Contribution ID: **365** Type: **Poster**

Pulsed Ultraviolet Light Decontamination of Artificially-Generated Microbiological Aerosols

Wednesday 21 June 2017 13:30 (1h 30m)

Airborne transmission of infectious organisms is a major public health concern, particularly within healthcare and communal public environments. Methods of environmental decontamination utilising pulsed ultraviolet (UV) light are currently available, however it is important that germicidal efficacy against airborne contamination is established. This study demonstrates evidence of the dose-response kinetics of airborne bacterial contamination when exposed to pulsed UV-rich (PUV) light.

Bacterial aerosols (*Staphylococcus epidermidis*) were generated using a 6-Jet Collison nebuliser, and introduced into a custom-designed aerosol chamber which enabled prolonged airborne suspension and circulation. Bacterial aerosols were exposed to short duration pulses (˜20 µs) of UV-rich light emitted from a xenon-filled flashlamp. The lamp was operated using a 1 kV solid–state pulsed power source, with a pulse frequency of 1 Hz, and output energy of 20 J/pulse. Post-treatment, air samples were extracted from the chamber using a BioSampler liquid impinger, and the surviving fraction was enumerated using standard microbiological culture methods.

Results demonstrate successful aerosol inactivation, with a 66.4% reduction achieved with only 10 pulses of UV-rich light (P=<0.0002). Inactivation using continuous UV light was also investigated in order to quantify the comparative efficacy of these antimicrobial light regions. In addition to determining the inactivation kinetics, the spectral outputs of the pulsed and continuous UV sources were captured and compared in order to assess their comparative UV-C content, and subsequently assess how this UV content relates to their germicidal efficiency.

Overall, results provide evidence of the dose-response kinetics of bacterial aerosols to PUV-rich light. As with continuous UV light, safety restrictions limit its application to unoccupied environments, or within sealed enclosures such as air handling units, however the reduced treatment times with PUV provides operational advantages over continuous light treatment.

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Session Classification: Poster session III - Pulsed Power Industrial and Bio-Medical Applications

Track Classification: Pulsed Power Industrial and Bio-Medical Applications