

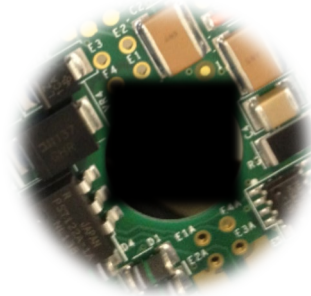
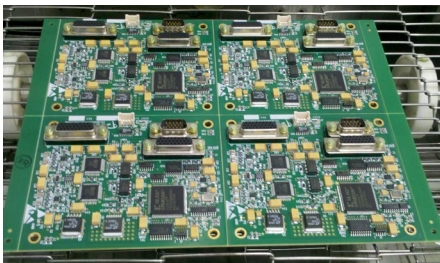
# AQUANOX A4382 Inline Process Stability Cleaning Case Study

**Background:** An OEM Energy Company has been struggling to achieve **consistent** cleaning underneath components with low gaps including QFN's, BGAs, and chip caps. This is even with using a high-powered inline cleaner. The inconsistency in the process has resulted in a very costly field failure due to flux contamination underneath a few low standoff devices. Past testing included IC results which registered below the industry accepted Anion and Cation limits during qualification, however, this was using the IPC B-52 Board without QFN's or the specific problematic AVX capacitor.

**Objective:** To determine if using AQUANOX A4382 with the lower surface tension and better solubility will improve cleaning underneath AVX component devices, ensuring consistent and reliable final product, or if will improve both reliability and throughput, while reducing rework and warranty liability.

**Cleaning Evaluation:** During the evaluation, only the conveyor speed was varied; 2.0 ft/min and 1.0 ft/min. All other process parameters were held constant and can be referenced below.

The wash section was configured with Electrovert intermix spray manifold technology. This manifold utilizes combination of "V-Jet" fan spray and "JIC" solid stream coherent spray nozzles. Production boards were processed at 1.0 ft/min and at 2 ft/min though the Aquastorm 200. All boards were processed and visually inspected at the manufacturing plant. The visual cleanliness results are shared in the pictures. The assemblies inspected were shipped to KYZEN for IC testing.



**Hypothesis:** DI water is not capable of consistently cleaning underneath a 2mil gap



-DI Water

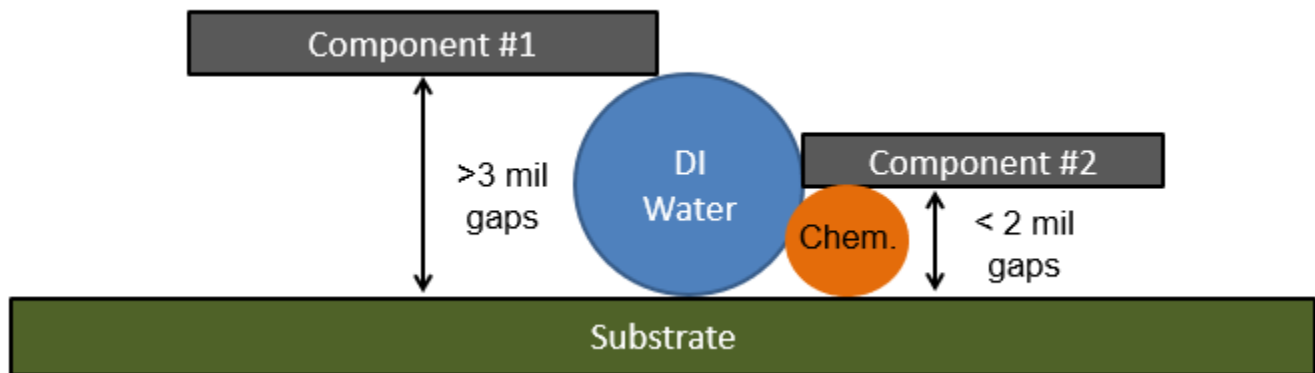
~74 dynes/cm

= large droplet

- Chemistry Bath

15-35 dynes/cm

= small droplet



**Process improvement Criteria:**

	<b>Prior to Trial</b>	<b>Goals</b>
<i>Chemistry:</i>	<i>DI Water</i>	<i>Green Chemistry</i>
<i>Concentration:</i>	<i>0%</i>	<i>3-5%</i>
<i>Temperature:</i>	<i>145°F/62.77°C</i>	<i>≤140°F/60°C</i>
<i>Wash Cycle:</i>	<i>2.0 foot/min</i>	<i>≥ 2.0 ft/min+</i>
<i>Flux/Paste Materials:</i>	<i>Water Soluble SAC305 Paste</i>	<i>Same</i>

## Evaluation:

Aquastorm AS200C with Torrid Dryer

	PRE WASH	WASH	WASH HURRICANE	CHEM ISO	RINSE	HURRI CANE	FINAL RINSE	DRYER	DRYER	DRYER
<b>Top PSI</b>	20	88	40	44	70	40	21	N/A	Torrid	Torrid
<b>Bottom PSI</b>	20	70	20	35	60	30	19			
<b>TEMP</b>										
<b>Set Point</b>	140°F				135°F			200°F	190°F	190°F

## Test Plan:

1. Visually inspect boards to dial in the process.
2. Validate the process with IC once process parameters have been established with no visual flux residue.

## Test Plan Details:

TEST	TEST #1	TEST #2	TEST #3	TEST #4
Temp:	145F/62.8C	145F/62.8C	145F/60C	145F/62.8C
Belt Speed	2ft/min	1 ft/min	2 ft /min	2 ft/min
Chemistry	DI water	DI	3%	8%
Next Step	Test #2 if flux	Test#3 if flux	Test #4 if flux	

AVX components are to be mechanically removed

- Inspection of component underside
- Inspection of PCB underneath component.

## Post Cleaning – DI Water

Wash Temp: 145°F/62.8°C

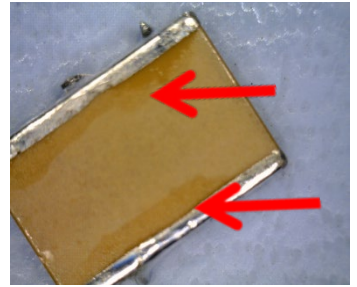
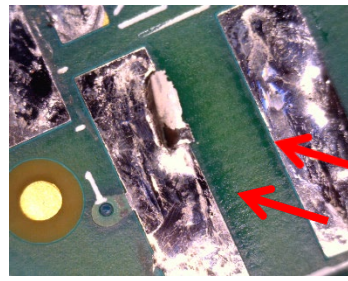
Belt Speed: 2.0 fpm

Solvent: 10 Megohm DI

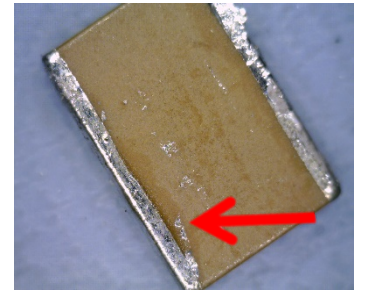
### NOT VIABLE PROCESS:

- All AVX Caps have Flux on the bottom side of the components.
- Both assemblies had flux on the PCB as well.

## Card #1 and #2



Board 1, C1 flux on cap underside and PCB



Board 1, C2 flux on cap underside and on PCB

## Post Cleaning – DI Water

Wash Temp: 145°F/62.8°C

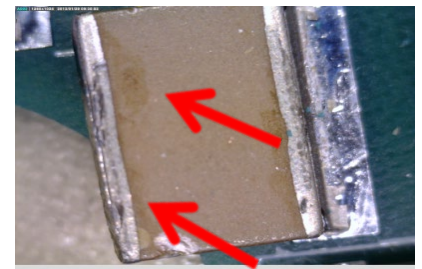
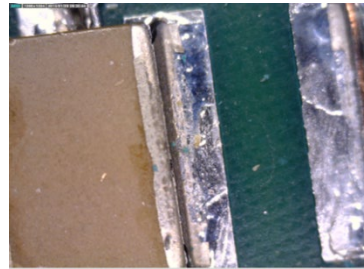
Belt Speed: 1.0 fpm

Solvent: 10 Megohm DI

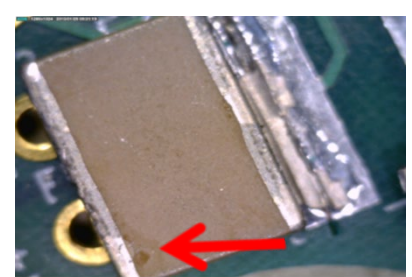
### NOT VIABLE PROCESS:

- AVX Caps have Flux on the bottom side of the components.
- No flux residue on any of the PCB's under the components

## Card #3 and #4 @1 foot per minute



Board 3, C1 flux on cap underside, no visual residue on PCB



Board 4, C1 flux on cap underside, no visual residue on PCB

## Post Cleaning – A4382

Wash Temp: 140°F/60°C

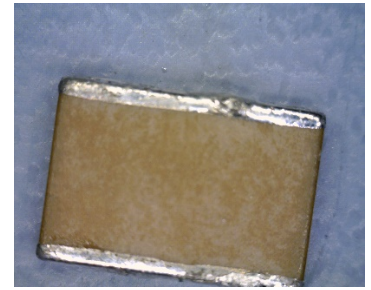
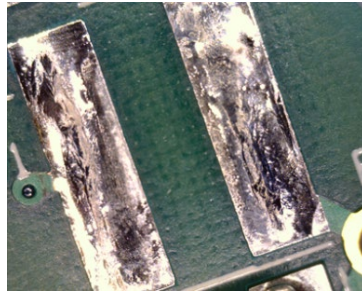
Belt Speed: 2.0 fpm

Solvent: A4382 @ 3%

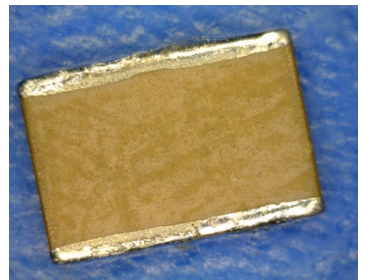
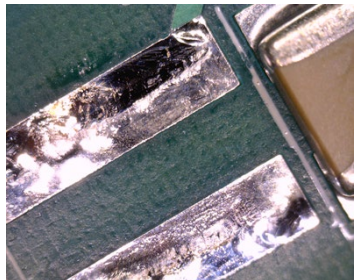
### VIABLE PROCESS:

- AVX Caps did not have flux residue on any of the components
- No flux residue on any of the PCB's under the components

## Card #5 and #6 @ 2 foot per minute



*Board 5, C2 No Flux on cap underside, no visual residue on PCB*



*Board 6, C2 No flux on cap underside, no visual residue on PCB*

### Validation-Visual Inspection:

- 6 Assemblies
  - Destructive Testing by using a Xacto knife to remove the problematic AVX capacitors.
  - Each component was inspected at 50x for flux residues on the PCB and the bottom-side of the component under
- 6 Assemblies processed with AQUANOX A4382
  - Assemblies handled with gloves
  - Packaged in vacuum sealed Clean Room bags.

## Validation-Ion Chromatography

Anion IC Data						
	#1	#2	#3	#4	#5	#6
Fluoride	0.1089	0.1119	0.1115	0.1125	0.1169	0.1192
Chloride	0.1415	0.0863	0.1137	0.0919	0.1294	0.1459
Nitrite	0.0199	N/D	N/D	N/D	N/D	N/D
Bromide	1.1285	0.7015	0.9591	0.8045	0.7345	1.1993
Nitrate	0.0674	N/D	0.0654	N/D	N/D	0.1092
Phosphate	N/D	N/D	N/D	N/D	N/D	N/D
Sulfate	0.0440	0.0534	0.3397	0.0537	0.0372	0.0284
Acetate	0.3581	0.1290	0.8499	0.6143	0.5205	0.5010
Adipate	N/D	N/D	N/D	N/D	N/D	N/D
Formate	0.4050	0.2692	0.5690	0.3760	0.3169	0.3498
Methane Sulfonate	N/D	N/D	N/D	N/D	N/D	N/D
Total Weak Organic Acids	0.7631	0.3982	1.4189	0.9903	0.8374	0.8507
Cation IC Data						
Lithium	N/D	N/D	N/D	N/D	N/D	N/D
Sodium	N/D	N/D	N/D	N/D	N/D	N/D
Ammonium	N/D	N/D	0.0726	N/D	N/D	N/D
Potassium	N/D	N/D	N/D	N/D	N/D	N/D
Magnesium	N/D	N/D	N/D	N/D	N/D	N/D
Calcium	0.0202	0.0195	0.0560	0.0369	0.0368	0.0678

Table 3: Results of anion/cation IC. N/D=Not detectable. Units are µg/in<sup>2</sup>

## AQUANOX A4382 @ 3% IC Results

Anions	Fluoride	Chloride	Bromide	Nitrite	Nitrate	Sulfate	Phosphate	Total Inorganic Anions	Total WOA	Total Anions	Conductivity (µS)
Limits (µg/in.sq.)	<1	<2	<10	<4	<4	<4	<4	NA <sup>1</sup>	<150	NA <sup>1</sup>	<2.5 <sup>2</sup>
1	0.00	0.48	0.53	0.14	2.11	0.05	0.00	3.31	11.72	15.03	1.3
2	0.00	0.45	0.51	0.19	2.03	0.07	0.00	3.25	11.27	14.52	0.8
3	0.00	0.42	0.52	0.24	2.15	0.05	0.00	3.38	10.04	13.42	1.0
4	0.00	0.38	0.52	0.15	2.16	0.03	0.00	3.24	10.28	13.52	1.0
5	0.00	0.28	0.38	0.14	1.47	0.02	0.00	2.29	9.29	11.58	0.9
6	0.00	1.42	0.69	0.17	2.18	0.10	0.00	4.56	13.66	18.22	1.5

## DI Water Only IC Results

## Qualification Process Improvements

	New Validated Conditions	Past Conditions	Improvements
Chemistry:	pH 9.8 Cleaning Agent	DI water greater than 2 megohm	No Visual residues. Lower Cation and Anion detected
Concentration:	4-6%	0	Lower failure costs
Temperature:	140°F/60°C	145°F/60°C	Same, possible lower parameters with further optimization
Wash Cycle:	2.0 foot/min (~3 min)	2.0 foot/min (~3 min)	Equal

### Objective Achieved:

Next Generation AQUANOX A4382 provided the OEM customer with consistent cleaning performance over their previous cleaning process, while achieving:

- Low concentration
- No visual residue
- No rinsing issues
- Consistent cleanliness
- Low cost of operation
- Change monthly running 24/7 for PM, not decrease in cleaning.

Most Importantly:

- Objective Evidence to Support Process Change
- **No Field Returns**

*Additional testing to be done to improve cycle time*

**More information on [AQUANOX A4382](#) is available on our website or by contacting your KYZEN Sales Representative directly. [www.kyzen.com](http://www.kyzen.com)**