Assessment of Non-Destructive Decontamination Methodologies for Mixed Porous Surfaces: Aging of Technology under High Humidity and UV Conditions

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Disclaimer

- The U.S. Environmental Protection Agency (EPA) through its Office of Research and Development (ORD) funded and managed the research described. It has been subjected to the Agency's review and has been approved for publication and distribution. Note that approval does not signify that the contents necessarily reflect the views of the Agency. Mention of trade names, products, or services does not convey official EPA approval, endorsement, or recommendation.
- Battelle is a contractor to EPA and provided technical support for the work described.

Background - Urban Surface Decontamination

- EPA has done extensive research on using physical and chemical decontamination technologies

Decontamination testing using test stand

Example RAD decontamination technology (DeconGel 1108)

RAD decontamination testing of Wash Aid

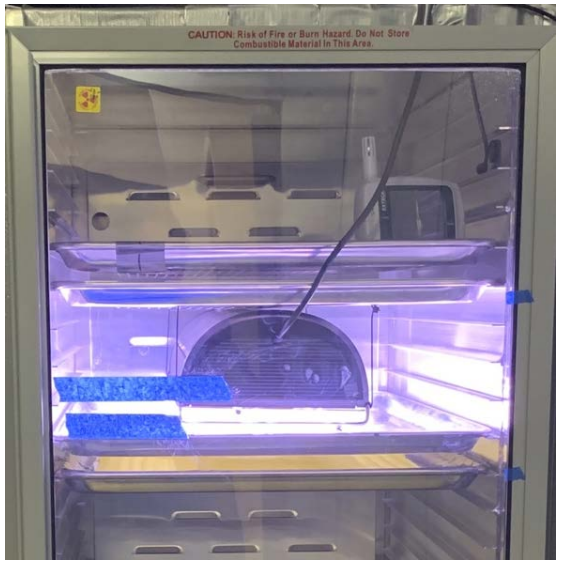
Background – EPA Wide-Area Demonstration

Wide Area Decontamination Demonstration-Battelle

Experimental Design

- Contaminate mixed brick coupon surfaces
- Target activity of 1.7µCi Cs-137

Application of contamination to the brick surfaces



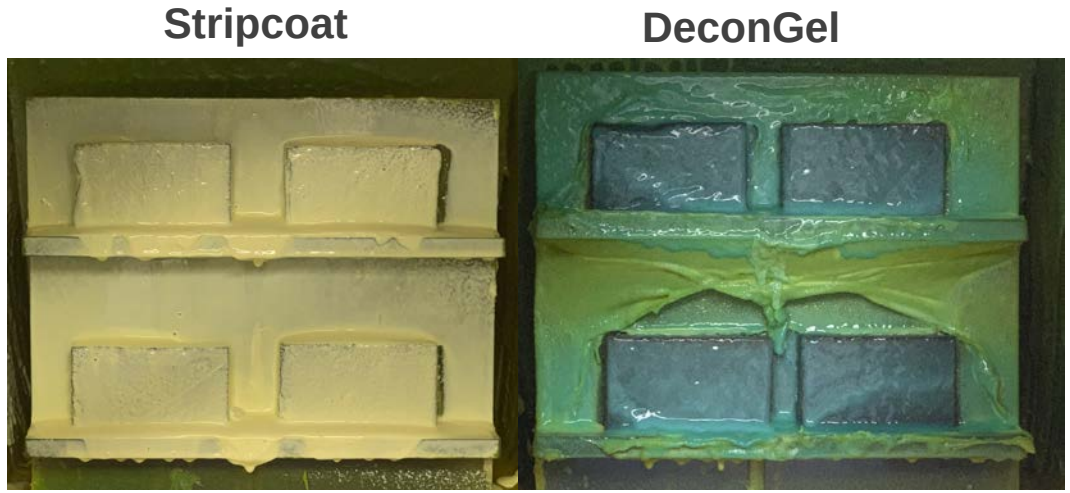
Aged in RH, UV controlled chamber

- Phase 1: 9 month test – contaminated bricks aged at high humidity
- Phase 2:12 week test at high humidity plus UV exposure after coating
- Humidity: 85%±5%
- UV intensity: 100µW/cm^2 A and 70 µW/cm^2 B

Experimental Design

- Measure pre-decontamination activities by Canberra Inspector 1000

Activity Measurement by Canberra Inspector 1000



Decontamination technologies application

- Application of decontamination technologies: Stripcoat and DeconGel 1128

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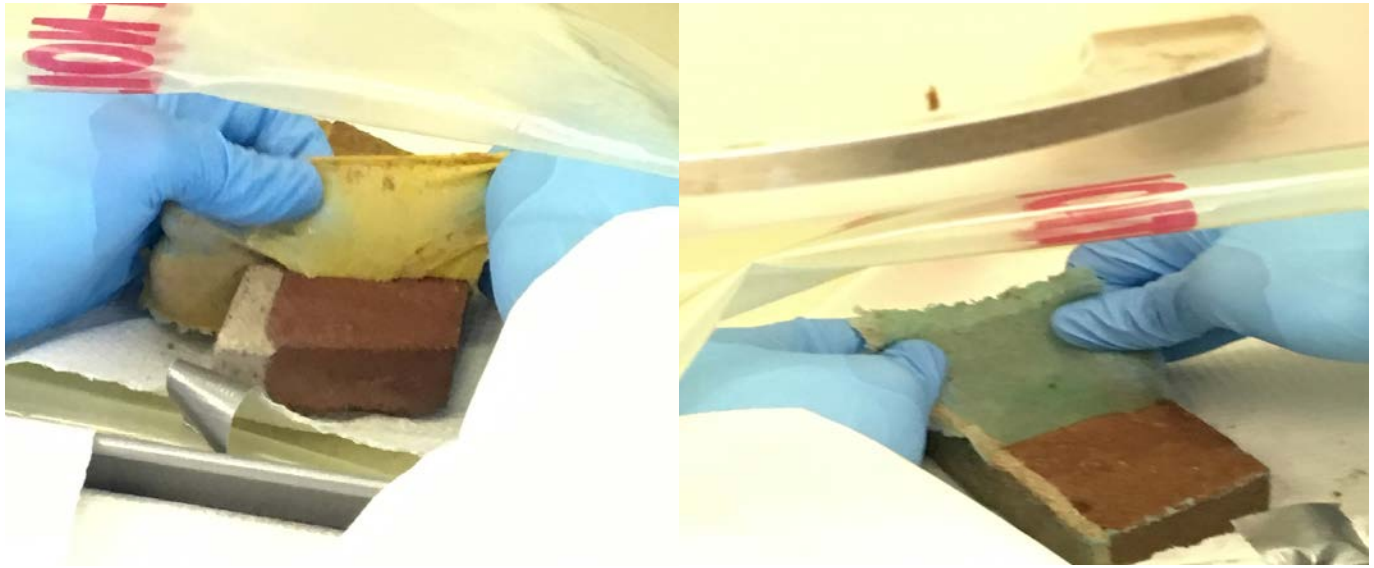
Experimental Design

- Remove decontamination technologies from applied coupon surfaces
- Measure post-decontamination activities
- Decon performed in containment fume hood with plenty of ventilation
- 4 brick replicates for each time period



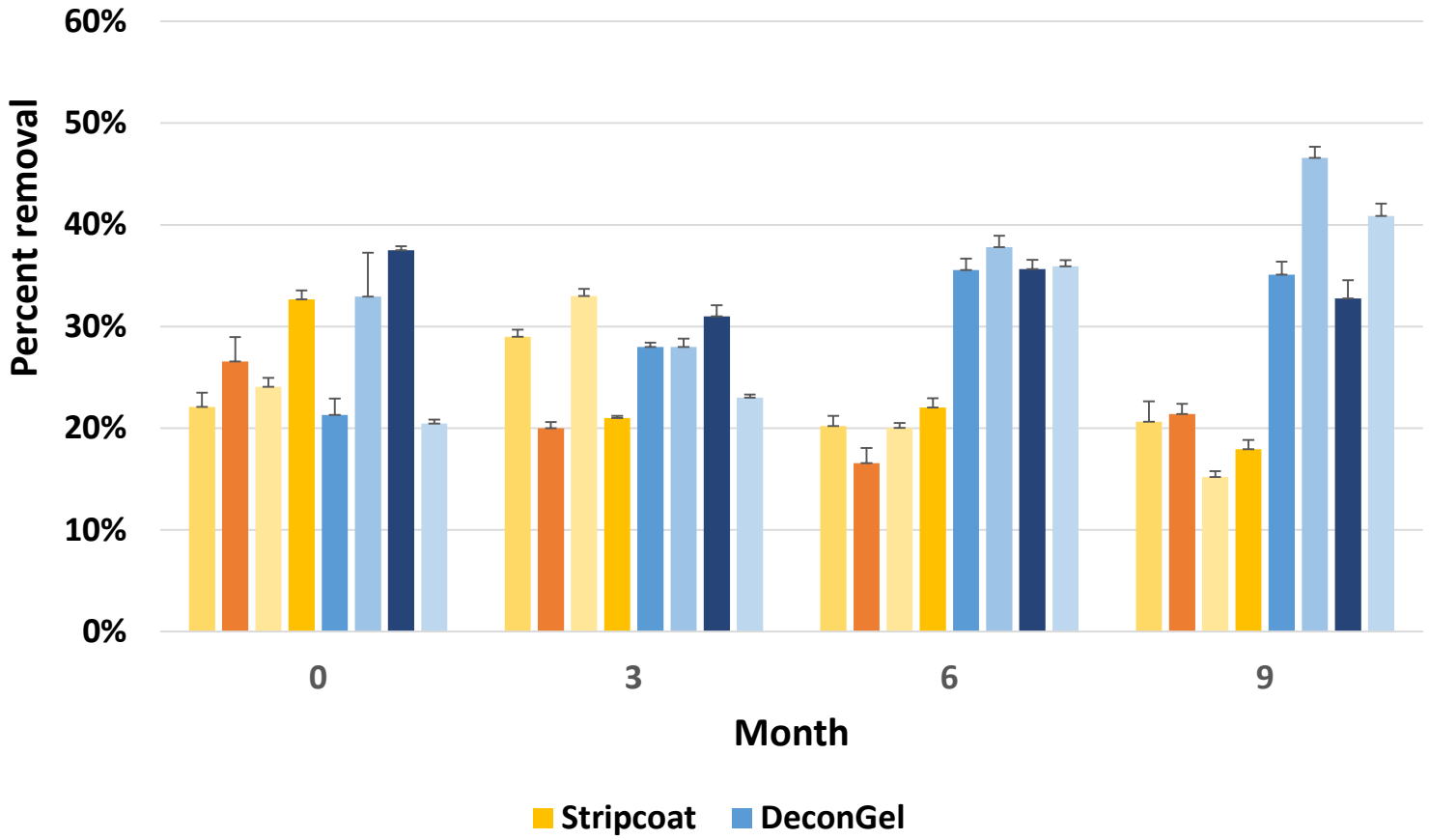
Remove decontamination technologies

$$\%R = 1 - (Activity_{final}/Activity_{initial}) \times 100\%$$

%R of Stripcoat and DeconGel for High Humidity Experiments

Month	Stripcoat			DeconGel		
	% removal	Average	STD	% removal	Average	STD
0	22% 27% 24% 33%	26%	5%	21% 33% 37% 20%	28%	8%
3	29% 20% 33% 21%	26%	6%	28% 28% 31% 23%	28%	3%
6	20% 17% 20% 22%	20%	2%	36% 38% 36% 36%	36%	1%
9	21% 21% 15% 18%	19%	3%	35% 47% 33% 41%	39%	6%

%R (all reps) for High Humidity Experiments



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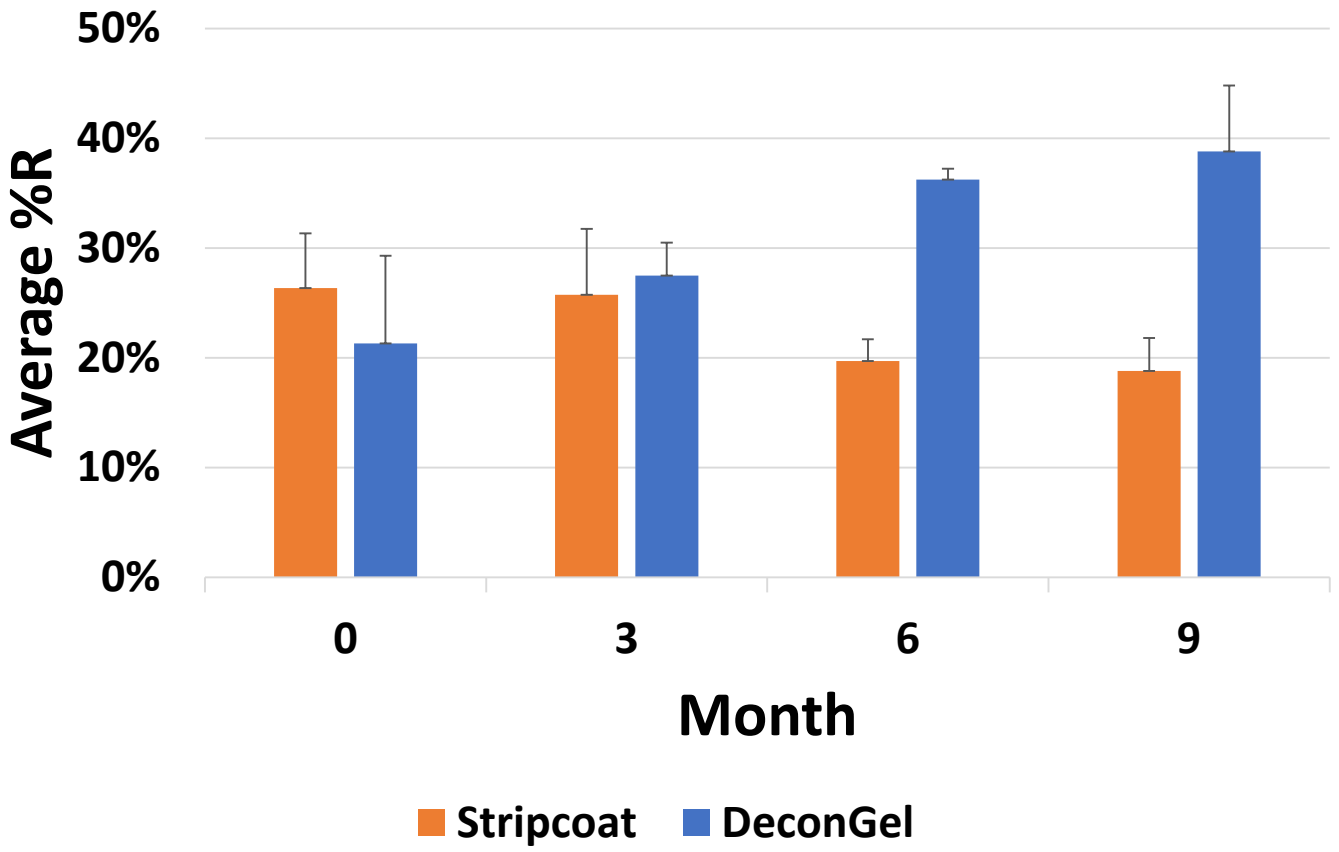
Average %R for High Humidity Experiments



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Qualitative Results for High Humidity Experiment

Month	Stripcoat		DeconGel	
	Time for removal (min)	Coating removed	Time for removal (min)	Coating removed
0	1	100%	10	~10% remain on brick, ~90% remains on mortar
	1	100%	10	<5% remain on brick and mortar
	1	100%	10	<5% remain on brick, ~10 remains on mortar
	1	100%	20	~25% remain on brick, ~100% remains on mortar
3	1	100%	13	<5% remain on brick, ~100% remains on mortar
	1	100%	8	<5% remain on brick, ~100% remains on mortar
	1	100%	35	<5% remain on brick, ~100% remains on mortar
	1	100%	>20	~33% remain on brick, 100% remains on mortar
6	1	100%	5	100%
	2	100%	4	100%
	2	100%	3	100%
	5	100%	3	100%
9	1	100%	4	100%
	1	100%	5	100%
	1	100%	5	100%
	1	100%	3	100%

Observations from High Humidity Experiments

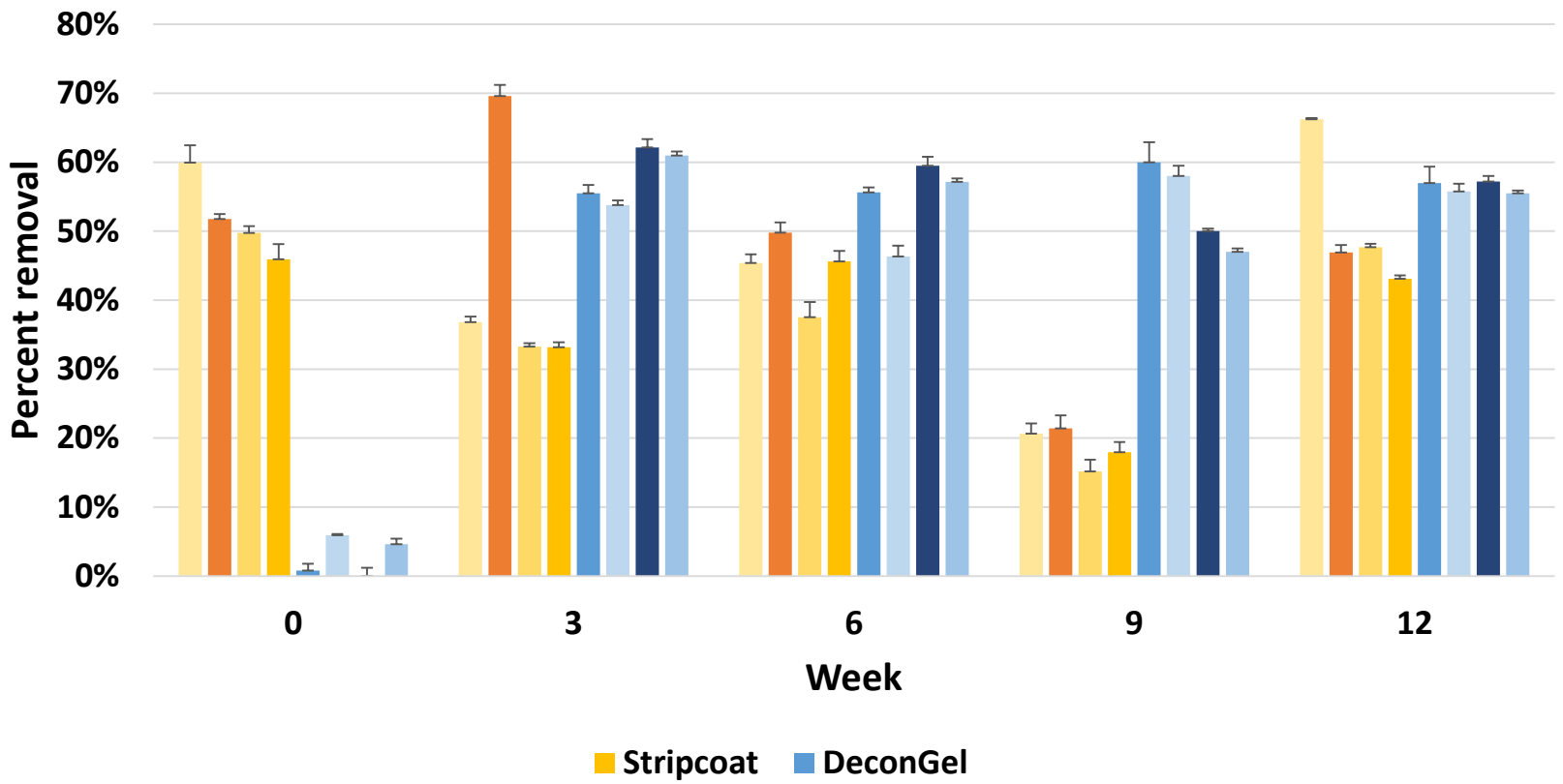
- Stripcoat was relatively easy to peel off.
- Time required for removal the Stripcoat coating was in the range of 1 to 5 minutes.
- 100% of dried Stripcoat from brick surfaces were removed.
- DeconGel was hard to peel off, especially on mortar.
- Time required for removal the DeconGel coating was in the range of 3 to 35 minutes.
- At time zero and three months, the dried DeconGel could not be removed from mortar. At six months and nine months, the coatings were completely removed from the brick and mortar surfaces.

%R of Stripcoat and DeconGel for High Humidity and UV Experiments

Weeks	Stripcoat			DeconGel		
	% removal	Average	STD	% removal	Average	STD
0	60% 52% 50% 46%	52%	6%	1% 6% NR[1] 5%	3%	3%
3	37% 70% 33% 33%	43%	18%	56% 54% 62% 61%	58%	4%
6	45% 50% 38% 46%	45%	5%	56% 46% 59% 57%	55%	6%
9	21% 21% 15% 18%	40%	5%	60% 58% 50% 47%	54%	6%
12	66% 47% 48% 43%	51%	10%	57% 56% 57% 55%	56%	1%

[1]No removal (%R was 0% or slightly negative because of activity measurement uncertainty)

%R for High Humidity and UV Experiments



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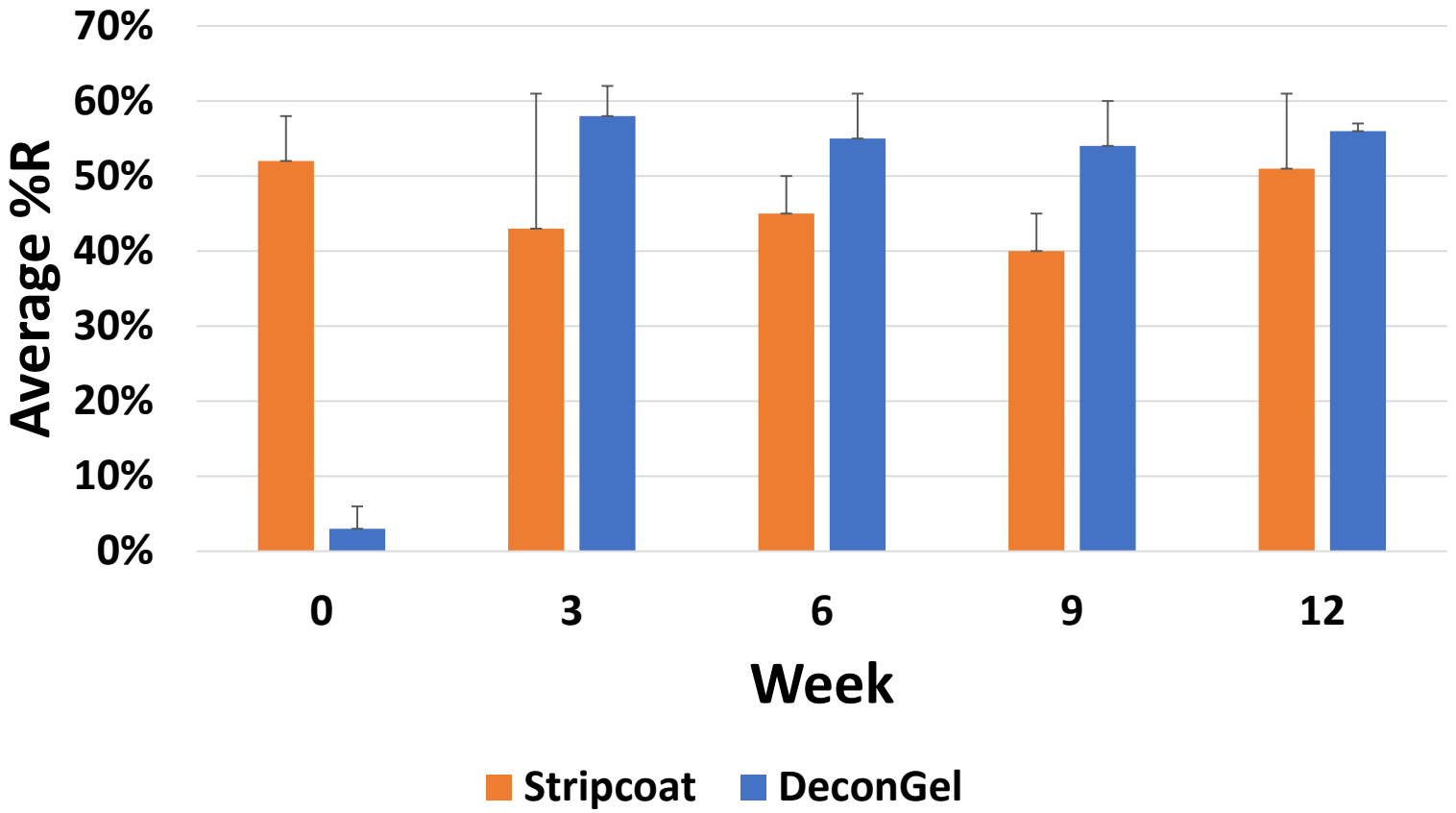
Average %R for High Humidity and UV Experiments



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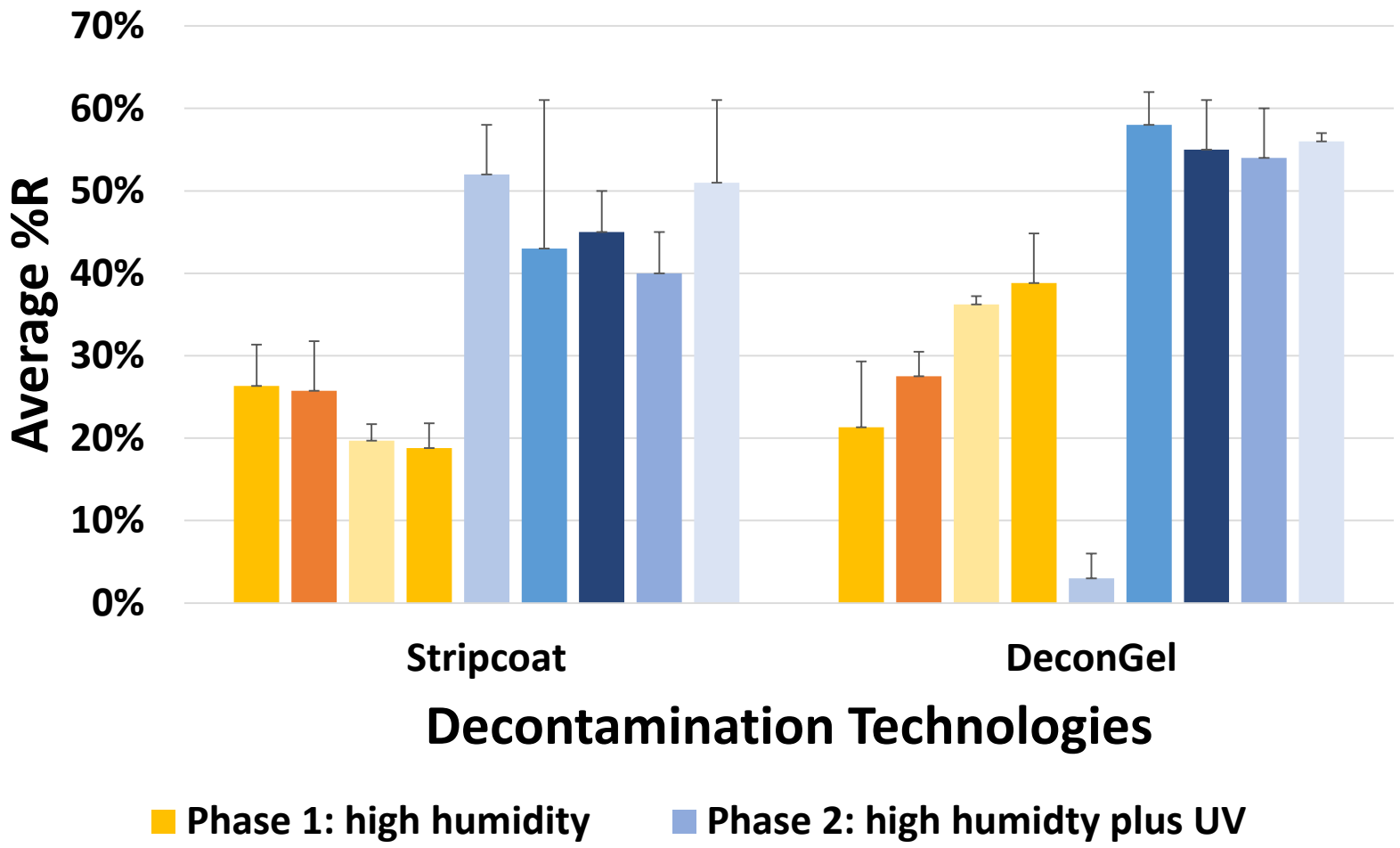
Qualitative Results For High Humidity Plus UV Experiments

Week	Stripcoat		DeconGel	
	Time for removal (min)	Coating removed	Time for removal (min)	Coating removed
0	1	100%	~10	0%
	1	100%	~10	0%
	1	100%	~10	0%
	1	100%	~10	0%
3	2-3	100%	10	100%
	2-3	100%	2	100%
	2-3	100%	10	100%
	2-3	100%	3	100%
6	1.5-2	100%	2-3	>90%
	1.5-2	100%	2	100%
	1.5-2	100%	2	100%
	1.5-2	100%	2	100%
9	2	100%	15	>95%
	1	100%	<10	>95%
	1	100%	3	100%
	1	100%	3	100%
12	~2	100%	~2	>95%
	~2	100%	~2	>95%
	~2	100%	~2	>95%
	~2	100%	~12	>90%

Observations from High Humidity and UV Experiments

- Stripcoat was relatively easy to peel off.
- The time required for removal of Stripcoat coating was in the range of 1 to 3 minutes.
- 100% of dried Stripcoat from brick surfaces were removed.
- DeconGel was hard to peel off. An assistance of plastic utensil was always needed.
- Time required for removal the DeconGel coating was in the range of 2 to 15 minutes.
- At time zero, the dried DeconGel could not be removed within 10 minutes. From three weeks to twelve weeks, more than 90% of coating were removed from the brick surfaces.

Average %R at Different Experiment Conditions



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Summary

- Each decontamination technology has its own advantages and disadvantages
- Dried DeconGel was more easily peeled off when time in high relative humidity increased
- On porous surfaces, the dried Stripcoat was easier to be peeled off than dried DeconGel coating
- At high humidity plus UV condition, DeconGel performed better than Stripcoat when time in high RH increased
- Overall, %R during UV experiments were higher than the elevated RH experiment only. Bricks from different buildings were used. Clarifying experiment underway.

Questions?