CLEANING LABORATORY EVALUATION SUMMARY

SCL #:	2019
DateRun:	11/25/2019
Experimenters:	Alicia McCarthy, Dan Aspach, Zoe Lawson, Rimsha Paneru
ClientType:	Additive Manufacturing
ProjectNumber:	Project #1
Substrates:	Stainless Steel, Liquid
PartType:	Part
Contaminants:	Resins/Rosins
Cleaning Methods:	Immersion/Soak
Analytical Methods:	HSPiP
Purpose:	To identify the Hansen solubility parameters of grey, grey pro, high temp, elastic, and tough resins.
Experimental Procedure:	Twenty-four standardized solvents for HSPiP testing were placed into individual 22ml vials per resin. The resin was poured into a ¼ teaspoon, 1.25ml, and added to a vial; this process was repeated for each of the 24 solvents. Visual observations and ratings were taken after 15 minutes of unheated immersion. The following rating key was based on how the resin dissolved in the solvents.

Chemistries Evaluated:

(1) Toluene; (2) Dimethyl carbonate; (3) Xylenes; (4) Benzyl alcohol; (5) Ethylene glycol; (6) Methyl acetate; (7) Undecane; (8) Ethyl acetate; (9) Methanol; (10) Ethanol; (11) 1,3- Dioxolane; (12) Diethyl carbonate;(13) 1- propanol; (14) 2- propanol; (15) Propylene carbonate; (16) Thiophene; (17) 1-methoxy2-propanol; (18) Dimethyl sulfoxide; (19) Acetone; (20) 1-butanol; (21) Dimethyl glutarate; (22) Anisole; (23) 2-butoxy ethyl acetate; (24) Ethyl lactate

Results:

	Rating				
Solvent	Grey	Tough	High Temp.	Elastic	Grey Pro
1	1	2	2	0	1
2	2	2	1	2	2
3	1	2	2	0	1
4	0	0	1	2	1
5	0	0	0	2	0
6	1	2	1	2	1
7	0	0	0	0	0
8	1	2	1	1	1
9	2	2	1	0	1
10	1	0	1	1	1
11	2	2	1	2	1
12	2	0	1	2	1
13	2	0	1	1	0
14	2	0	1	2	0
15	1	2	1	2	1
16	2	2	1	1	1
17	1	0	1	2	1
18	2	0	2	1	0
19	2	2	2	0	1
20	1	0	1	1	0
21	2	0	2	2	1
22	1	2	2	2	1
23	1	0	2	1	0
24	1	2	0	2	1

Observations from Testing:

The two hardest resins to dissolve were the High Temp. Resin and the Grey Pro resin within the 10-minute cleaning time. There was no change in ratings even after a full 20 minutes of immersion. Isopropanol (#14) was not effective at dissolving the Tough and Grey Pro resin. Most of the resins settled on the bottom of the vial and agitation after rating did improve solubility with some of the solvents.

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HSPiP Program Sphere Results:

A core value for D, P, and or H value of 0.25 or less is considered good, and 0.75 or higher is considered a bad.

Resin	D Value	P Value	H Value	Core Values
Grey	16.49	0.84	10.97	±[0.30, 0.65, 0.90]
Tough	18.72	10.35	15.49	±[0.35, 1.95, 0.75]
High Temp.	18.61	15.76	14.87	±[1.45, 1.15, 1.15]
Elastic	20.83	11.82	13.87	±[0.20, 0.65, 0.45]
Grey Pro.	16.51	16.67	12.86	±[0.25, 0.15, 0.30]

Summary:

Substrates:	Stainless Steel, Liquid
Contaminants:	Resins/Rosins

Company Name:	Product Name:	Conc.:	Efficiency:	Effective:	Observations:
Fisher Scientific	Dimethyl glutarate (CAS:1119-40-0)			☐	
EM Science	Toluene			☐	
Alfa Aesar	Dimethyl Carbonate 99%			☐	
Alfa Aesar	Methyl Acetate			☐	
TCI America	Undecane			☐	
Fisher Scientific	Methanol (CAS: 67-56-1)			☐	
Fisher Scientific	Propylene carbonate 99.5% (CAS: 108-32-7)			☐	
Alfa Aesar	Thiophene			☐	
Fisher Scientific	Dimethyl Sulfoxide - DMSO (CAS: 67-68-5)			☐	
Fisher Scientific	Acetone (CAS: 67-64-1)			☐	
Alfa Aesar	1-Butanol 99.4%+			☐	

Conclusion:

Additional solvents will be needed for testing to create a better sphere of solubility for each resin. It would also be helpful going forward to get coupons made of the resins so we can test cured and uncured a the same time. Once the spheres are considered “good”, the D, P, and H values will be plugged into the software to create a junction value of all of the resins. This junction value will be used to identify the safer solvent options.