Temperature Controlled Radiological Decontamination

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Introduction

In the efforts to clean up during a nuclear catastrophe, there is need for an immediate response plan to reduce or eliminate contamination. During such emergencies, effective solutions can vary and materials and supplies can be difficult to obtain. With such a large variation of surfaces in a typical urban setting, experiments need to be done to conclude a clear strategy for cleaning these variations of materials and surfaces. It is particularly important for an immediate response to be established to help those get back into their homes and businesses as quickly as possible. For this reason, this study seeks to analyze the methods establishing the most useful means of decontamination. This test is to establish the usefulness of ionic washes at different temperatures on materials contaminate with radioactive Cs-137

Test Details

Fine & Coarse Aggregate Tests:

- 1.0g of fine or coarse aggregate was separated into each 2.0mL micro centrifuge tubes, one for each temperature chosen:
  - 5°C, 20°C, 40°C, 60°C, and 90°C
- Aggregate was contaminated with Cs-137
- Aggregate is decontaminated by adding 1.0mL of Ionic wash solution (0.1 M KCl) via pipette.
- Next, duplicate 25uL aliquots of the decontamination solution are taken from each tube and transferred into respective gamma tubes containing 975uL of deionized water for each time step:
  - 0 min, 10, 60, 120, and one day
- The tubes then are counted directly on the Ortec (HPGe) & Wizard (NaI) detectors.

Solid Coupon Static Tests:

- Cylindrical coupons of concrete crafted:
  - Quikrete: 51.23% coarse aggregate, 15.51% fine aggregate
  - 1" height, 1" diameter
  - Cured for 90 Days.
- Coupons were contaminated with Cs-137 by pipette and counted (Ortec)
- Coupons were placed in an ionic wash solution (0.1 M KCl) kept at temperature:
  - 20°C, 40°C, 60°C, and 90°C
- Dual aliquots were taken from solution at:
  - 10, 15, 30, 60, and 120min
- Coupons also counted (Ortec) at 60min and 120min

Results

Fine & Coarse Aggregate Tests

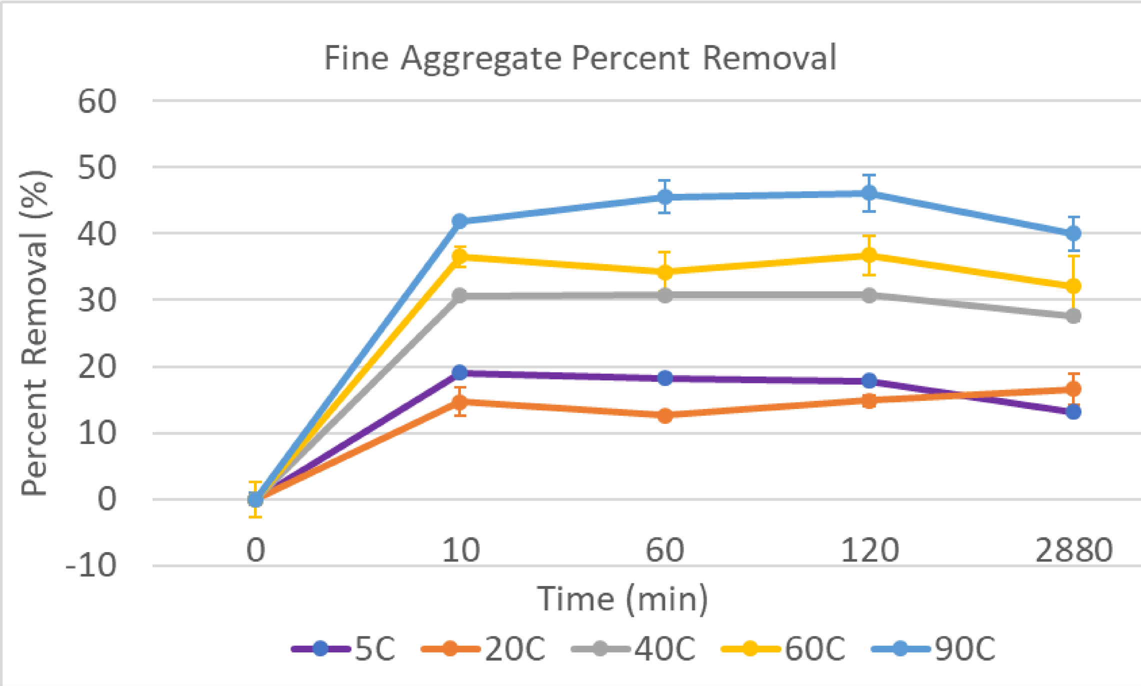

Figure 1: Percent removals on fine aggregate at each temperature over 2 days. T=0 is the contamination step, before any decontamination.

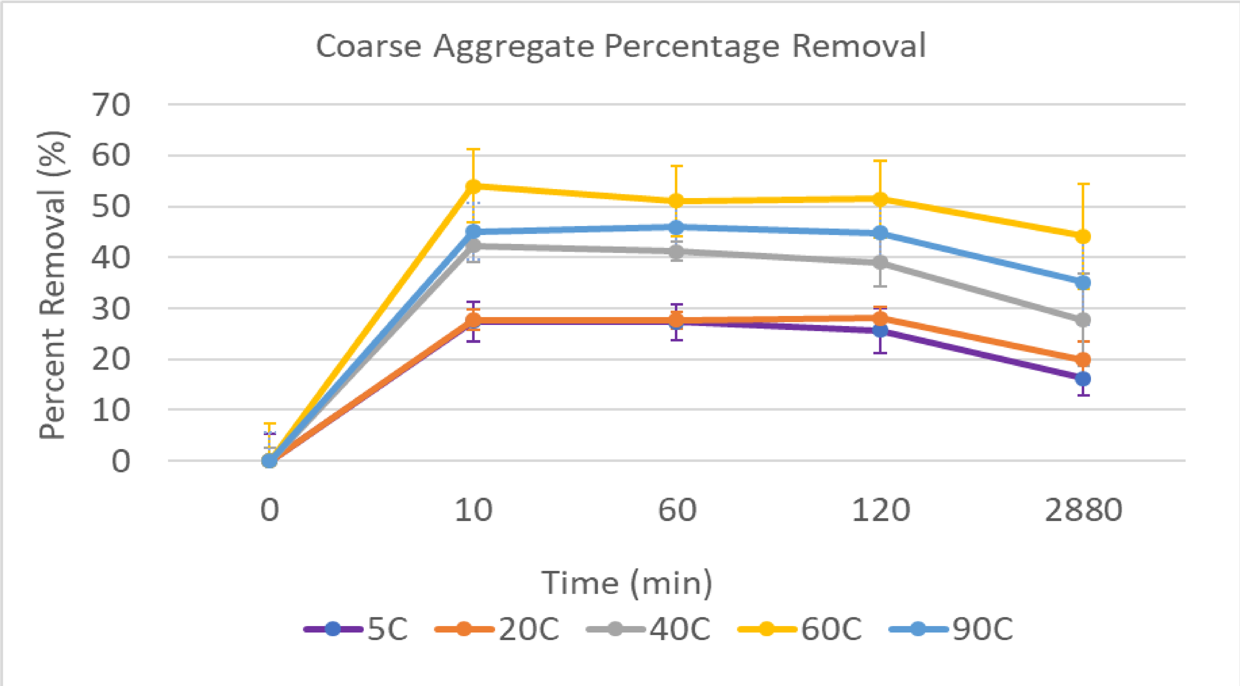

Figure 2: Percent removals on coarse aggregate at each temperature over 2 days. T=0 is the contamination step, before any decontamination.

Solid Coupon Static Tests

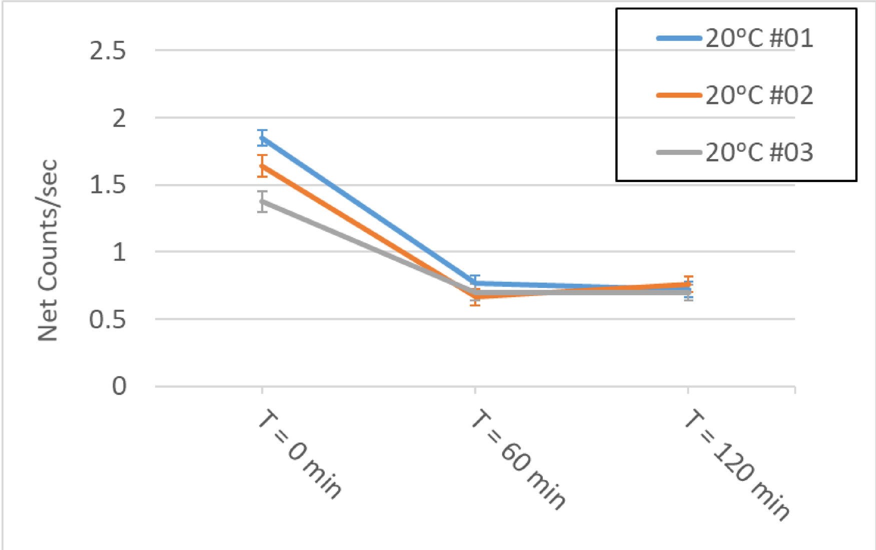

Figure 3: Net counts/sec above background from the triplicate coupons at each time step for 20 ̊C. In these graphs, T=0, would be the contamination step, before any decontamination.

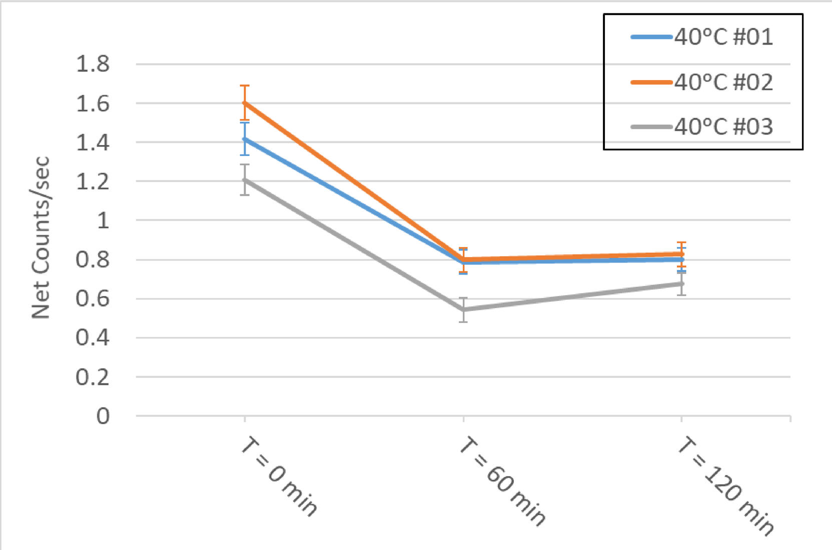

Figure 4: Net counts/sec above background from the triplicate coupons at each time step for 40 ̊C. T=0, would be the contamination step, before any decontamination.

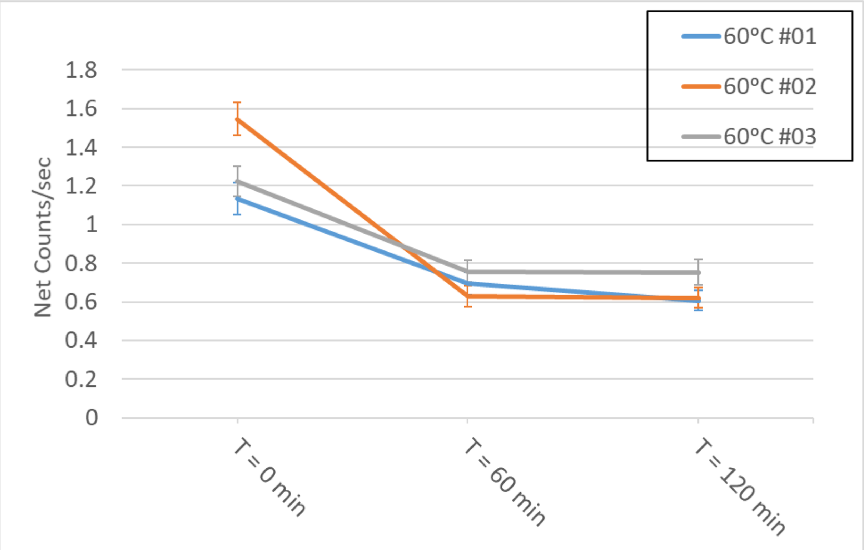

Figure 5: Net counts/sec above background from the triplicate coupons at each time step for 60 ̊C. T=0, would be the contamination step, before any decontamination.

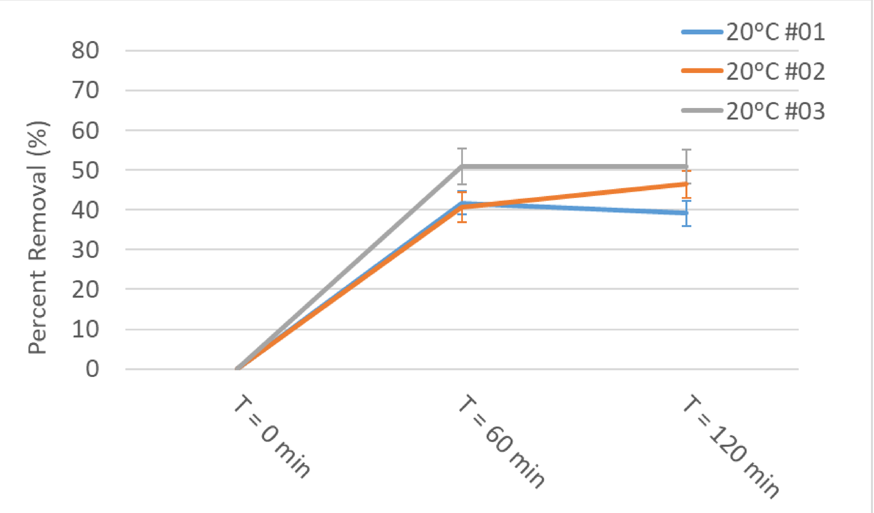

Figure 6: Percent removals on the triplicate coupons at each 20 ̊C over 2 hours. T=0, would be the contamination step, before any decontamination.

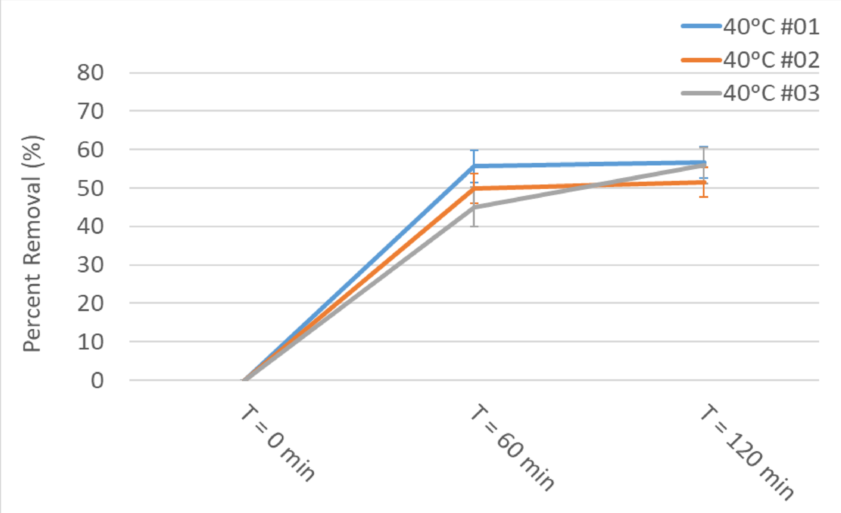

Figure 7: Percent removals on the triplicate coupons at each 40 ̊C over 2 hours. T=0, would be the contamination step, before any decontamination.

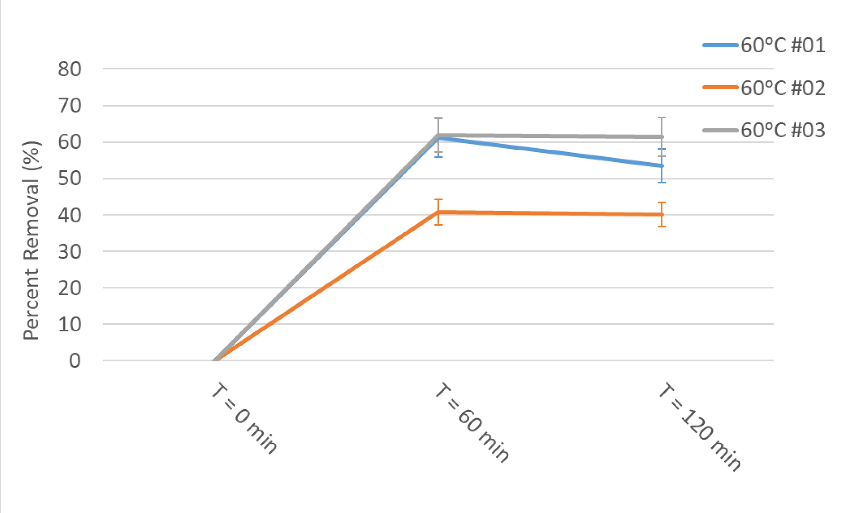

Figure 8: Percent removals on the triplicate coupons at each 60 ̊C over 2 hours. T=0, would be the contamination step, before any decontamination.

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Results

Fine & Coarse Aggregate Tests

These tests showed that for fine aggregate as temperatures increase, the removal increases. Coarse aggregate differs. As temperature increases, percent removal does as well, but only up to a certain temperature. Above 60 degrees, the percent removal decrease. It appears the best temperature for decontamination is between 60 and 90 degrees Celsius.

Solid Coupon Static Tests

For this test we can see that as temperatures are increased, the percent removals also increase. Further tests to increase temperature are needed.

This data also shows, at higher temperatures the majority of removal happens within the first 60 minutes and afterwards the decontamination of the surface is almost negligible with percent removals dipping down under 5%.

Future plans

The next steps are to run solid coupon static tests up to 90 degrees Celsius to find the temperature most efficient for decontamination.

Next, I would like to run a set of flow tests, using a flowing ionic wash to test removals on the similarly made solid coupons from the static tests. This test will give percent removals, hopefully higher than static tests.

Also, I would like to run tests with pressurized water on similar solid coupons. This would be to compare flow and static tests with percentage removals for high pressure test.

References

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