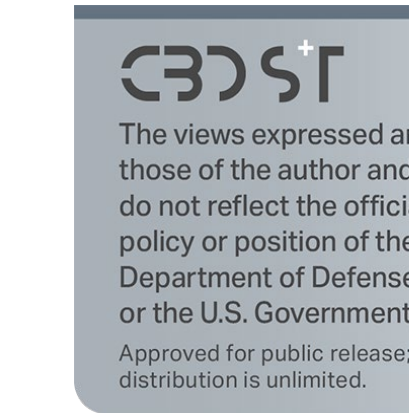


Decontamination Efficacy Testing for CWA and Toxic Chemical Mitigations

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Background

The use of decontamination products is something nearly everyone is familiar with, from hand sanitizer to household bleach. Stores are stocked with multiple choices for consumers to choose from. There are many different types of decontamination products on the market, formulated for specific types of chemicals. Still, there is and likely forever will be a need for the development of new decontamination products for emerging threats. The evaluation of decontamination products for toxic chemicals is approached by considering multiple factors, such as surface type, application of the surface to be decontaminated, application of target chemicals, application method of decontamination product, resonance times, and other factors. MRIGlobal performs studies for the decontamination of toxic chemicals, including nerve agents, blister agents, Fentanyl and Fentanyl analogs, and other drugs of abuse. Decontamination products can be applied by spray, wipe, and powder application. Each decontamination type requires control measures to accurately determine the effectiveness of the product. Positive controls are made of the sample matrix including the target chemical but without the presence of the decontamination product; while negative controls are made of the sample matrix including the decontamination product but without the presence of the target chemical.

Definition of Study Purpose

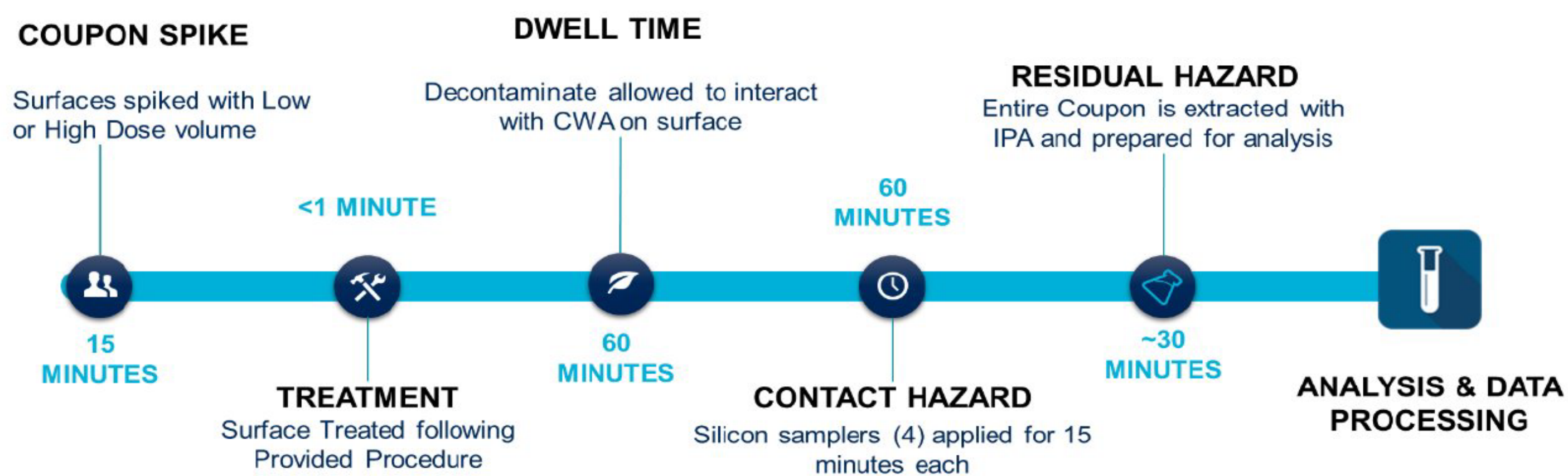
Determining if the target chemical is being decontaminated by neutralization, degradation or removal should be evaluated. Decontamination products could destroy the target chemical while creating a more hazardous end product compound. Some decontamination products when tested simply remove or trap the target chemical from the original surface, but the target compound can be detected on the decontamination product or solution run off. Decontamination products (wipes or solution) should be extracted and analyzed for; target chemicals, degradation and process byproducts of the decontamination process.

Decontamination –the action of removing dangerous substances from a material

Removal –the act of taking something away from somewhere

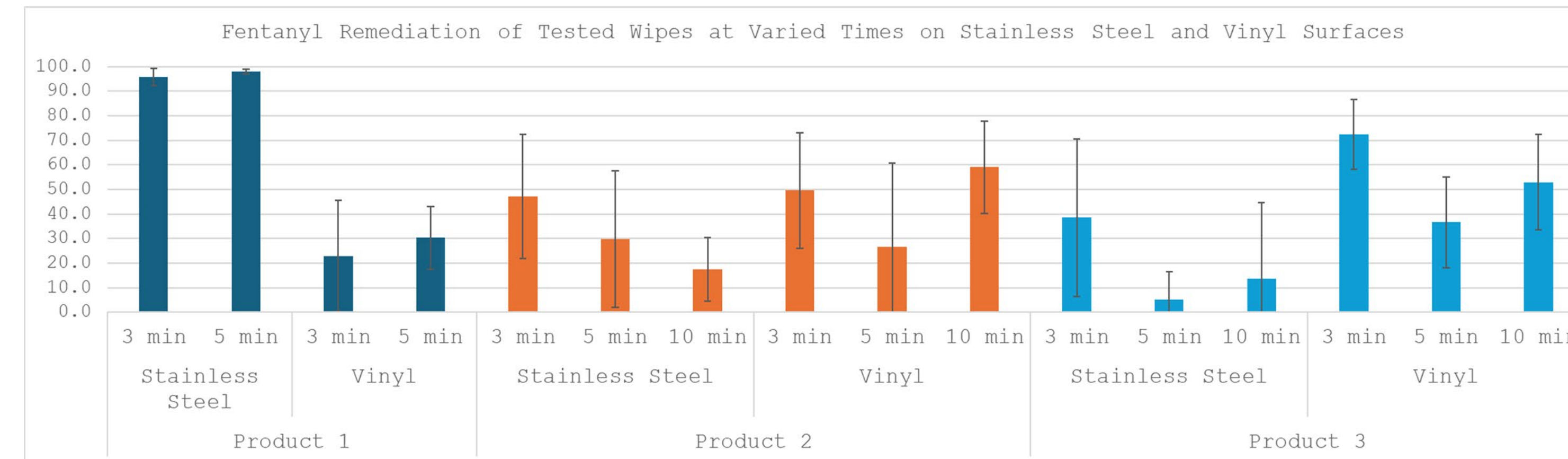
Destruction/Degradation –the act of destroying something into a new compound (new compounds can be neutral or hazardous)

Neutralization - the act of making a substance neutral (not an acid or an alkali).



Example Study

Example Study: Target chemical Fentanyl (single mass/wipe ratio), tested across 2 surface materials, against 3 dwell times, wipe decontamination application method, Decon Contact time. Samples in replicates of 3. Extracts filtered and analyzed by GC/MS.



Example Study Improvements: Increasing replicates from 3 to 10 to evaluate variability. Evaluate additional variables such as decon dwell time and target compound mass/wipe.

Variables

Reproducibility: Variations in results can arise from various sources such as; target compound, decontamination application, or surface sample reproducibility. E.g. Is the decontamination product a wipe? How is the wipe being applied, what direction, what pressure is being used, how many passes is the wipe used. Is the decontamination product applied as a sprayed product? What distance is the nozzle? How much volume/mass is applied to the surface? Is the surface flat or upright allowing for run off?

Target Compounds: What is the target compound purity, are the impurities of the starting material known? Can the target compound be applied as solid, liquid, or vapor?

Surface Variations: Does the surface to be decontaminated have variations (e.g. porosity, exposed seams) if so consider increasing the replicates. Would the end product be applied to a vertical or horizontal surface, should it be tested in both orientations?

Target compound application method: Target compound mass to Surface Ratio, target compound Mass to decontamination mass ratio.

Environmental conditions: Temperature and humidity variations can be tested, environmental interferants such as rain or dirt can be simulated in the laboratory.

Weathering time: Variations in the time target compounds sit on the surface prior to decontamination application/process.

Dwell time: Variations in the time decontamination solution/products sit on the target compound.

Controls and Quality Assurance Considerations

The following data quality objectives are commonly used at MRIGlobal to ensure quality data reporting:

Calibration curves for target analyte:

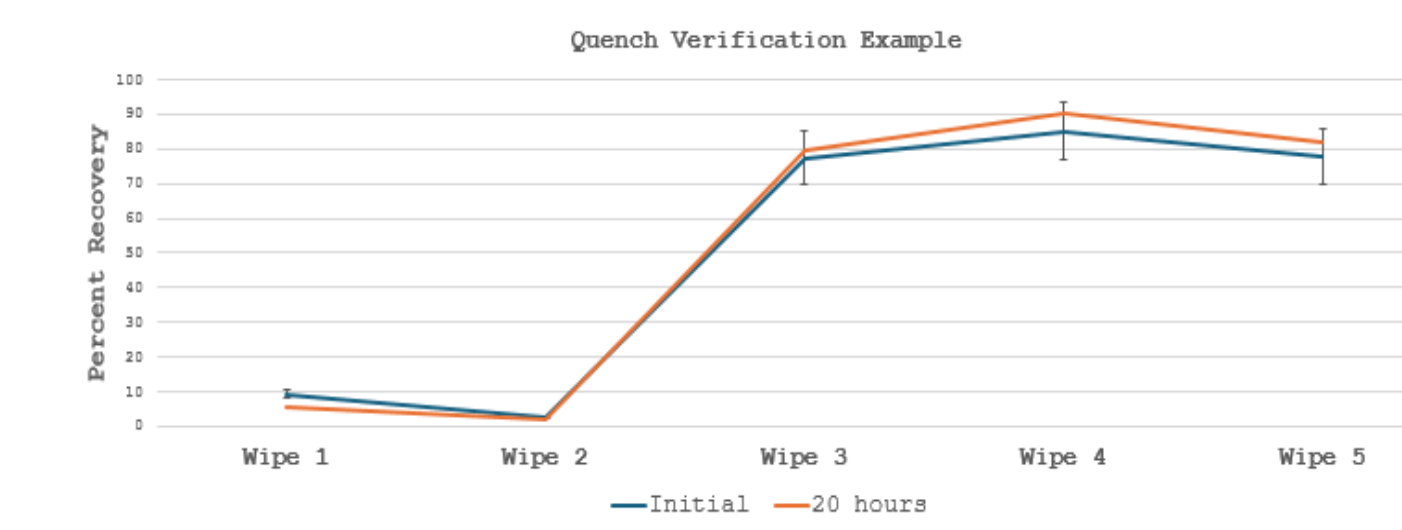
- Regression Fit: $R^2 \geq 0.99$ vs 0.98
- Single point relative error for standard curve points: $\pm 30\%$

Continuing Calibration Verification (frequency analyzed start of day, every 10 samples and end of day / acceptable ranges $\pm 25\%$)

Sensitivity Standards (frequency analyzed start of day, every 10 samples and end of day / acceptable ranges greater than 5:1 signal to noise)

System blanks (frequency analyzed start of day, every 10 samples and end of day / acceptable levels, less than calibration range, less than 5:1 signal to noise)

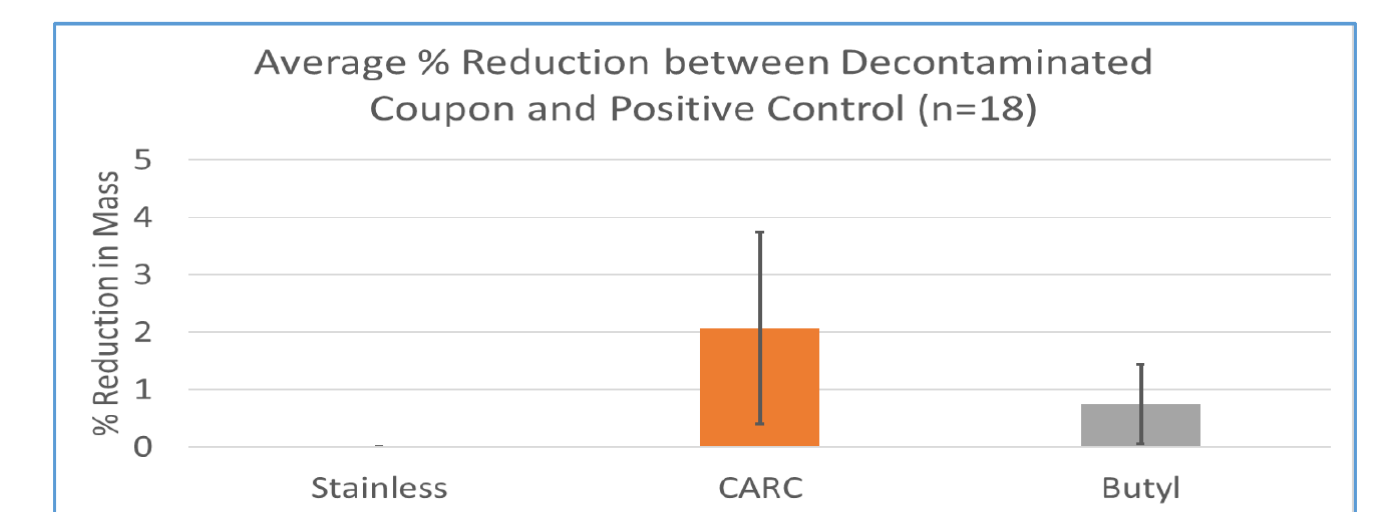
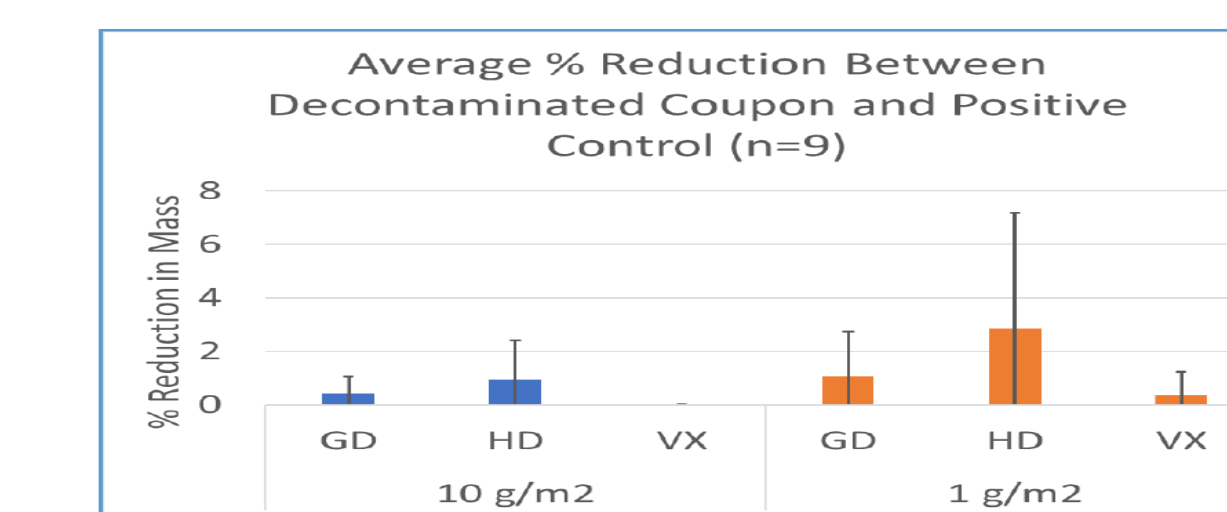
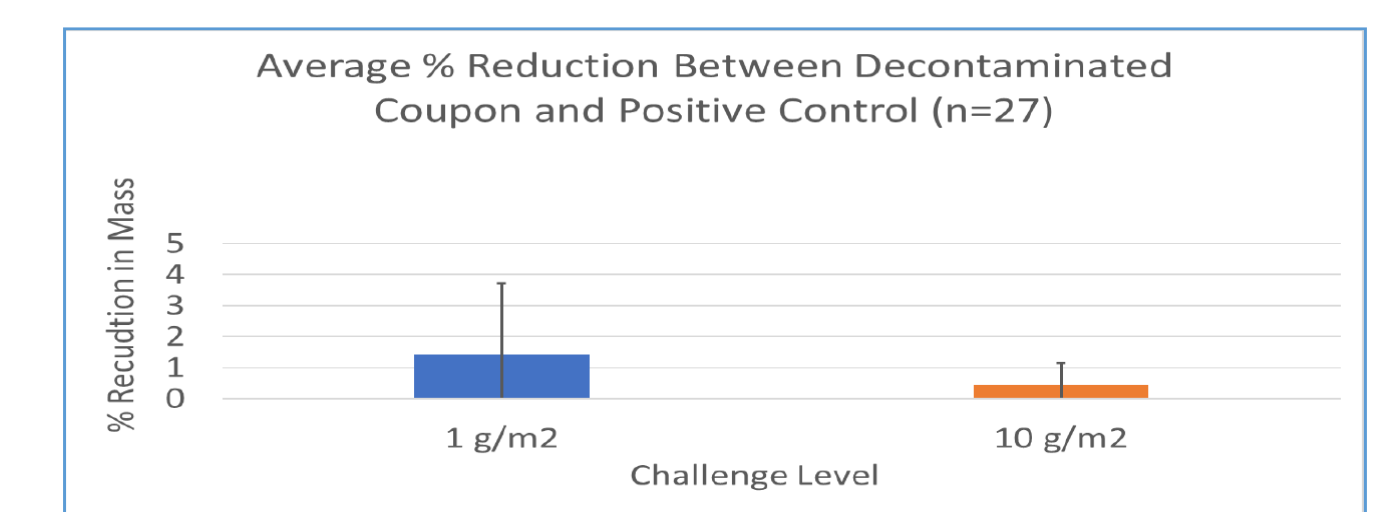
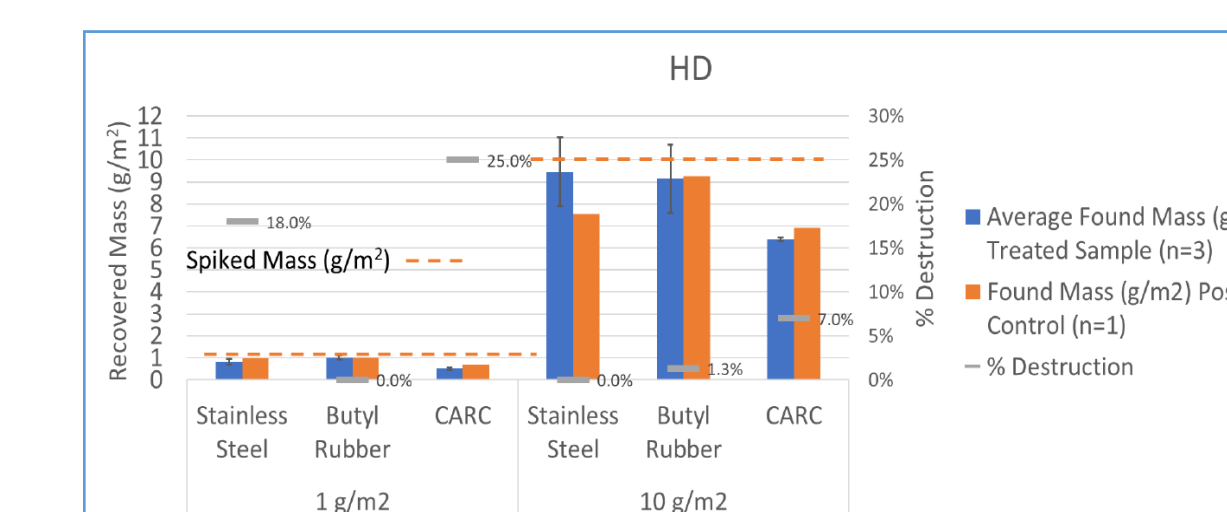
Method Spike -Samples spiked with target chemical and carried through the process without the decontamination product. When a neutral product can replace the decontamination product it should be used (water for liquid decontamination product)



Sample Quenching: To ensure the reaction has stopped once the sample is extracted a decontamination sample is prepared and analyzed, the same sample vial is analyzed at multiple time points (encompassing the longest wait time a sample could have between preparation and analysis).

Reporting

Final reporting of data should evaluate variables in multiple ways to draw conclusions.



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