CLEANING LABORATORY EVALUATION SUMMARY

SCL #:	2002
DateRun:	03/20/2002
Experimenters:	Carole LeBlanc, Jason Marshall, Off Site, Purav Dave, Heidi Wilcox
ClientType:	Electronics Manufacturer
ProjectNumber:	Project #1
Substrates:	Stainless Steel, Steel
PartType:	Coupon
Contaminants:	Adhesive, Cutting/Tapping Fluids, Lubricating/Lapping Oils, Oil
Cleaning Methods:	Plasma
Analytical Methods:	Gravimetric
Purpose:	To evaluate plasma cleaning for parts cleaning
Experimental Procedure:	Chamber with a plate in it to put coupons on. The plate can be heated or left at ambient. We will run experiments at ambient. This technology is generally used to clean computer wafers and is done at approximately 250 C The process is done in a vacuum with plasma that can consist of gases such as O2, NF3, CF4, N2H2 and Argon. We will use mainly O2 gas plasma. The plasma is pumped into the chamber and when it reacts with the organic contaminants a blue glow can be seen. When all the organics are oxidized the glow is purple (pure O2 plasma). Want to use or test organic contaminants that contain H, C, O etc. Things such as lipids and metals are hard to remove with this process. Their chemical structure would deter or inhibit cleaning. Contaminants: Company Product Composition Solutia Inc. Gelva Multipolymer Resin Solution 2895 Resin solid: 50862-46-9 Ethyl Acetate: 141-78-6 Heptane: 142-82-5 Isopropyl Alcohol: 67-63-0 Ethanol: 64-17-5 Vinyl Acetate: 108-05-4 Bencyn, Inc. B-5186, Metal Working Compound Hydrotreated Heavy Napthenic Distillate: 64742-52-5 Polyisobutene: 9003-29-6 Aliphatic Alkyl Phosphate: 3946469-2 Acrylic Copolymer: 63197-48-8 The Valvoline Co. Tectyl 505, Petroleum Based Rust Preventative Aliphatic Hydrocarbon: 8052-41-3
Results:	Trial 1. O2 plasma, Valvoline contaminant, steel coupons (#’s 12, 13, 14) Flow rate of O2 plasma was 300 cc/min Temp on plate reading 18 C Vp in chamber from contaminant was 0.04 T (0.03T when all valves open and 0.07 T when shut. Difference in Vp can be contributed to contaminant) Pressure .19T Power 300 Watts Time 5 minutes Stopped flow after 5 minutes. Opened valves and flushed out chamber (no vacuum). Temp on plate reading 21 C (2 degree increased in plate temp due to reaction and plasma flow) 2. Same coupons, same conditions for 5 more minutes. Only difference end temperature after this 5 minutes was 25 C @ atmospheric pressure 3. O2 & N2H2 plasma, Valvoline contaminant, steel coupons (#’s 16, 17, 18) Flow rate 500 cc/min O2, 70 cc/min N2H2 Pressure .26T Power 500 Watts Time 5 minutes When stopped flow temperature at 30 C. Open valve and purge chamber and temp reads 33 C @ atmospheric pressure 4. O2 plasma, Solutia, Inc, Gelva Mulipolymer Resin 2815, stainless steel coupons (#’s 6,7,8) Flow rate of O2 plasma was 300 cc/min Pressure .19T Power 300 Watts Time 5 minutes Stopped flow after 5 minutes. Opened valves and flushed out chamber (no vacuum). Temp on plate reading 27 C @ atmospheric pressure This contaminant also visibly changed. Looks bubbly? 5. Same coupons as in 4 for another 5 minutes

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6. O2 plasma, Bencyn, Inc B-5186, Stainless steel coupons (#'s 21, 22, 23)
Flow rate of O2 plasma was 300 cc/min
Pressure .19T
Power 300 Watts
Time 5 minutes
Stopped flow after 5 minutes. Opened valves and flushed out chamber (no vacuum). Temp on plate reading 31 C @ atmospheric pressure
This contaminant also visibly changed to a yellow color from a brown color

7. O2 plasma, one coupon of each contaminant, Stainless steel (#'s 15, 16, 27)
Temperature 50 C
Power 500 Watts
Flow rate O2 plasma 500 cc/min
Pressure .19T
(Increase Temp, Pressure and Power)

8. O2, CF4 plasma, one coupon of each contaminant, (#'s 17, 11, 24)
Temperature 50 C
Power 500 Watts
Flow rate O2 plasma 500 cc/min, CF4 50 cc/min
Pressure .19T
(Increase Temp, Pressure, Power and change composition of plasma)

Table 1. Cleaning Efficiencies							
Trial #	1	2	3	4	5	6	7
Plasma Type	O2	O2	O2 & N2H2	O2	O2	O2	O2
Cleaner	Valvoline 5	Valvoline 10	Valvoline 5	Gelva 5	Gelva 10	Bencyn 5	Bencyn 10
Coupon 1	42.16	27.56	59.86	18.45	4.16	7.50	1.69
Coupon 2	35.11	19.70	52.55	18.26	3.40	4.43	2.60
Coupon 3	30.86	15.91	56.03	16.72	3.38	2.97	1.84
Ave	36.04	21.06	56.15	17.81	3.65	4.96	2.04
Std Dev	5.71	5.94	3.65	0.95	0.45	2.31	0.49
Total	57.10			21.46		7.01	

Trial 8

	Valvoline	Gelva	Bencyn
Increase Flow & temp	38.97	22.28	9.33
Increase Flow & temp w CH4	27.72	21.89	8.09

Summary:

Substrates:	Stainless Steel, Steel				
Contaminants:	Adhesive, Cutting/Tapping Fluids, Lubricating/Lapping Oils, Oil				
Company Name:	**Product Name:**	**Conc.:**	**Efficiency:**	**Effective:**	**Observations:**
No Specific Vendor	Oxygen Plasma	100	36.04	☐	Valvoline 5
No Specific Vendor	Oxygen Plasma	100	57.10	☐	Valvoline 10 (total)
No Specific Vendor	O2 & N2H2 Plasma	100	56.15	☐	Valvoline 5
No Specific Vendor	Oxygen Plasma	100	17.81	☐	Gelva 5
No Specific Vendor	Oxygen Plasma	100	21.46	☐	Gelva 10 (total)
No Specific Vendor	Oxygen Plasma	100	4.96	☐	Bencyn 5
No Specific Vendor	Oxygen Plasma	100	7.01	☐	Bencyn 10 (total)

Conclusion:

Questions to answer:
Not very good cleaning efficiencies. Are we just baking the contaminant or removing? Evaluate back at lab. Fluorine may increase cleaning efficiencies. DO NOT WANT TO USE due to money and chemical issues. Water addition to decrease ashing and lift more contaminant off? Decrease pressure not increase?