CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 2021

DateRun: 01/03/2021

Experimenters: Justin Kiander

ClientType: Additive Manufacturing

ProjectNumber: Project #1

Substrates: Plastic

PartType: Coupon

Contaminants: Resins/Rosins

Cleaning Methods: Immersion/Soak

Analytical Methods: Gravimetric, Visual, HSPiP

Purpose: The purpose of this experiment was to determine the effectiveness of baseline HSPiP solvents in removing soil from 3D printed coupons via unheated immersion.

Experimental Procedure: One 3D printed "Durable Coupon" was obtained for each of the 24 baseline HSPiP solvents being tested. An initial weight was recorded, then coupons were soiled with Photopolymer Resin (Durable) provided by the company and a dirty weight was recorded. Coupons were submerged into their respective solvents for 10 minutes at room temperature. Once 10 minutes had passed, coupons were allowed to dry for 24 hours. Following the drying step, a clean weight was recorded. Effectiveness of the solvents was determined by rating the removal of resin and damage to the coupon.

Results:

Solvents	Initial wt of cont	Final wt of cont	%Cont Removed	Resin Removal	Damage to Substrate
Toluene	0.15	0.01	93.33	1	0
Dimethyl Carbonate	0.08	0.02	75	0	1
Xylene	0.08	0.03	62.5	1	0
Benzyl Alcohol	0.03	0.27	-800	1	0
Ethylene Glycol	0.1	0.14	-40	0	1
Methyl Acetate	0.03	0.04	-33.33	1	0
Undecane	0.1	0.06	40	0	1
Ethyl Acetate	0.05	0.01	80	1	0
Methanol	0.21	0.01	95.24	1	0
Ethanol	0.06	0.08	-33.33	1	0
1,3-Dioxolane	0.13	0.06	53.85	1	0
Diethyl Carbonate	0.06	0.02	66.67	1	0
1-Propanol	0.04	0.02	50	0	1
2-Propanol	0.04	0.01	75	1	0
Propylene Carbonate	0.06	0.09	-50	0	1
Thiophene	0.07	0.05	28.57	1	1
1-Methoxy-2-Propanol	0.07	0.03	57.14	1	0
DMSO	0.07	0.11	-57.14	0	1
Acetone	0.06	0.02	66.67	0	1
1-Butanol	0.05	0.03	40	1	0
Dimethyl Glutarate	0.05	0.26	-420	1	0
Anisole	0.07	0.09	-28.57	1	0
	0.04	0.12	-200	0	1

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2-Butoxy Ethyl Acetate					
Ethyl Lactate	0.08	0.09	-12.5	1	0

Rating Key:

Resin Removal: 0 = Not Removed, 1 = Removed.

Damage to Substrate: 0 = No Damage, 1 = Damage

Coupons cleaned with Ethylene Glycol, Undecane, Propylene Carbonate, DMSO, and Acetone were still wet and possessed a residue of solvent and resin across the cleaned area. Coupons cleaned with Dimethyl Carbonate, 1-Propanol, and 2-Butoxy Ethyl Acetate possessed slight residues or patches of residue within the cleaned areas. The coupon cleaned with Thiophene possessed a wet spot at the center of the cleaned area, however, it is possible that this spot could have come from an accidental drop of solvent from another coupon.

A significant number of coupons resulted in a negative percent removal of soil indicating that solvent was absorbed by the substrate. There was no visual identification of damage to the substrates following the cleaning process, except for the presence of a residue. Percent removals verify this observation as none exceed 100% which would indicate that the substrate was being stripped by the solvent.

Summary:

Substrates:	Plastic				
Contaminants:	Resins/Rosins				
Company Name:	**Product Name:**	**Conc.:**	**Efficiency:**	**Effective:**	**Observations:**
Fisher Scientific	Methanol (CAS: 67-56-1)		0.00	☑	Methanol was the most effective solvent removing 95.24% of soil.
EM Science	Toluene		0.00	☑	Toluene was the second most effective removing 93.33%.

Conclusion:

The most effective solvent on Durable substrates was Methanol with a removal of 95.24% and no damage to the substrate. Toluene was the second most effective with a removal of 93.33%. No substrate was reported to have been stripped by solvents by a significant number did absorb solvent following the cleaning process. Next steps would be to discuss with senior lab staff on how best to optimize HSPiP testing.