer to how it originally was measured.

Data recorded from the readings can be calculated as percent detergency in the following equation to determine the cleaning efficacy of each formulation:

% DET = R(cleaned) - R(soiled) / R(unsoiled) - R(soiled) X 100

Results:

Gravimetric:

| Cleaner | Soil | Initial wt of cont. | Final wt of cont. | %Cont Removed | % AVG | % Overall |
|---|---|---|---|---|---|---|
| PnB Glycol Ether 98% | Rust Veto | 0.0668 | 0.0023 | 96.56 | 97.85 | 96 |
| | | 0.1438 | 0.0036 | 97.50 | | |
| | | 0.1607 | 0.0008 | 99.50 | | |
| | Lenox Synthetic Lubricant | 0.1147 | 0.0044 | 96.16 | 95.86 | |
| | | 0.1118 | 0.0039 | 96.51 | | |
| | | 0.1355 | 0.0069 | 94.91 | | |
| | Synergy 735 | 0.0894 | 0.0020 | 97.76 | 96.22 | |
| | | 0.0985 | 0.0030 | 96.95 | | |
| | | 0.1009 | 0.0061 | 93.95 | | |
| | Supertech General Purpose Grease | 0.1332 | 0.0183 | 86.26 | 93.17 | |
| | | 0.0708 | 0.0032 | 95.48 | | |
| | | 0.0492 | 0.0011 | 97.76 | | |

The one outlier found under the grease soil is most likely due to this coupon having more grease applied to it than the others in its group. The amount of grease applied to this coupon is likely an overestimate of

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the level of soiling found within the actual application. The two other coupons that were more accurately soiled garnered more accurate results to what was expected.

Cleanospector:

| Cleaner | Soil | RFU Initial | RFU Dirty | RFU Clean | % DET | % AVG | % Overall |
|---|---|---|---|---|---|---|---|
| PnB Glycol Ether 98% | Rust Veto | 5.4 | 1026 | 5.6 | 99.98 | 99.90 | 99 |
| | | 5.8 | 1439.5 | 6.3 | 99.96 | | |
| | | 5.9 | 1277.3 | 8.9 | 99.76 | | |
| | Lenox Synthetic Lubricant | 5.8 | 376.9 | 6.4 | 99.84 | 99.93 | |
| | | 4.7 | 334.3 | 4.9 | 99.93 | | |
| | | 4.5 | 410.6 | 4.4 | 100.02 | | |
| | Synergy 735 | 4.5 | 319.5 | 13.3 | 97.21 | 98.27 | |
| | | 5.1 | 1182.5 | 25.8 | 98.24 | | |
| | | 4.7 | 1743.7 | 15.8 | 99.36 | | |
| | Supertech General Purpose Grease | 4.6 | 2782 | 166.2 | 94.18 | 97.50 | |
| | | 4.7 | 2743 | 27.5 | 99.17 | | |
| | | 4.5 | 2734 | 74.5 | 99.16 | | |

Summary:

| **Substrates:** | Carbon Steel |
|---|---|
| **Contaminants:** | Cutting/Tapping Fluids, Greases, Lubricating/Lapping Oils, Oil |

| Company Name: | Product Name: | Conc.: | Efficiency: | Effective: | Observations: |
|---|---|---|---|---|---|
| Dow Chemical Company | PnB Glycol Ether | 98% | 96.00 | ☑ | It is possible that the temperature and duration of time of cleaning may be able to be decreased without losing efficacy. |

Conclusion:

PnB Glycol Ether is very effective in removing all of the soils tested. An actual modified alcohol product, such as the Dowanol PnBGE or Dowclene, is predicted to perform to even higher standards than shown with this test based on the addition of surfactants and other active ingredients along with the solvent.

Future testing will include the pre soiled carbon steel supplied parts.