



Development and Evaluation of “Safe, Affordable, Friendly, and Effective” UVC Sterilizer for Reusing N95 Medical Masks

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Abstract

The shortage of NIOSH-approved N95 FFRs (filtering facepiece respirators) become a raised concern to healthcare-workers during COVID-19 pandemic. The ultraviolet germicidal irradiation (UVGI) has been recommended by CDC to reuse medical mask. This study aims to develop UVC germicidal cabinet to sterilize N95 FFRs with 4 to 5 log reduction without losing properties. *Methodology*: UVC germicidal cabinet is fitted with 2 low-pressure mercury discharge lamps (UVC T8, 40W) at the top and bottom. The radiometric performance tests were conducted and calculated exposure time for decontamination was calculated targeting 1 J·cm⁻² or 10 000J·m⁻². Four samples of 1870+N95 3M™ were selected to decontaminate and tested after decontamination. *Result*: The peak wavelength of UVC light source is 253.89 nm ± 0.60 nm with UVC irradiance value in the range from 6.56 W·m⁻² at P#9 to 17.9 W·m⁻² at P#5. The result showed no ozone production from the lamp after 1-hour monitoring with ≤1% instability after 6 minutes of lamp operation. The calculated time is 564.961 sec or 10 minutes according to maximum UVC irradiance at P#5 (17.9 W·m⁻²) resulting in UVC dose of 3 463.21 J·m⁻² at minimum UVC irradiance at P#9 which still exceed D₉₀ values. No visible change and unfavorable odor were detected up to 12 cycle. The SEM showed no significant change up to 10 cycle, the distortion and fusion became obviously at cycle 15 and totally damaged at cycle 16 correlated with % filtration efficiency which below 95%; 90.407 0% at 16 cycle at the maximum point "P#5". *Conclusions*: This study demonstrated decontamination of N 95 FFRs in dose 1 J·cm⁻² up to 10 cycle without losing properties and recommend to put on the center of UVC germicidal cabinet to gain targeted dose. Prospective studies with more models of N 95 FFRs are required and the strength test of respiratory coupons and straps are recommended.

Keywords: ultraviolet germicidal irradiation (UVGI), UVC, COVID-19, FFRs (filtering facepiece respirators), N95 respirators.