

# CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 1996  
 DateRun: 10/23/1996  
 Experimenters: Jay Jankauskas  
 ClientType: Manufacturers of Precision Parts and Assemblies  
 ProjectNumber: Project #1  
 Substrates: Aluminum, Brass, Copper, Stainless Steel  
 PartType: Coupon  
 Contaminants: Cutting/Tapping Fluids, Lubricating/Lapping Oils, Oil  
 Cleaning Methods: Immersion/Soak  
 Analytical Methods: Gravimetric  
 Purpose: To determine cleaning chemicals and equipment

**Experimental Procedure:**  
**Phase 1 Test Results:**  
 The first part of phase I involved testing the cleaning efficiencies of nine aqueous chemicals in removing the three cutting oils provided by Machine Shop. For each combination of cleaner and contaminant, three 316 stainless steel coupons were contaminated with the respective oil and were then cleaned in a 2 liter beaker with stir-bar agitation. Cleaning was performed for 5 minutes at 130 F. All cleaning chemicals were diluted to 4% by volume with ordinary tap water. After cleaning the parts were rinsed in room temperature DI water for 1 minute and then dried in a convection oven. Cleanliness was determined by a gravimetric method. The coupons were weighed before and after contamination, and after cleaning. The cleaning efficiencies for all nine chemicals are shown below in Table 1 and Figure 1.

The second part of the first phase involved testing out the corrosiveness of each cleaning chemical on 260 Brass, 110 copper and 6061 Aluminum. Three coupons of each substrate were precleaned and then immersed in a four percent solution of each chemical for 24 hours at 150 F. A weight analysis was performed to determine the percent of substrate that would be corroded at the given conditions for a one year period (the one year period calculation is commonly used by chemical companies to evaluate corrosion). The coupons were also noted for any etching that may have occurred. The results for the corrosion tests are shown in Table 2 and Figure 2.

**Results:** Table 1: Cleaning Efficiencies for Machine Shop.

|                               | Castrol<br>Ilocut-5721 |       | Texaco<br>Cleartex D |       | C-Eblis<br>Cutting Oil |       |
|-------------------------------|------------------------|-------|----------------------|-------|------------------------|-------|
| Cleaning Chemistry            | Ave.                   | Std.  | Ave.                 | Std.  | Ave.                   | Std.  |
| Calgon Corporation AK-6215    | 87.24                  | 7.56  | 88.47                | 5.17  | 88.67                  | 4.71  |
| Ardrox Inc. Ardrex 6333       | 88.77                  | 5.49  | 94.42                | 0.56  | 98.79                  | 0.6   |
| Buckeye Shopmaster            | 57.31                  | 6.51  | 49.84                | 16.84 | 64.37                  | 0.53  |
| Oakite Prod. Inproclean #2000 | 62.62                  | 9.78  | 88.19                | 14.23 | 89.55                  | 7.25  |
| Brulin Corporation 815GD      | 93.04                  | 1.64  | 87.11                | 16.63 | 98.23                  | 1.82  |
| WR Grace Daraclean 235        | 53.02                  | 15.26 | 4.46                 | 6.22  | 91.04                  | 3.11  |
| Petroferm Bioact 50           | 63.23                  | 11.32 | 85.92                | 1.46  | 97.2                   | 2.27  |
| U.S. Polychemical Ultra CR    | 80.61                  | 1.65  | 56.72                | 19.12 | 78.36                  | 1.67  |
| U.S. Polychemical De-Ox 007   | 50.11                  | 22.05 | 50.4                 | 7.44  | 59.2                   | 10.19 |

Table 2: Corrosion Test Results for Machine Shop.

|                              | Brass |      | Copper  |      | Aluminum |      |
|------------------------------|-------|------|---------|------|----------|------|
| Cleaning Chemistry           | Ave   | Std  | Ave     | Std  | Ave      | Std  |
| Calgon Corporation AK-6215   | 5.83  | 1.00 | 1.64(1) | 0.80 | 0.40     | 0.26 |
| Ardrox Inc. Ardrex 6333      | 9.53  | 1.55 | 3.01    | 0.26 | 0.00     | 0.17 |
| Buckeye Shopmaster           | 3.40  | 0.26 | 6.97    | 0.83 | 0.23     | 0.10 |
| Oakite Prod. Inproclean 2000 | 0.91  | 0.34 | 0.24    | 0.36 | 0.17     | 0.75 |

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|                           |       |      |         |      |       |      |
|---------------------------|-------|------|---------|------|-------|------|
| Brulin Corporation 815 GD | 2.80  | 0.24 | 2.08(2) | 1.30 | 0.29  | 0.17 |
| WR Grace Daraclean 235    | 0.283 | 0.12 | 0.99(3) | 1.19 | 0.691 | 0.46 |
| Petroferm Bioact 50       | 8.48  | 0.28 | 8.40    | 2.36 | 3.632 | 1.80 |

(1) Showed Slight etching

(2) Showed severe etching

(3) Coupons came out with some residue and recorded weight gains. This residue was washed off with acetone and actual weight losses were recorded as shown.

Summary:

|                         |   |               |                    |                                     |                      |
|-------------------------|---|---------------|--------------------|-------------------------------------|----------------------|
| <b>Substrates:</b>      | Aluminum, Brass, Copper, Stainless Steel              |               |                    |                                     |                      |
| <b>Contaminants:</b>    | Cutting/Tapping Fluids, Lubricating/Lapping Oils, Oil |               |                    |                                     |                      |
| <b>Company Name:</b>    | <b>Product Name:</b>                                  | <b>Conc.:</b> | <b>Efficiency:</b> | <b>Effective:</b>                   | <b>Observations:</b> |
| Calgon Corporation      | AK 6215   | 4             | 86.67              | <input checked="" type="checkbox"/> |                      |
| Buckeye International   | Shopmaster  | 4             | 64.37              | <input type="checkbox"/>            |                      |
| Oakite Products         | Inproclean 2000                                       | 4             | 89.55              | <input type="checkbox"/>            |                      |
| Brulin Corporation      | Formula 815 GD  | 4             | 98.23              | <input checked="" type="checkbox"/> |                      |
| Magnaflux               | Daraclean 235   | 4             | 91.04              | <input type="checkbox"/>            |                      |
| Petroferm Inc           | Bioact 50 (no longer available)                       | 4             | 97.20              | <input type="checkbox"/>            |                      |
| US Polychem Corporation | Polychem Ultra CR                                     | 4             | 80.61              | <input type="checkbox"/>            |                      |
| US Polychem Corporation | Polychem DEOX 007                                     | 4             | 59.20              | <input type="checkbox"/>            |                      |

Conclusion:

Equipment Suggestions:

Due to the size, complexity and amount of parts that Machine Shop produces, it would be necessary to use tumbling coupled with some sort of agitation (either ultrasonics or spray under immersion) to effectively clean off their parts. This type of agitation system could be retrofitted into an existing vapor degreaser or be bought as a separate unit. Generally, it is not economical to retrofit an existing degreaser with ultrasonics, but a spray under immersion retrofit could be quite cost effective. A coalescing or skimming unit should also be incorporated into the design to maximize the bath life.

Rinsing as drying should also be accomplished with a tumbling system. For the rinse stage, the temperature should not be operated higher than 120 F in order to deter spotting and oxidation of the brass and copper due to high temperatures. Drying should be performed with blown warm air coupled with tumbling. Try to keep drying temperature to a minimum and let the tumbling and the air velocity do the majority of the drying. This will reduce electricity costs as well as reduce oxidation. A rinse aid added to the rinse bath will definitely decrease drying time, so Machine Shop might want to look into this.

Listed in table 3 are the names of some companies that do vapor degreaser retrofits and/or sell stand alone units that combine tumbling with ultrasonics or agitation.

table 3: Companies that Perform Vapor Degreaser Retrofits

Company Name-Contact Name--Telephone Retrofits (R), Stand alone(S)

Degreasing Devices Co-Rod Murphy--508-765-0045 R,S

Blackstone Ultrasonics-Jay Nawani--800-766-2480 R,S

Branson Ultrasonics--203-796-0400 R,S

Blue Wave Ultrasonics--800-373-0144 R,S

Crest Ultrasonics-Patrick Lyness--860-974-1982 S

Mikro Industrial Finishing-Mark Kressner--203-875-6357 S