World Academy of Science, Engineering and Technology
International Journal of Health and Medical Engineering
Vol:12, No:11, 2018

Characterizing Nanoparticles Generated from the Different Working Type and the Stack Flue during 3D Printing Process

Authors : Kai-Jui Kou, Tzu-Ling Shen, Ying-Fang Wang

Abstract : The objectives of the present study are to characterize nanoparticles generated from the different working type in 3D printing room and the stack flue during 3D printing process. The studied laboratory (10.5 m× 7.2 m × 3.2 m) with a ventilation rate of 500 m^3/H is installed a 3D metal printing machine. Direct-reading instrument of a scanning mobility particle sizer (SMPS, Model 3082, TSI Inc., St. Paul, MN, USA) was used to conduct static sampling for nanoparticle number concentration and particle size distribution measurements. The SMPS obtained particle number concentration at every 3 minutes, the diameter of the SMPS ranged from 11~372 nm when the aerosol and sheath flow rates were set at 0.6 and 6 L/min, respectively. The concentrations of background, printing process, clearing operation, and screening operation were performed in the laboratory. On the other hand, we also conducted nanoparticle measurement on the 3D printing machine's stack flue to understand its emission characteristics. Results show that the nanoparticles emitted from the different operation process were the same distribution in the form of the uni-modal with number median diameter (NMD) as approximately 28.3 nm to 29.6 nm. The number concentrations of nanoparticles were 2.55×10^3 count/cm^3 in laboratory background, 2.19×10^3 count/cm^3 during printing process, 2.29×10^3 count/cm^3 during clearing process, 3.05×10^3 count/cm^3 during screening process, 2.69×10^3 count/cm^3 in laboratory background after printing process, and 6.75×10^3 outside laboratory, respectively. We found that there are no emission nanoparticles during the printing process. However, the number concentration of stack flue nanoparticles in the ongoing print is 1.13×10^6 count/cm^3, and that of the non-printing is 1.63×10^4 count/cm^3, with a NMD of 458 nm and 29.4 nm, respectively. It can be confirmed that the measured particle size belongs to easily penetrate the filter in theory during the printing process, even though the 3D printer has a high-efficiency filtration device. Therefore, it is recommended that the stack flue of the 3D printer would be equipped with an appropriate dust collection device to prevent the operators from exposing these hazardous particles.

Keywords : nanoparticle, particle emission, 3D printing, number concentration
Conference Title : ICOHS 2018 : International Conference on Occupational Health and Safety
Conference Location : Tokyo, Japan
Conference Dates : November 12-13, 2018