Decay of clusters and single spores of *Bacillus anthracis* Sterne in air, on surfaces and in simulated aerosol state and exposed to environmental factors

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Introduction: The environmental fate of organisms in the environment is of great importance to the military and the general population for exposure assessment and decontamination purposes.

Objective: This study was conducted to determine the effect of UVC and solar radiation exposure, temperature, and relative humidity on the survival of bacteria spore clusters and single spores on surfaces, in air and in simulated aerosol state.

Methodology: *Bacillus anthracis* Sterne spores were suspended as aerosol, pipetted onto surfaces, or aerosolized and deposited onto surfaces (including membrane filters, quartz slides and fibers). Organisms were exposed to either UVC or simulated solar light for various lengths of time. Reference samples were prepared similarly but were not exposed to UV light. Loss of viability in exposed and unexposed samples were analysed using the culture method and the amount of decay was calculated for each exposure condition.

Results: The results indicated that the culturable fraction decreased with increased exposure time. UVC exposure results indicated that it is easier to kill single spores and smaller size clusters on surfaces and in air compared to larger size clusters. Solar exposure results indicated that the clusters on surfaces have similar decay curves. Spores on quartz slides have similar decay curve shape as the spores on filters. On the other hand, the decay curve of spores on fibers decreases and then plateaus as the exposure increases. Temperature and RH tests indicate that higher survival fraction is observed in lower temperature and higher RH conditions. Lower survival was observed in higher temperature and lower RH conditions. Data from this study will be useful in algorithm development, improved modelling and validation.

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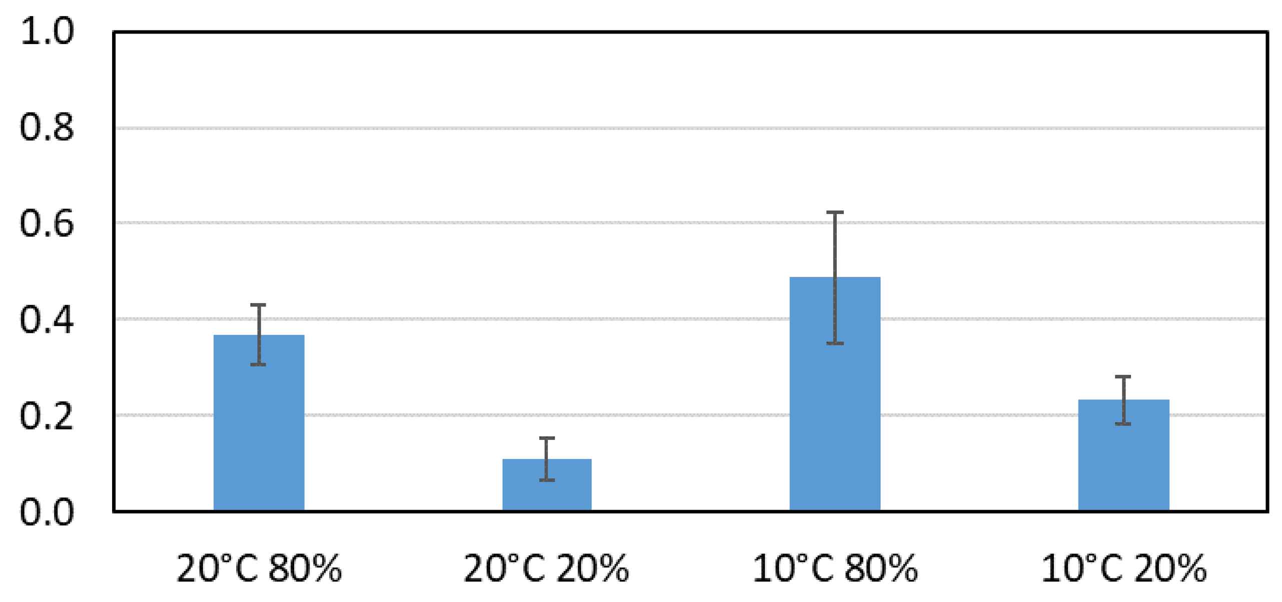
These data exhibit slow initial loss of viability known as the "shoulder" region as the exposure dose, or radiation fluence, increases from zero. However, at higher fluence, the SF decreases more rapidly with an apparent exponential decay, represented as a straight line on a logarithmic/linear plot of SF vs. fluence. A mathematical expression commonly applied to these types of measurements is given by a Multi-Hit model:

$$SF = 1-[1-\exp(-kF)]^n$$

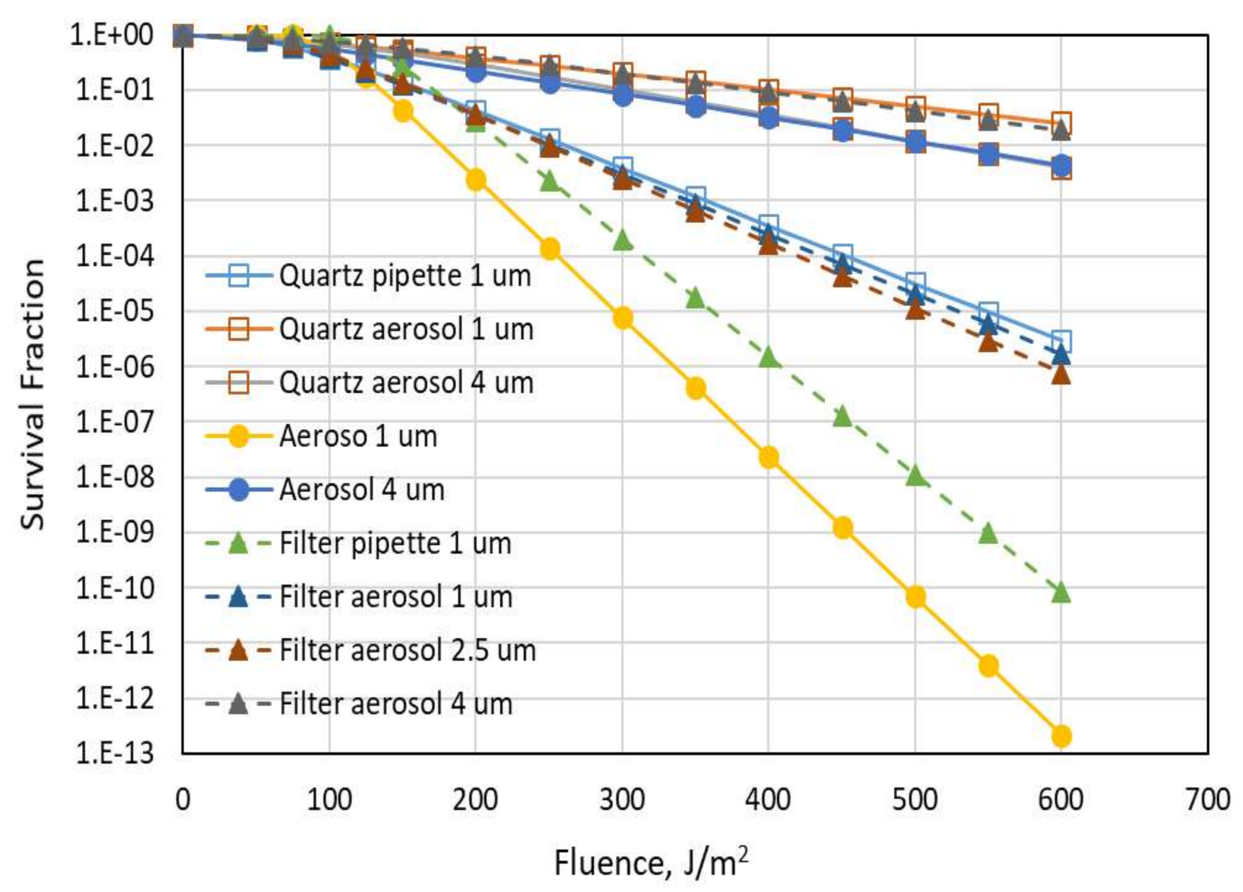
SF – survival fraction; F – fluence; k – decay rate; n – recovery factor. k and n values are provided in tables.

Solar dose was calculated for 280-400 nm wavelengths

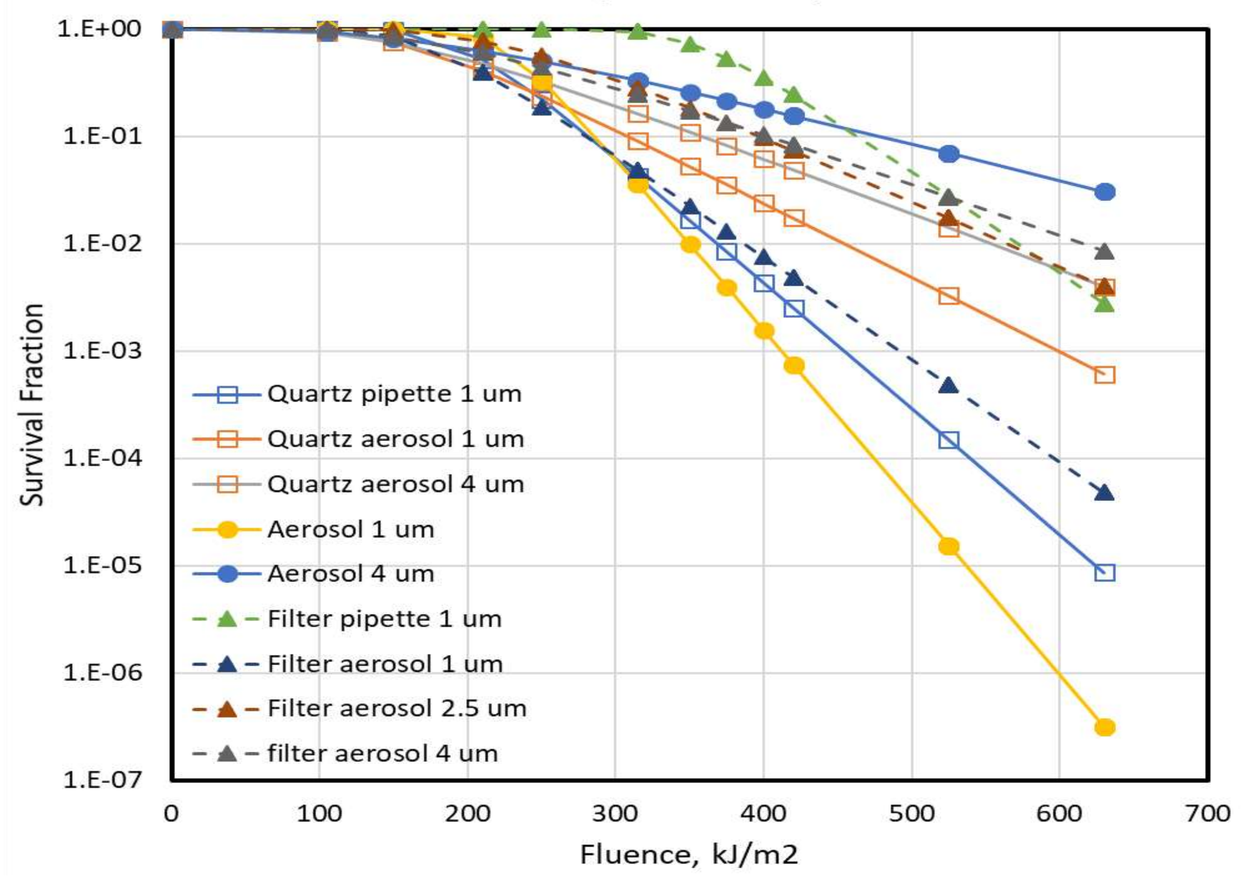
Effect of T and RH on Ba Sterne Pipetted on to a Filter and Exposed Solar Light



Ba Sterne Decay with UVC Exposure



Ba Sterne Decay with Solar Exposure



k and n values for UVC exposure

	k (m^2/J)	n
Quarts pipette1 µm	-0.024	5.23
Quartz aerosol 1 µm	-0.007	1.70
Quartz aerosol 4 µm	-0.011	2.96
Aerosol 1 µm	-0.058	278.10
Aerosol 4 µm	-0.010	1.76
Filter pipette 1 µm	-0.049	490.00
Filter aerosol 1 µm	-0.025	5.51
Filter aerosol 2.5 µm	-0.027	8.24
Filter aerosol 4 µm	-0.008	2.35

k and n Values for solar Exposure

	k (m^2/kJ)	n
Quarts pipette1 µm	-0.027	211.26
Quartz aerosol 1 µm	-0.016	14.54
Quartz aerosol 4 µm	-0.012	7.63
Aerosol 1 µm	-0.037	4182.80
Aerosol 4 µm	-0.008	4.75
Filter pipette 1 µm	-0.022	2888.00
Filter aerosol 1 µm	-0.022	49.90
Filter aerosol 2.5 µm	-0.014	27.20
Filter aerosol 4 µm	-0.011	8.76

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