

CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 2004

DateRun: 05/03/2004

Experimenters: Jason Marshall

ClientType: Jewelry Mfr

ProjectNumber: Project #2

Substrates: Sterling/Silver

PartType: Coupon

Contaminants: Oil

Cleaning Methods: Immersion/Soak

Analytical Methods: Gravimetric

Purpose: To identify alternative to TCE in vapor degreasing operation. Evaluation of products on first soil

Experimental Procedure: Ten products were selected based on client request for vapor degreasing solvents. Each product was used at full strength in a 250 ml beaker and heated to 96 F on a hot plate. Thirty preweighed silver plated copper coupons were coated with the Exxon Mobil Vacmul 03D (94741-44-2) using a hand held swab. Coupons were weighed a second time to determine the amount of soil added to each coupon. Three coupons were cleaned in each solution for 5 minutes using stir-bar agitation. After cleaning parts were weighed a final time and efficiencies were calculated.

Results: Seven of the ten products removed over 89% of the soil within five minutes using immersion cleaning. Two products, Flux Remover C and Heavy Duty Degreaser C, removed less than 60% and Vertrel MCA removed just under 80%. The table below lists the amount of soil added, the amount remaining after cleaning and efficiencies for each coupon cleaned.

| Cleaner | Initial wt | Final wt | % Removed |
|------------------------|------------|----------|-----------|
| HFE 7100 | 0.0283 | 0.0018 | 93.64 |
| | 0.0906 | 0.0078 | 91.39 |
| | 0.0960 | 0.0044 | 95.42 |
| HFE 7200 | 0.0445 | 0.0053 | 88.09 |
| | 0.0455 | 0.0051 | 88.79 |
| | 0.0679 | 0.0063 | 90.72 |
| AK 225 | 0.0926 | 0.0038 | 95.90 |
| | 0.0799 | 0.0025 | 96.87 |
| | 0.0497 | 0.0023 | 95.37 |
| Vertrel CCA | 0.0955 | 0.0031 | 96.75 |
| | 0.1159 | 0.0016 | 98.62 |
| | 0.0858 | 0.0017 | 98.02 |
| Vertrel MCA | 0.0581 | 0.0146 | 74.87 |
| | 0.0563 | 0.0177 | 68.56 |
| | 0.1140 | 0.0097 | 91.49 |
| Flux Remover C | 0.0530 | 0.0320 | 39.62 |
| | 0.1081 | 0.0695 | 35.71 |
| | 0.0773 | 0.0557 | 27.94 |
| Heavy Duty Degreaser C | 0.1056 | 0.0120 | 88.64 |
| | 0.0707 | 0.0330 | 53.32 |
| | 0.0556 | 0.0374 | 32.73 |
| Ensolv | 0.0592 | 0.0030 | 94.93 |
| | 0.1291 | 0.0034 | 97.37 |
| | 0.0804 | 0.0024 | 97.01 |
| Ensolv A | 0.1173 | 0.0025 | 97.87 |
| | 0.1112 | 0.0026 | 97.66 |
| | 0.0558 | 0.0026 | 95.34 |
| Metalnox M6760 | 0.0838 | 0.0022 | 97.37 |
| | 0.0582 | 0.0027 | 95.36 |
| | 0.0851 | 0.0029 | 96.59 |

Summary:

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|-------------------------------|------------------------|---------------|--------------------|-------------------------------------|----------------------|
| Substrates: | Sterling/Silver | | | | |
| Contaminants: | Oil | | | | |
| Company Name: | Product Name: | Conc.: | Efficiency: | Effective: | Observations: |
| 3M | HFE 7100 | 100 | 93.48 | <input checked="" type="checkbox"/> | |
| 3M | HFE 7200 | 100 | 89.20 | <input checked="" type="checkbox"/> | |
| AGA Chemical | AK 225 | 100 | 96.05 | <input checked="" type="checkbox"/> | |
| DuPont | Vertrel CCA | 100 | 97.80 | <input checked="" type="checkbox"/> | |
| DuPont | Vertrel MCA | 100 | 78.31 | <input type="checkbox"/> | |
| Micro Care | Flux Remover C | 100 | 34.42 | <input type="checkbox"/> | |
| Micro Care | Heavy Duty Degreaser C | 100 | 58.23 | <input type="checkbox"/> | |
| Enviro Tech International Inc | Ensolv | 100 | 96.44 | <input checked="" type="checkbox"/> | |
| Enviro Tech International Inc | Ensolv A | 100 | 96.96 | <input checked="" type="checkbox"/> | |
| Kyzen Corporation | Metalnox M6960 | 100 | 96.44 | <input checked="" type="checkbox"/> | |

Conclusion: The seven successful products will be used on the second supplied oil under the same conditions.