Fire Properties Database of Engineering Plastics

S. Gandhi
Galaxy Scientific Corporation
Egg Harbor Township, NJ 08234-5562

Research Objective: To develop a database for the fire properties of commercial and developmental polymeric materials in order to better understand the relationship between polymer molecular structure and its flammability.

Approach: A database of the combustion properties of commercial well characterized polymeric materials is an integral part of the FAA's Fire Resistant Materials program. Such a database will provide the benchmark for new fire safe polymer system(s) that meet the FAA's fire performance goals for aircraft cabin materials. Flammability properties are determined for thermally-thick samples of a series of cyanate ester family of thermoset resins and nine thermoplastic materials which included polycarbonate, polyethylenenaphthalate, polyetherimide, polyamide-imide, polysulfone, polyphenlesulphide, polyphenylsulfone, polyetheretherketone (PEEK), and polyimide. Samples are tested at four heat flux levels, 35, 50, 75, and 100 kW/m^2 in horizontal configuration using the retainer edge frame per ASTM Standard E1354. The flammability measurements include ignition, heat release rate, burning character-- charring or non-charring using the oxygen depletion method in a Cone calorimeter. These measurements are further used to determine the material properties of heat of gasification and effective heat of combustion that relate to the polymer structure.

Accomplishment Description: Rate of heat release is the single most important parameter determining the fire hazard of a burning material because it relates to the survivability of the occupants in the cabin. The fire performance of cabin materials used in is assessed from their ignitability, heat release, and flamespread properties. It is seen that the rate of heat release depends upon the charring character of polymers greatly affects defined. This is evidenced by the distribution of surface cracks and high char integrity. A single peak HRR can not be characterized for engineering plastics that exhibit irregular, unsteady burning behavior. Typical heat release curves for the engineering plastics tested at 50 and 75 kW/m^2 are shown in Figure 1. The peak heat release rate of thick specimens is not a reliable fire parameter for characterizing the fire resistance of char forming thermoplastics. Steady-state (average) burning behavior, total heat release, and the heat of gasification are better indicators of the fire resistance of these char forming thermoplastic polymers.

Significance: The fire properties database provides a baseline for commercial plastics and components and a benchmark for newly developed fire resistant polymers.

Expected Results: A comprehensive database of the fire properties of state-of-the-art polymeric materials linked to the NIST Fire on the Web Internet site for use by aircraft manufacturers and material suppliers.

Reference:

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Point of Contact: Dr. Richard Lyon, AAR-422, FAA William J. Hughes Technical Center, Atlantic City International Airport, NJ 08405, 609-485-6076, FAX, 609-485-6909, e-mail: rlyon@admin.tc.faa.gov.

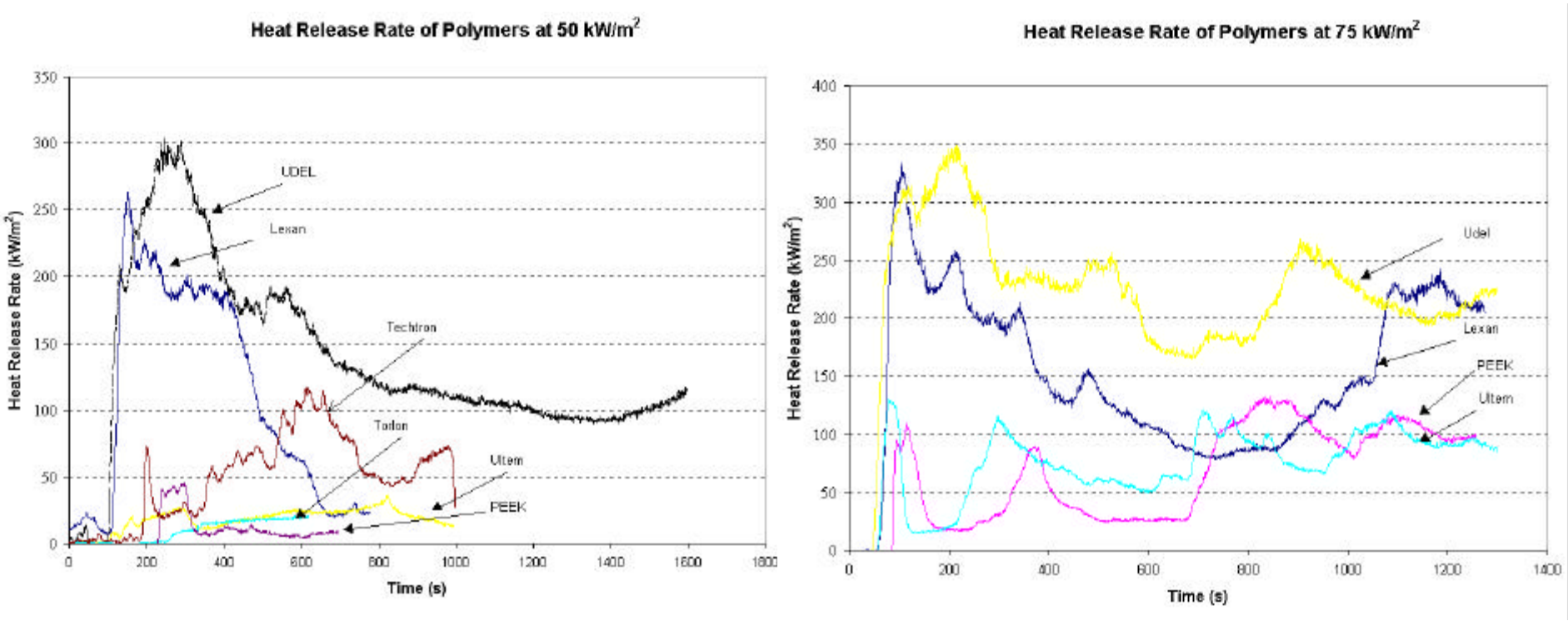

Figure 1. Heat Release Rate Curves for Engineering Plastics at 50 kW/m^2 and 75 kW/m^2.