Effects of Liquid Disinfectants on Aircraft Cabin Interior Materials

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Abstract

With the outbreak of the coronavirus disease (COVID-19) in December 2019, the airline industry implemented meticulous and frequent interior disinfection procedures to increase the passengers' confidence that they would not contract the virus while in an aircraft. However, the requirement for excessive use of liquid chemical disinfectants raised concerns on its potential negative impacts on material performance. Thus, there was a need to identify and evaluate the effect of liquid disinfectants on mechanical, flammability, and physical properties of materials used in an aircraft interior leading to the current research effort.

The materials and liquid disinfectants used in this investigation were selected in conjunction with the SAE Seat and SAE Cabin Interior Committee. Effect of five different liquid disinfectants was evaluated on twenty-eight commonly used aircraft interiors materials. Materials under consideration were conditioned using the submersion method or the wiping method. The submersion conditioning simulated accelerated cycle testing by submerging the test specimens fully in liquid disinfectants for extended time. After submersion, test specimens were allowed to dry at ambient conditions. The wiping conditioning simulated the real-world application of liquid disinfectants in an aircraft interior. This was achieved by wiping the test specimen by hand for 1000 cycles. The specimens were then allowed to dry between each cycle. After conditioning, change in specimen color, texture, and weight was documented for all test specimens.

Flammability performance was evaluated for every material by conducting a Vertical Bunsen Burner test with a 60-second flame exposure per 14 CFR § 25.853 Appendix F. For each combination of material and liquid disinfectant type, minimum of three specimens were tested. The purpose of these tests was to compare the flammability performance of the material when conditioned with liquid disinfectants against unconditioned specimens. This was achieved by defining criteria, which stated that if the increase in average burn length of conditioned specimens was less than or equal to 50% of the average burn length obtained from unconditioned specimens, the specimen would be considered "normally equivalent". Flammability properties of conditioned plastics, seatbelt webbings, synthetic leather, decorative laminates, carpets, and fiberglass laminates were considered equivalent to the unconditioned specimens based on the criteria. For natural leather and fabric materials, few liquid disinfectants yielded significantly different flammability properties in comparison to their corresponding unconditioned specimens.

Mechanical properties were only evaluated for structural materials and the required loading conditions were selected based on the material type. For each configuration, a minimum of five specimens were tested. For plastics and decorative laminates, the tensile properties were evaluated following ASTM D638. For honeycomb sandwich panels, three different loading conditions were evaluated which were flatwise compression (ASTM C365), long beam flexure strength (ASTM D7249), and climbing drum peel (ASTM D1781). For fiberglass laminates, two different loading conditions were evaluated, which were uniaxial tension (ASTM D3039) and short beam shear strength (ASTM D2344). Statistical evaluation with modified coefficient of variation was used to determine equivalency of conditioned specimen to unconditioned specimens.