Using Microscale Combustion Calorimetry as a Predictor for Radiant Panel Behavior of Insulating Microfiber Blankets

Fredrick Vance, PhD, Aearo Technologies LLC, a 3M company

Nurkan Turkdogru Gurun, PhD, Aearo Technologies LLC, a 3M company

Mary Colston, Aearo Technologies LLC, a 3M company

Eumi Pyun, PhD, 3M Company

Liyun Ren, 3M Company

The insulation of an aircraft in recent years has been accomplished with a relatively small number of well-known sets of fibers or foams, limited most notably by their flammability characteristics. These materials provide the required thermal performance along with acoustic absorption suited to their purpose, whether it be in a commercial plane or a high-end luxury jet. Meanwhile, other markets like consumer apparel have benefited from the recent proliferation of polymeric microfibers, offering premium performance in the form of reduced weight, reduced thickness, or better tolerance to environmental insults like water and debris.

This study is focused on the early stage development of novel polymer-based microfiber blankets or webs suitable for cushioning, thermal insulation, and acoustic absorption in aircraft. Various fiber web constructions were evaluated with the aim of improving acoustic performance while meeting flammability requirements for airworthy certification. The fibers were constructed from a combination of materials including homopolymers and flame retardants, and the webs employed a combination of fibers varying in both composition and fiber size. Microscale Combustion Calorimetry (MCC) was employed to understand how various polymer components would impact flammability compliance as measured by the radiant panel test described in FAR 25.856(a) Appendix F Part VI. Preliminary results indicate that MCC does not definitively predict the radiant panel flammability outcome, suggesting that factors such as fiber size and web density control the kinetics of flaming combustion in these webs. These results could lead to improved sets of insulating materials suitable for aircraft use based on polymers with intrinsically higher heat of combustion and heat release capacity than the polymers these new insulating materials may displace.