Process Control Future State: How the Micro-Scale Combustion Calorimeter is changing how Industry Characterizes Flammability Properties

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Heat release testing of non-metallic raw materials is performed at The Boeing Company during Quality Control Receiving Inspection to ensure that flammability requirements have been met before parts can be fabricated. However, the Ohio State University (OSU) test method for heat release can often exhibit so much variation that the results obtained are often outside of requirements as defined in material specifications. When this occurs a non-conformance report is generated resulting in additional costs for sample preparation and testing. Over the past two years 65 NCRs have been generated with an estimated annual cost of around $130k.

A new methodology for heat release characterization of raw materials using the Micro-scale Combustion Calorimeter (MCC) method is reported. During the development phase of the MCC method for aerospace applications a side by side study of the relative precision of the OSU and MCC test methods testing was carried out using a set of common phenolic composite raw materials. The study afforded an estimated Coefficient of Variation of 6% and 1% respectively for OSU Two Minute Total and MCC Total Heat Release test results.

Unlike the OSU method, which only evaluates material heat release over a two minute period, the MCC test method will provide a measure of the total heat release of a material. This method also provides information on material heat release capacity, ignition temperature, and amount of charring generated during combustion. Flammability parameters, such as these, provide important support to ongoing IAMFTW activities directed towards developing standardized guidance utilizing the MCC method to assess a material change relative to flammability properties.

A novel data visualization software package has been developed to optimize the characterization of raw materials for their heat release properties. This software package has also been licensed by one of the commercial manufacturers of the MCC instrument. Boeing is now poised to replicate this testing technology to raw material suppliers, which will support a future state of Supplier Delegation for raw materials testing and the electronic transfer of flammability data.

Recent MCC results of thin composites and their constituent materials have been consistent with heat release as an additive property of non-metallic raw materials that can be characterized using the MCC method. The results from these studies are promising and point to the development of heat release libraries of raw materials. Searchable libraries would in turn provide designers with accurate heat release estimates for new material configurations.