

Investigation of batch-specific recovery variability in commonly used sample media for UAV spray drift studies

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Introduction



UAV Drift Trials

- The Unmanned Aerial Pesticide Application System Task Force (UAPASTF) contracted with the Stone Environmental field team to conduct nine GLP UAV drift deposition field trials.
- Field Trials conducted over 2 years (2023-2024)
- GLP PTSA Storage Stability Trial

Sample Media

- Dura-Lar® Mylar

Analyte

- PTSA(1,3,6,8-Pyrenetetrasulfonic acid tetrasodium salt)

Sample Media Introduction

Dura-Lar® (Mylar):

4 in x 4 in custom cut cards

Over **10,000** cards analyzed!

Four different “batches”

Mylar 1: 0.020-inch (20 mil)

Mylar 2: 0.010-inch (10 mil)

Mylar 3: 0.010-inch (10 mil)

Mylar 4: 0.020-inch (20 mil)



Extraction and Analytical Methodology

- PTSA Fluorometry: concentration of PTSA was measured with a Fluorometer
- Solvent: Diluted Isopropyl alcohol (10% IPA)
- Extraction Volume: fortification mass dependent
 - Typically between 10mL and 100 mL
- Mylar washed with solution until PTSA fully extracted



Circumstances of Discovery (Problem?)

Storage Stability Testing

- GLP Storage Stability study to identify recovery performance of PTSA and Mylar performance over time
- Day 0 recovery approximately 50% of expected...
- No obvious errors found, further investigation warranted



What could those initial findings mean?

What happened?

1. Calculation Error?
 1. QC'd, triple checked, unlikely
2. Method Error?
 1. Previously trialed, unlikely
3. Mylar Recovery issue?
 1. Plausible but further testing was needed to confirm...
 2. First step was a simple fortification recovery test



Initial Testing Results

Comparison of 3 Mylar Batches (Percent Recovery)								
Low Concentration (0.1 g/L PTSA)					High Concentration (1 g/L PTSA)			
	Mylar 1	Mylar 2	Mylar 3			Mylar 1	Mylar 2	Mylar 3
Average*:	99%	93%	35%		Average*:	97%	97%	45%
STD	0.05	0.04	0.10		STD	0.01	0.01	0.05

*average of 10 samples

More testing needed...

New Study Design

Questions to answer

1. Did each of the 4 mylar batches differ in recovery from one another?
2. Did batches 1,2,4 perform similarly but differently from batch 3?
3. Was there a mass and/or concentration dependence for recovery?
4. How did surface energy of mylar compare to the surface tension of field study tank mixes?



Mylar Fortification and Recovery Details

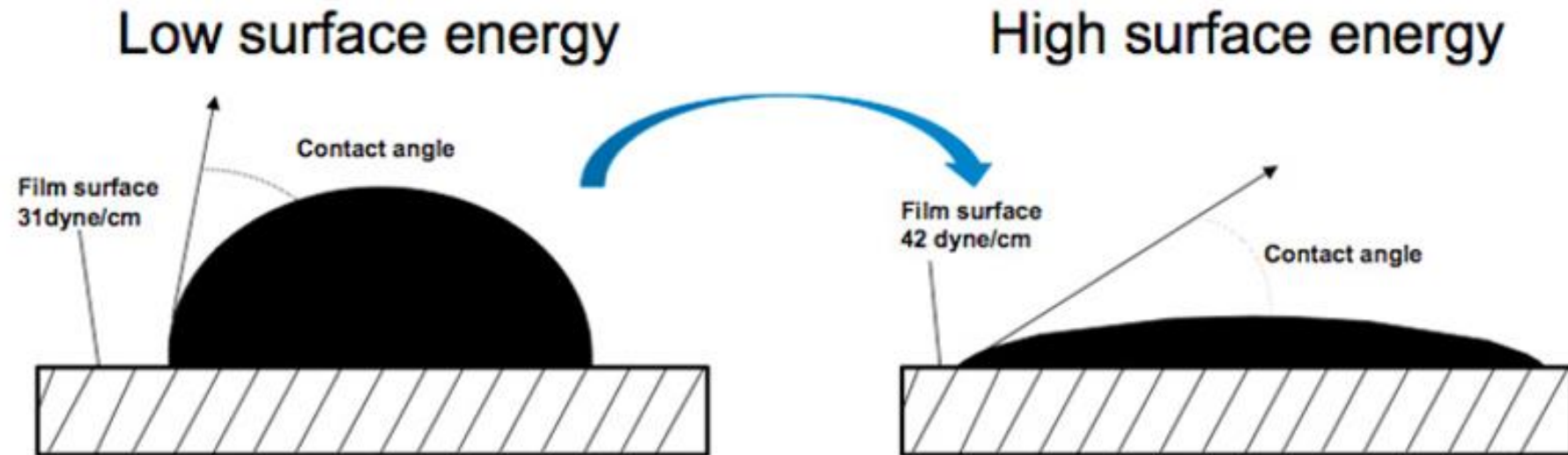
- 33 samples per batch, total of 132 samples
- All samples were spiked on the same day in the same environment and left until completely dry
- Dried samples were photographed at the time of collection
- All samples were analyzed on the same day using fluorometry

Dye Mass Spiked (mg)	Spiking Solution Concentration for 10 µL	Spiking Solution Concentration for 100 µL	Number of Mylar Samples
Control	-	-	3
0.2	0.02 g/L	0.002 g/L	6
1.0	0.1 g/L	0.01 g/L	6
2.0	0.2 g/L	0.02 g/L	6
20.0	2 g/L	0.2 g/L	6
200.0	20 g/L	2 g/L	6

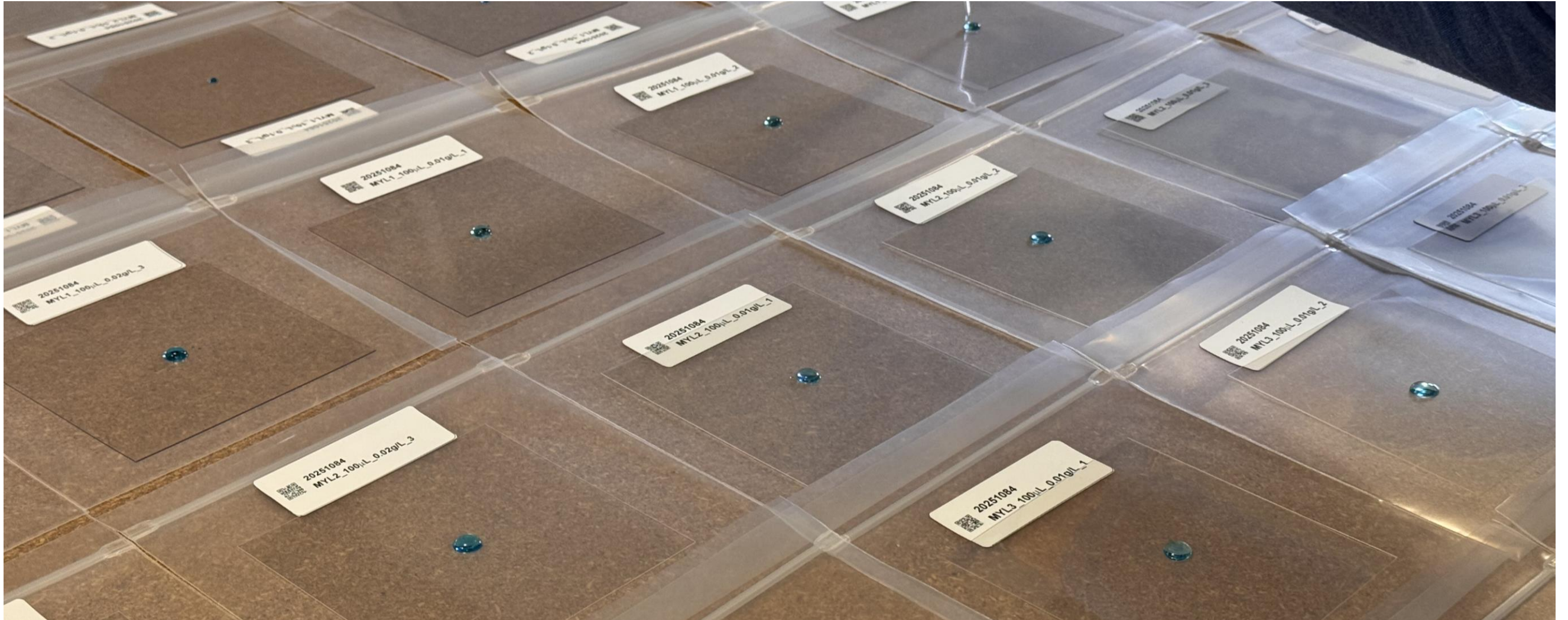
Surface Energy Testing

- Characterize surface energy of each mylar batch
- *Accu Dyne Test*™ Marker-Pens, dynes/cm
- Marker pens measure the surface energy of the mylar using liquids with known surface tension
- Surface energy determination made based on liquid behavior on the card

SURFACE ENERGY

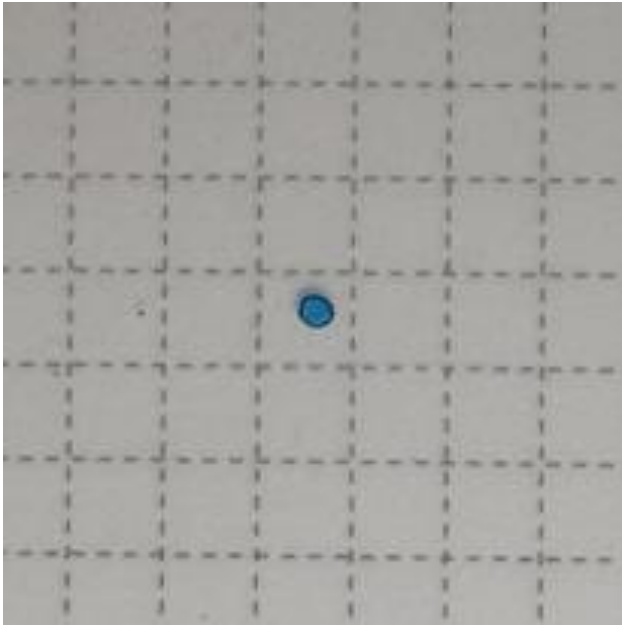


Spike Day



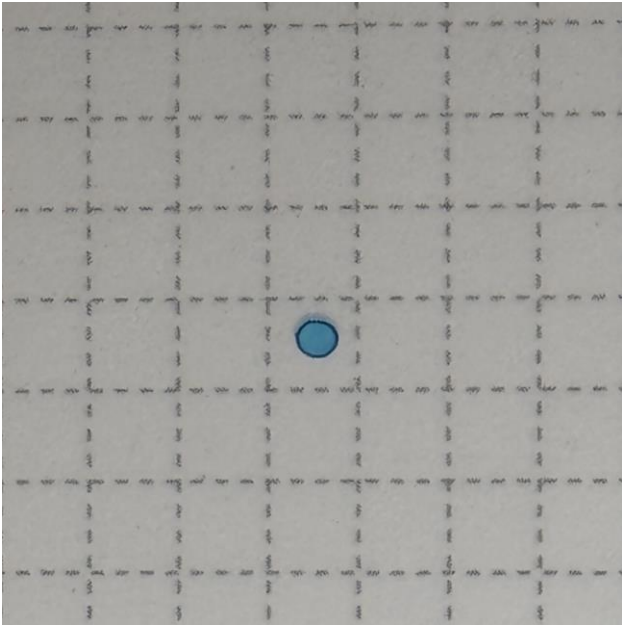
Spike Day: 100 μ L x 0.02 g/L

Mylar Batch 1

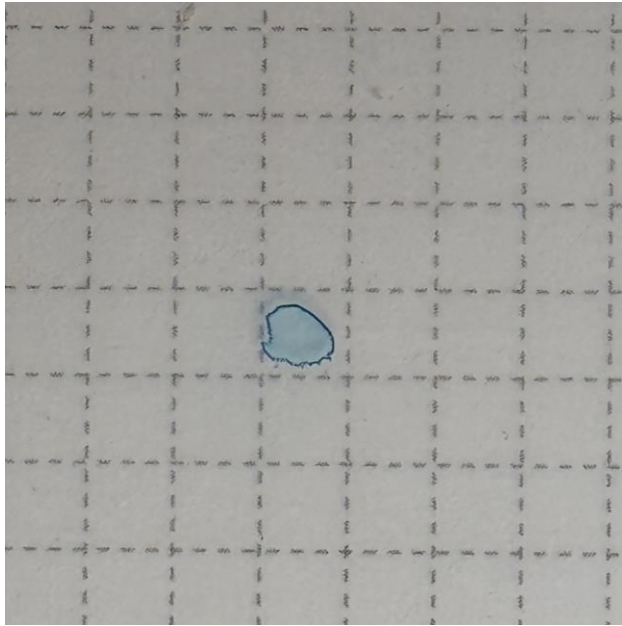


1 inch

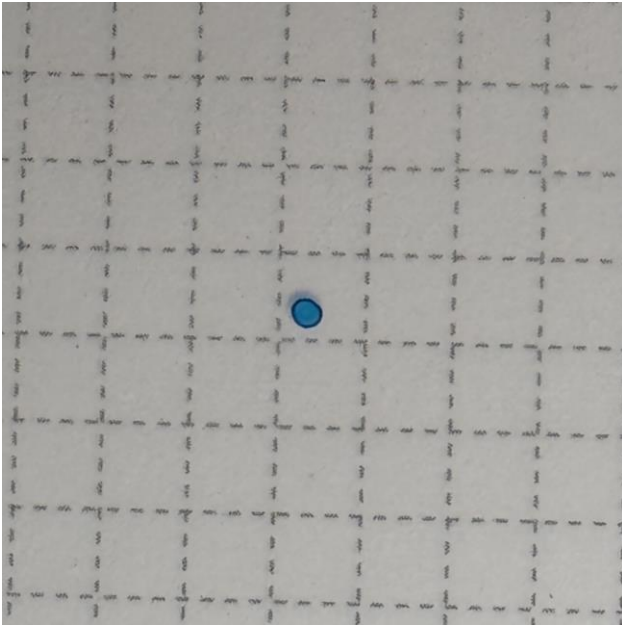
Mylar Batch 2



Mylar Batch 3



Mylar Batch 4



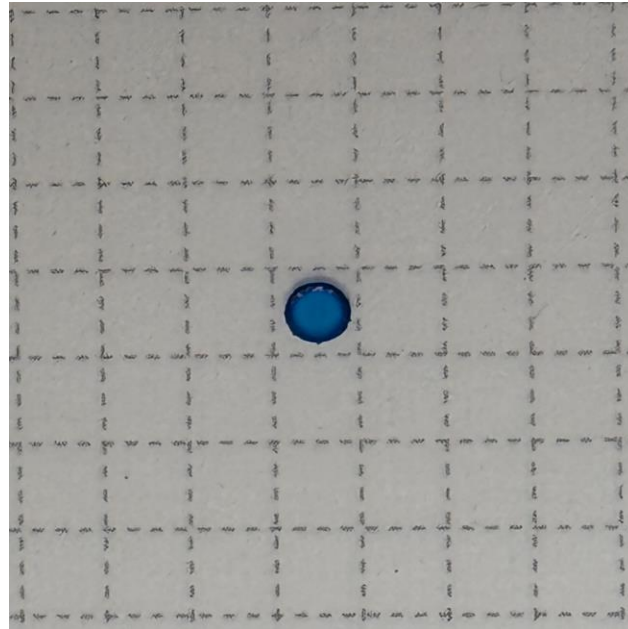
Spike Day: 100 μ L x 0.2 g/L

Mylar Batch 1

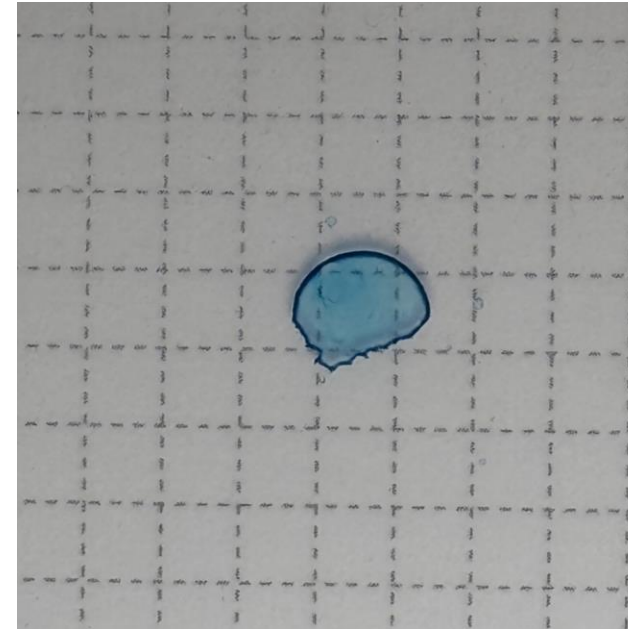


1 inch

Mylar Batch 2



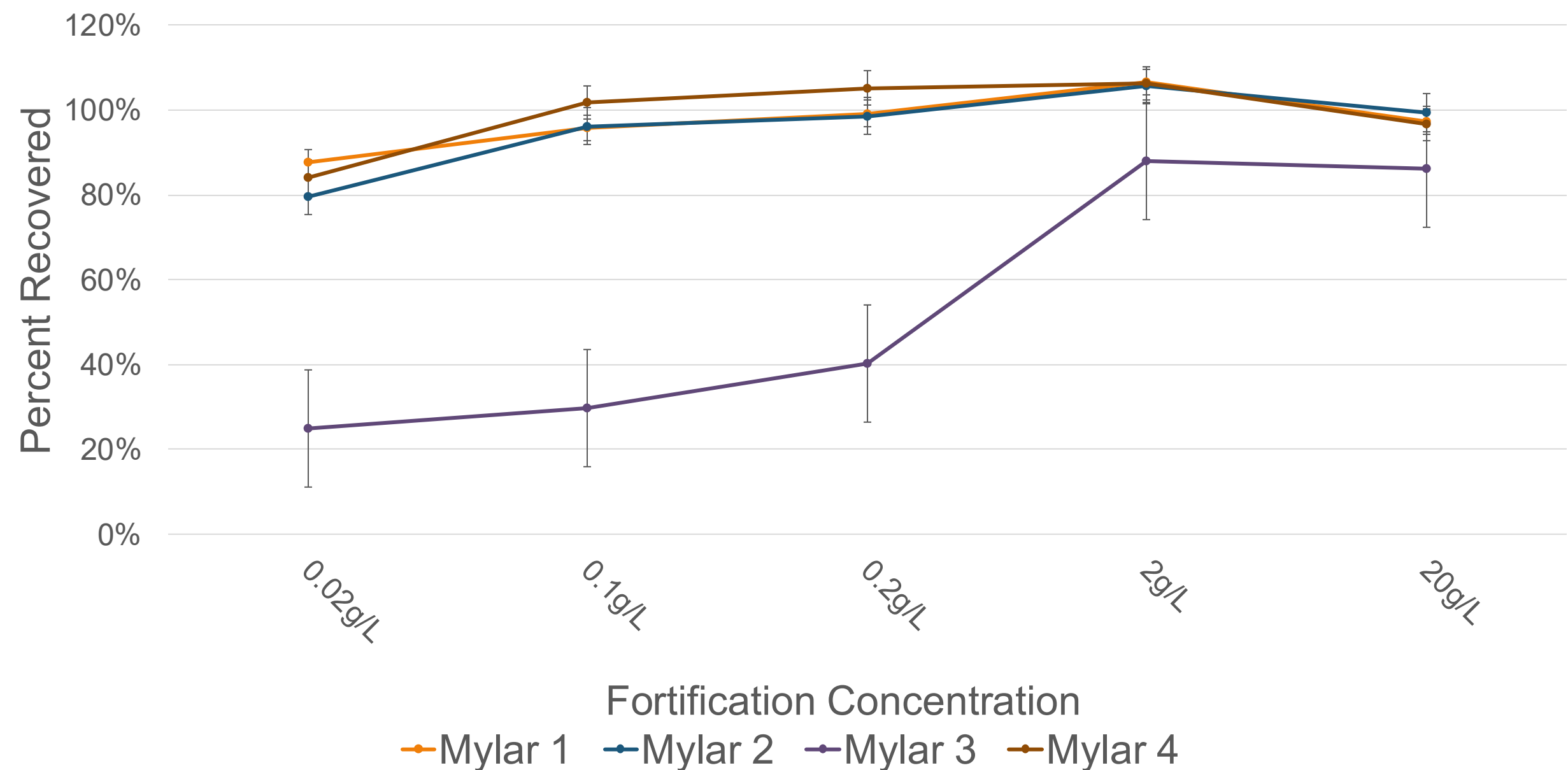
Mylar Batch 3



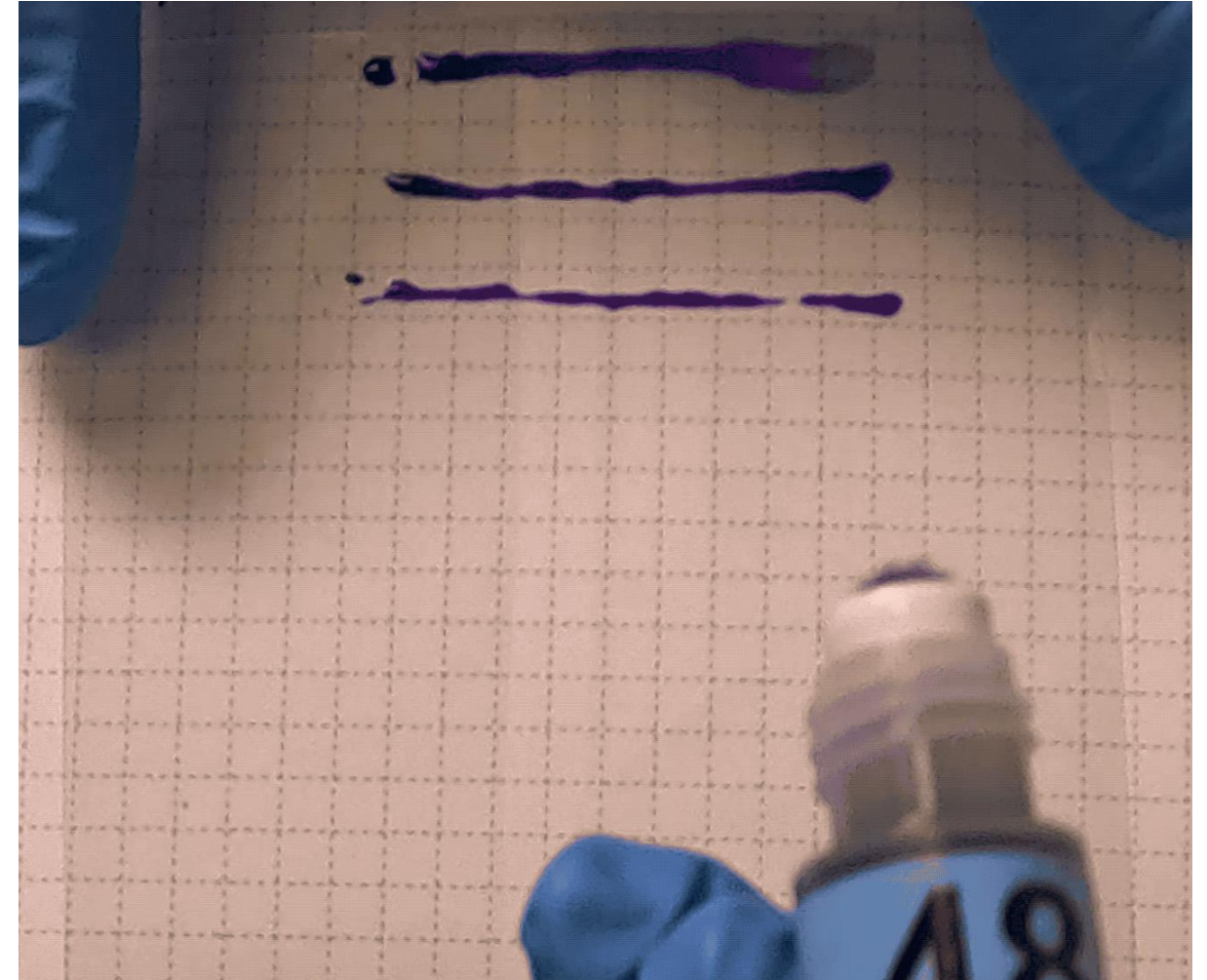
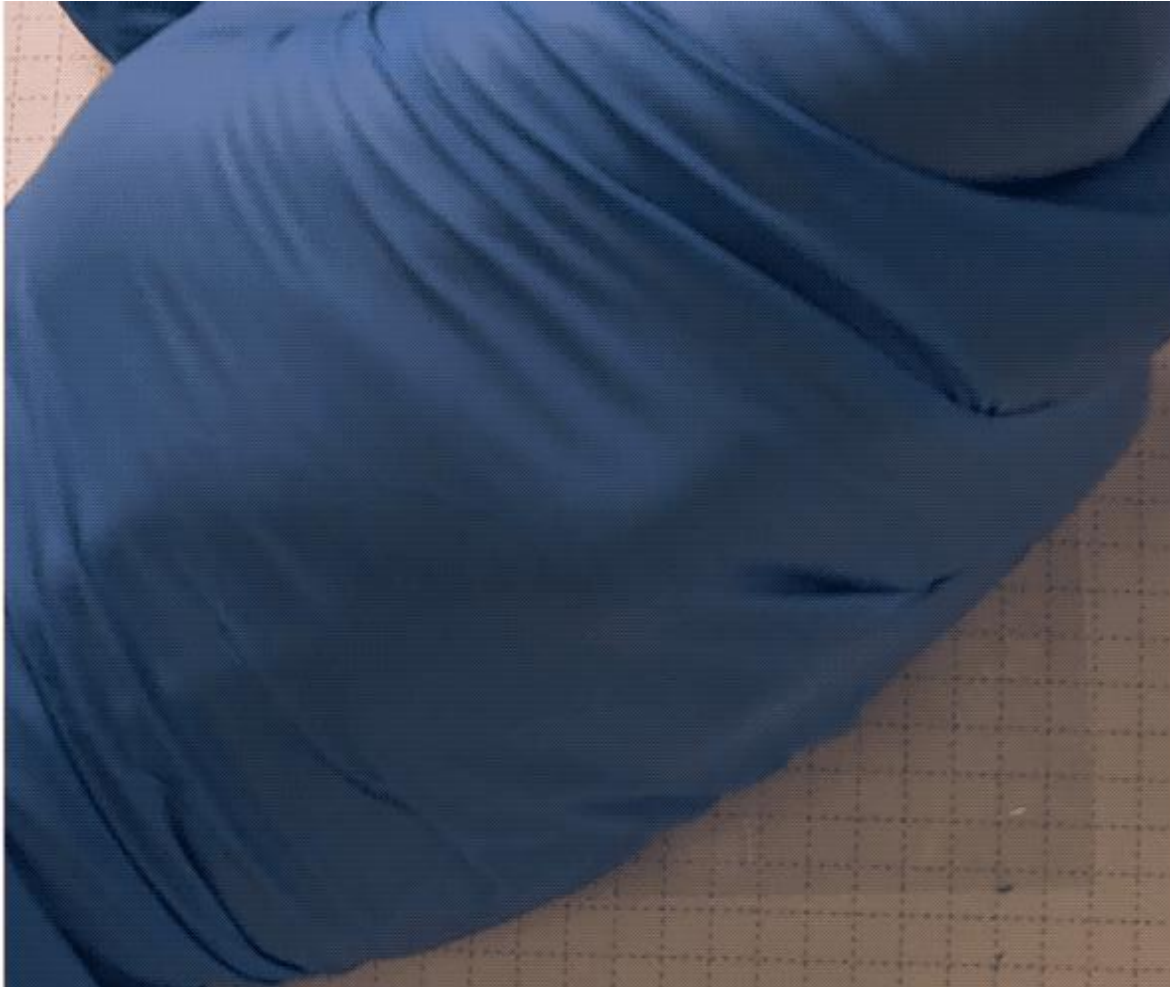
Mylar Batch 4



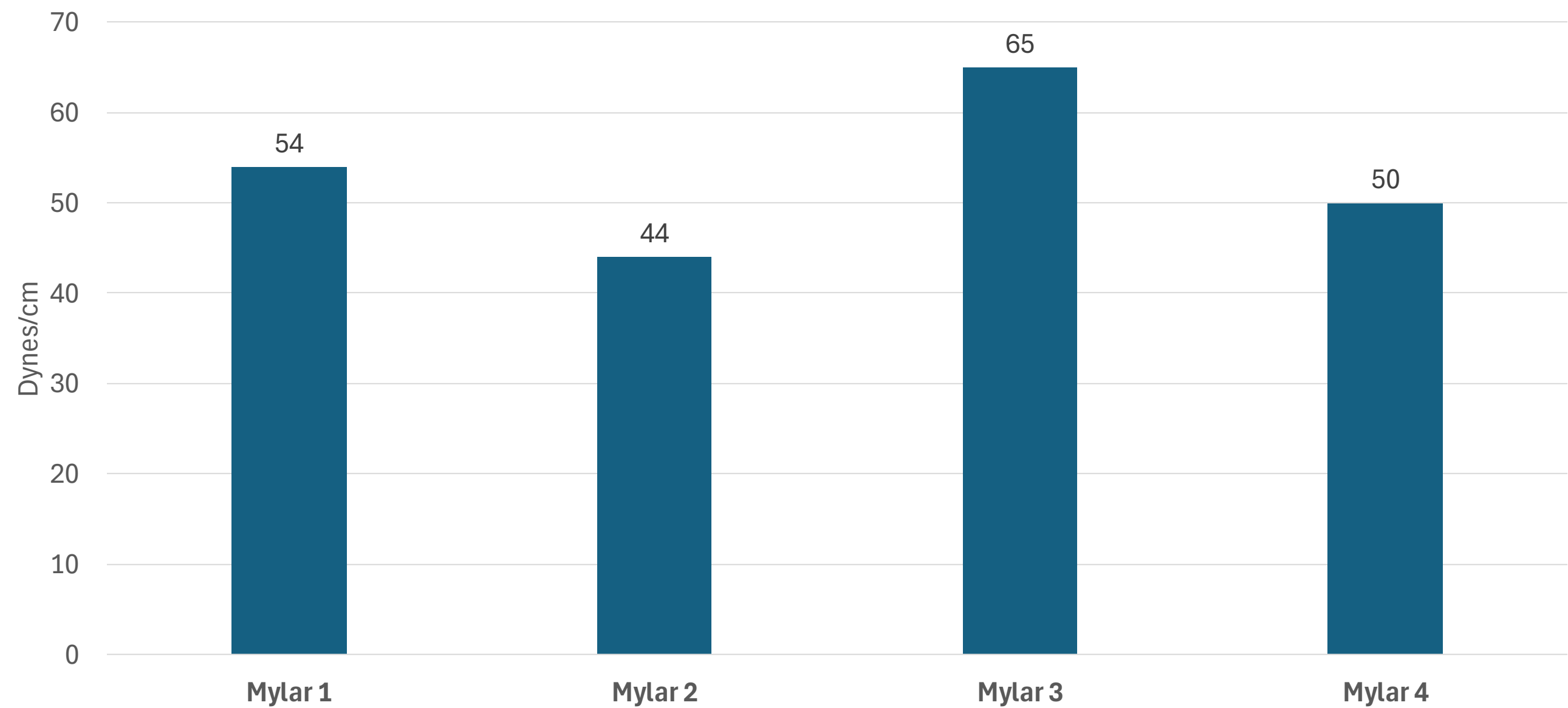
Mylar Study Recovery Results: 10µL Spike Volume



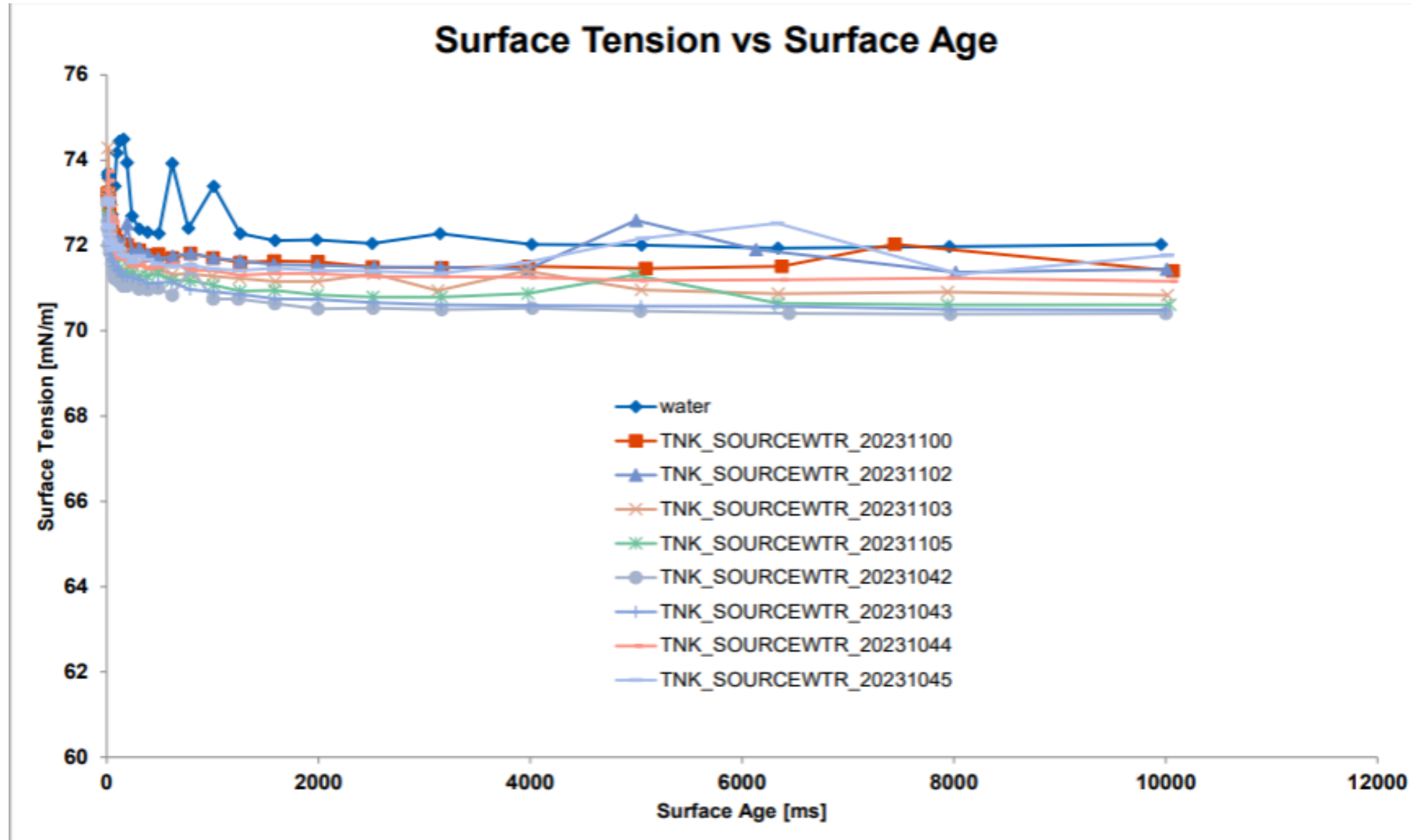
Surface Energy Testing



Surface Energy Results



Tank Mix Tension Results



Results Summary

PTSA Fluorometry

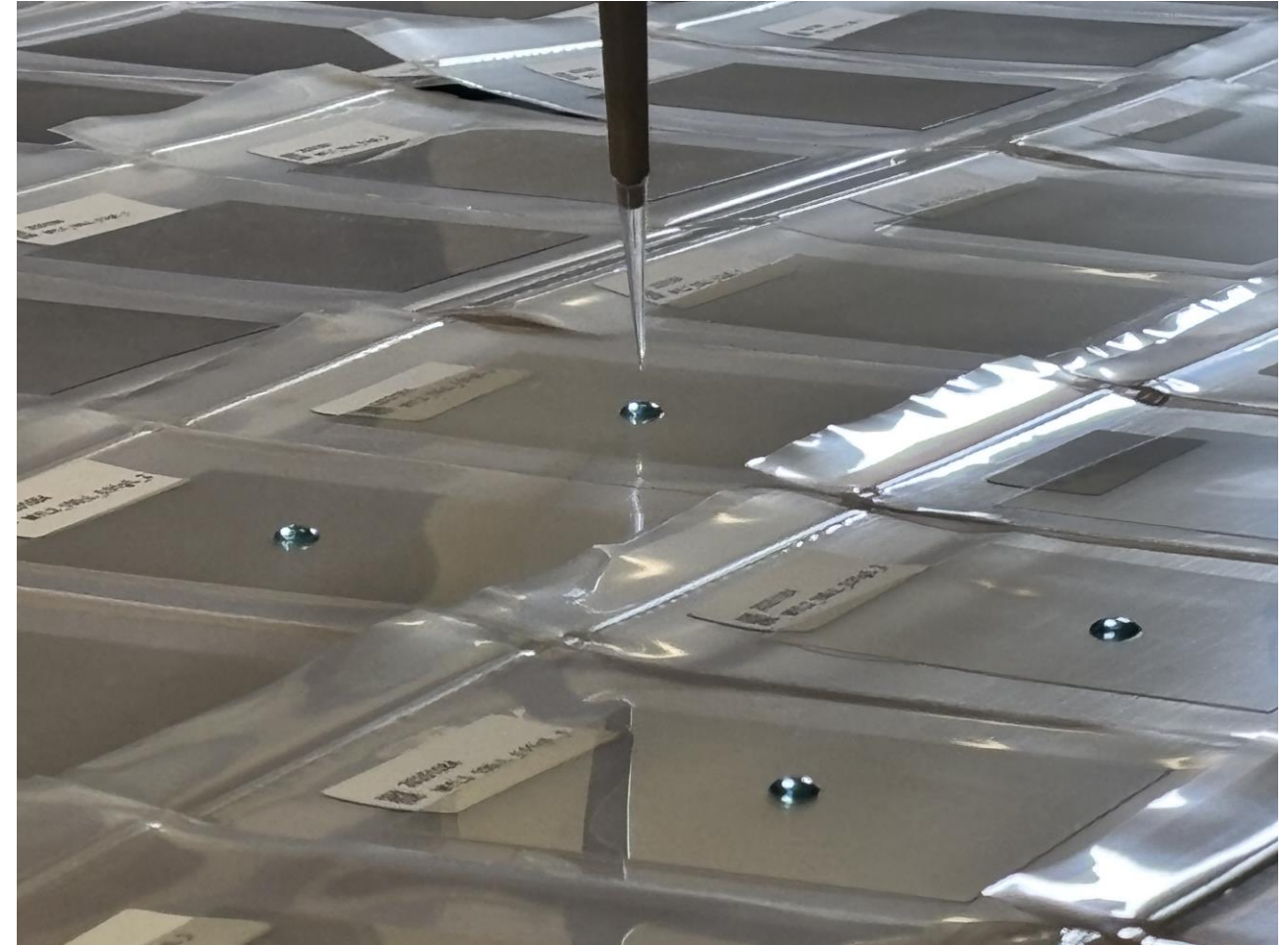
- Generally, there was a statistically significant difference in PTSA recovery between Mylar 1,2,4 vs Mylar 3

Surface Energy

- Difference in Surface Energy (dynes/cm) between all batches, Mylar 3 being the highest
 - Mylar 1: 54, Mylar 2: 44, Mylar 3: 65, Mylar 4: 50

Tank Mix Surface Tension

- No practical difference between Tank Mix surface tension



Final Conclusions and Takeaways

Final Conclusions

1. PTSA recovery was clearly different in Mylar 3 compared to Mylar 1,2,4 despite manufacturer assurance they originate from the same lot
2. Always test recovery rates for your sample media and dosing solutions prior to field trials when conducting fluorometric analysis for drift trials even if using mylar purchased previously from the same manufacturer/distributor

Thank you.

Contact / tdupuis@stone-env.com

Note: All data generated by this study protocol is proprietary to the UAPASTF and its member companies.