The Effects of Contaminant-Aging on Decontamination Efficacy for Rapid Remediation of Concrete Surfaces

Katherine Hepler | *Argonne National Laboratory*

The time between contamination and decontamination allows contaminants to chemically bind to contaminated surfaces and/or penetrate into the subsurface of contaminated materials. These processes, herein referred to as contaminant aging, pose a problem for effectively decontaminating porous urban materials. In this work, we evaluated the decontamination efficacy of two decontamination methods on concrete samples contaminated with soluble cesium and silica particles with 0.5 μm and 2 μm diameters. Concrete samples were aged between 1 and 59 days, with half of the coupon receiving 1 mL of artificial rainwater about once every three days. After aging, coupons were either decontaminated or analyzed to determine contaminant penetration depths. Decontamination methods were performed in quintuples for two decontamination methods: 1) flowing 0.1M KCl wash solution across coupon surfaces for 15 min or 2) pressurized washing with 0.1M KCl solution using a 2000psi/1.2GPM power washer fitted with a 15 degree nozzle held 27 cm above coupon surfaces for about 5 seconds per coupon. Contaminant depth profiles were created by removing the top surface of the coupon at least 20 times, measuring the activity in each removed layer, normalizing the total activity removed to the measured decontamination efficacy following the last layer removal, and determining the penetration thickness using the coupon dimensions, bulk density, and mass of material removed for each layer.

Soluble cesium removal steadily decreased over the first ten days until it reached low values (<10% removal) for samples aged without precipitation events and decontaminated by flowing solution across their surfaces. Introducing precipitation events halved the time to reach the lowest removal values. Particulate removals were mostly constant for the entire aging time and pressurized washing outperforming flow decontamination. A slight decrease in particle removal was observed after samples were exposed to the solution. We suspect particle decontaminated decreased following the initial exposure to solution either because particles settled into depressions along the coupon surface or migrated into the concrete subsurface via capillary pores. Overall, this study aims to provide additional insight on predicted decontamination efficacy over time and through that understanding aid in creating effective remediation strategies.