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Abstract

MICROORGANISM CONTROL FOR AIR CONDITIONING SYSTEMS
USING ULTRA-VIOLET LIGHT

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Microorganism, such as the common yeast and mold or the dangerous tuberculosis (TB) is in fact a potential health threat to the occupants working in the indoor environment. Nowadays, most of the people work in indoor environment equipped with air conditioning systems. If the air-handling unit (AHU) of the central air conditioning system is lacked of proper maintenance, due to the dark-moist condition inside and the dust-microorganism collected in the filter within the unit, microorganism will have a perfect condition to generate and duplicate in large amount. The microorganism will be transferred from AHU to the occupying zone through the air duct. Currently, the common methods used in microorganism control are (1) ventilation method and (2) filtration method. Both methods are high in cost. The use of ultra-violet light for microorganism control may be the most cost-effective way. This study experimentally investigates the usage of ultra violet light in microorganism control using an environmental chamber with a scale down AHU under different air experimental conditions. Favourable conditions for the growth of microorganism are generated within the AHU and the chamber before the activation of the UV light. The UV light was also applied to a classroom equipped with HVAC system in order to evaluate the effectiveness of UVGI for the real environment. Air samples are collected under different experimental conditions in sampling agar dishes using an impact type air sampler. Total bacteria count (PCA) and yeast and mold count (PDA) are measured in terms of colony forming unit (CFU). The experimental results show that the microorganism reduction rate is a function of the intensity of the ultra violet light, the air velocity, and the temperature of the air. When the experimental condition is set as no-fresh air, the microorganism can be reduced to a very low and safe level after 4 to 5 recirculated air changes. When the experiments are conducted under full-fresh air conditions, the microorganism reduction rate can be as high as 70 (PDA) to 95% (PCA) for low air velocity. In the real environment with occupants, it is observed that the microorganism concentration is directly proportional to the occupant's staying period. The longer the occupants stay in the conditioned space, the higher the microorganism concentration. However, the concentration is decreased right after the activation of UV lights. In general, as indicated by the experimental data, the utilization of UV light for microorganism control is very effective in HVAC system.

Keywords: Microorganism; HVAC; Ultraviolet light; Indoor air quality