CLEANING LABORATORY EVALUATION SUMMARY

SCL #:	2021
DateRun:	01/04/2021
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 solvents in removing soil from 3D printed coupons via unheated immersion.
Experimental Procedure:	One 3D printed "Grey Coupon" was obtained for each of the 24 baseline HSPiP solvents being tested. An initial weight of the coupon was recorded, then coupons were soiled with the Photopolymer Resin (Grey) 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 in air for 24 hours. Following the drying step, a clean weight was recorded. Effectiveness of the solvents was determined by rating the removal of the resin and damage to the coupon.

Results:

Solvent	Initial wt of Cont	Final wt of cont	%Cont Removed	Resin Removal	Damage to Substrate
Toluene	0.07	-0.06	185.71	1	0
Dimethyl Carbonate	0.02	-0.02	200	1	1
Xylene	0.1	0.01	90	1	0
Benzyl Alcohol	0.03	0.19	-533.33	1	0
Ethylene Glycol	0.09	0.15	-66.67	0	1
Methyl Acetate	0.04	-0.01	125	1	1
Undecane	0.06	0.05	16.67	0	1
Ethyl Acetate	0.03	-0.03	200	1	0
Methanol	0.06	-0.01	116.67	1	0
Ethanol	0.03	0.03	0	1	0
1,3-Dioxolane	0.04	-0.02	150	1	1
Diethyl Carbonate	0.03	-0.06	300	1	0
1-Propanol	0.03	0	100	1	0
2-Propanol	0.03	-0.01	133.33	1	1
Propylene Carbonate	0.02	0.07	-250	1	0
Thiophene	0.03	0.01	66.67	1	0
1-Methoxy-2-Propanol	0.05	0.04	20	1	0
DMSO	0.02	0.18	-800	1	0
Acetone	0.03	-0.02	166.67	1	1
1-Butanol	0.03	0.04	-33.33	1	0
Dimethyl Glutarate	0.03	0.22	-633.33	1	0
Anisole	0.04	0.04	0	1	0

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2-Butoxy Ethyl Acetate	0.04	0.03	25	1	0
Ethyl Lactate	0.05	0.07	-40	1	1

Rating Key:

Resin Removal: 0 = Not Removed, 1 = Removed

Damage to Substrate: 0 = Not Damaged, 1 = Damaged

Coupons cleaned with Dimethyl Carbonate, Methyl Acetate, and Ethyl Lactate possessed a chalky residue at the base of the cleaned area following the cleaning process. Coupons cleaned with Ethylene Glycol, Undecane, and 2-Propanol were still wet following the cleaning process and possessed traces of resin residue in the cleaned area. Coupons cleaned with 1,3-Dioxolane and Acetone were stripped with visual distinction and discoloration between the cleaned and uncleaned areas of the coupon.

However, there are also coupons that appeared to remove the resin and did not cause damage to the substrate, but removal percentages exceed 100. This could most likely mean that the solvent is stripping the coupon, but these is not visual distinction present from 10 minutes of immersion. Additionally, there are coupons that significantly increase in weight following the cleaning process. This indicates that the solvent is being absorbed by the coupon. Finally, there are coupons with no changes to weight, but appear to have remove the resin without damaging the substrate. This could most likely mean that the resin was dissolved, but the coupon had also absorbed some of the solvent during the cleaning process.

Summary:

Substrates:	Plastic				
Contaminants:	Resins/Rosins				
Company Name:	**Product Name:**	**Conc.:**	**Efficiency:**	**Effective:**	**Observations:**
Fisher Scientific	Acetone (CAS: 67-64-1)			☐	1-Propanol was the most effective solvent removing 100% of soil. Xylene was the second most effective removing 90%. Next steps would be to work with senior lab staff to optimize HSPiP testing.

Conclusion:

1-Propanol was the most effective solvent removing 100% of the resin with no damage to the substrate. Xylene was the second most effective removing 90% of the resin. Many of the remaining solvents either began to damage the coupon as indicated by removal percentages above 100 or were absorbed by the substrate as indicated by the negative removal percentages. Next steps would be to work with senior lab staff to optimize HSPiP testing.