CLEANING LABORATORY EVALUATION SUMMARY

SCL #:	1997
DateRun:	06/11/1997
Experimenters:	Andrew Bray
ClientType:	Aluminum Anodizing Job Shop
ProjectNumber:	Project #1
Substrates:	Aluminum
PartType:	Coupon
Contaminants:	Waxes
Cleaning Methods:	Vapor Degreasing
Analytical Methods:	Gravimetric, Visual
Purpose:	Steam before or after soak and rinse
Experimental Procedure:	This experiment was designed to determine whether it would be more effective to have the steam-cleaning step before or after the three-stage soak and rinse. The temperature of the rinse bath and the time of immersion were varied to explore what parameters would be ideal for wax removal. The test set-up is described below. Sample 1: three stage agitated tap water rinse followed by a steam cleaning; first rinse - 175 F for ten minutes; second rinse - 175 F for one minute; third rinse - 175 F for one minute; steam cleaning - 212 F for fifteen minutes. Sample 2: steam cleaning followed by a three-stage agitated tap water rinse; steam cleaning - 212 F for fifteen minutes; first rinse - 175 F for ten minutes; second rinse - 175 F for one minute; third rinse - 175 F for one minute. Sample 3: steam cleaning followed by a three-stage agitated tap water rinse; steam cleaning -212 F for fifteen minutes; first rinse - 185 F for fifteen minutes; second rinse - 185 F for five minutes; third rinse - 212 F for five minutes. When the cleaning procedures were completed, the coupons were placed in an oven at 120 F for thirty minutes to speed the drying process. The coupons were allowed to return to ambient temperature overnight before further inspection. SUBSTRATE MATERIAL: Aluminum 5052 Coupons CONTAMINANTS: Mobilewax 2305 CONTAMINATING PROCESS USED: Bars contaminated at Aluminum Anodizing Job Shop by dipping into a vat of masking wax and allowing wax to age.
Results:	Visual Observations: Sample 1: The three-stage rinse was not effective at removing the bulk of the wax. A small amount of wax was removed in the first rinse bath, while minute amounts were removed in the second and third rinse baths. The steam cleaning was effective at removing the bulk of the wax. The steam quickly liquefied the wax. The bulk of the wax on the side of coupon opposite the steam sheet off, leaving a thin layer of visible wax. The bulk of the wax on the side of the coupon where the steam was applied ran off in drips. The wax billowed up where the steam directly contacted it. Condensation formed but did not tend to run off the coupon. The side of the coupon that the steam was applied to remained covered in a frothy layer of wax. Sample 2: The steam cleaning performed the same as with the previous sample. In the first rinse bath there was very little if any improvement in wax removal. The wax did not appear to be as liquefied as it was on completion of the steam cleaning. Bubbles formed on the surface of the wax but did not freely shear off. When the bubbles sheared off, only a minute amount of wax was lifted with them. The second and third rinse baths provided very little, if any improvement in wax removal. Sample 3: Again, the steam cleaning was effective at removing the bulk of the wax, leaving a thin, visible film on the surface of the coupon. The temperature of the first rinse bath was increased to 185 F and the immersion time was increased to fifteen minutes. The agitation was increased to induce more bubble formation and stronger currents. This rinse provided slightly more removal than in Sample 2. However, the coupon still remained very contaminated. The temperature of the second rinse was also increased to 185 F and the immersion time was increased to five minutes. Again, this provided only marginal improvement. The temperature of the third rinse bath was increased to its boiling point. The remaining wax was almost completely removed. Gravimetric Analysis: It was not possible to use Contact Angle Goniometry or Optical Sensor Electron Emissions due to the amount of wax remaining on coupons 7 and 8. These tests are only effective at indicating the presence or absence of trace amounts of contaminants. They are not useful on substrates that remain visibly contaminated.

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Coupon #	Mass Initially	Mass Contaminated	Mass After Cleaning	Percent Removed
7	21.4434	24.7834	21.9861	83.75
8	21.5543	24.9181	21.8098	92.4
9	21.6204	24.9588	21.7678	95.58

Summary:

Substrates:	Aluminum				
Contaminants:	Waxes				
Company Name:	**Product Name:**	**Conc.:**	**Efficiency:**	**Effective:**	**Observations:**
Water	Steam	100	0.00	☑	

Conclusion:

Steam cleaning appeared to be more effective when used as the initial step in the cleaning process. It was very effective at removing the bulk of the wax. No significant increase in wax removal was noted in any of the rinse steps with the exception of the third rinse in Trial 3, Coupon 9. The remaining visible wax was almost entirely removed in this bath with the exception of two small areas. This may be attributed to the increase in agitation, temperature, and bubble formation. Further tests will be performed to explore the possible advantages of using an aqueous cleaner or wax stripper in the first rinse bath. This may allow for much lower rinse temperatures and subsequently, significant energy and water cost savings.