Progress on the Campaign 2, Level-2 Milestone: "Kel-F 800 Experimental Characterization and Model Development"

Brad Clements, T-1

Kel-F 800 is the binding polymer for the explosive PBX-9502. The project "Polymer Behavior under Dynamic Loading," led by Project Leader Brad Clements under Program Manager S. Bingert, Los Alamos National Laboratory (LANL) Associate Directorate for Weapons Physics, of the Joint DoD/DOE Munitions Technology Development Program, is tasked with a Level-2 milestone deliverable for Campaign 2. The project members consist of a team of polymer and materials experts in LANL's Theoretical (T), Materials Science and Technology (MST), Weapons Engineering Technology (WT), and Dynamic and Energetic Materials (DE) divisions. The deliverable date is October 2007. The deliverables include:

I. Experimental data including stress-strain measurements over a wide range of temperatures and rates (compressive and tensile), Split Hopkinson Pressure Bar measurements, plate-impact measurements, Differential Scanning Calorimetry measurements, Dynamic Mechanical Analysis, specific volume measurements, heat capacity measurements, and fracture studies and analysis.

II. A physics-based continuum-level constitutive model that adequately predicts the strain rate and temperature dependence of Kel-F 800 (as determined by experiments listed above).

III. An assessment of the characterization properties of FK 800. (FK 800 is the Kel-F 800 replacement being manufactured by 3M Corporation.)

The model must adequately capture the correct equation of state and deviatoric response of Kel-F 800, will be implemented into the finite element code EPIC, and validation tests will be done. Kel-F 800 is a semi-crystalline polymer. We will report crystal volume fractions between 5% and 15%.

Good progress has been made in FY06 towards the completion of the milestone. In Figs. 1–3, experimental and theoretical information on high rate deformation (Fig. 1), the viscoelastic properties (Fig. 2), and uniaxial compression stress-strain measurements (Fig. 3) summarize some of the recent progress made by the team.

For more information contact Brad Clements at bclements@lanl.gov.

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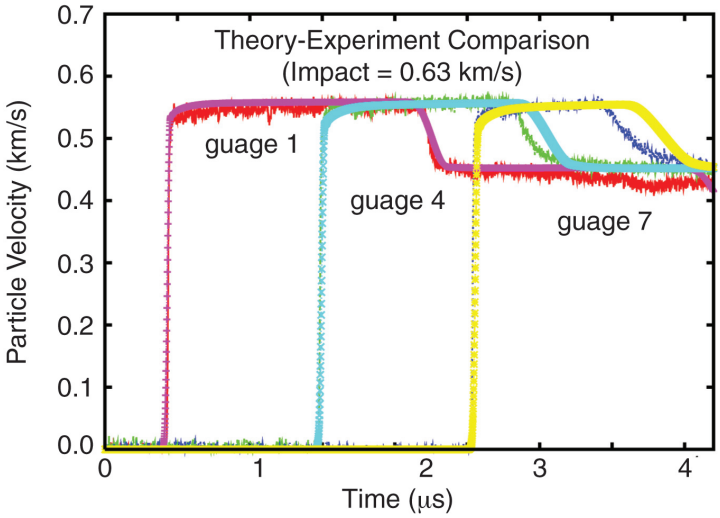

Fig. 1.
Experimental and theoretical particle velocity profiles for shocked Kel-F 800. The data are from DE Division (Dattelbaum, et al.).

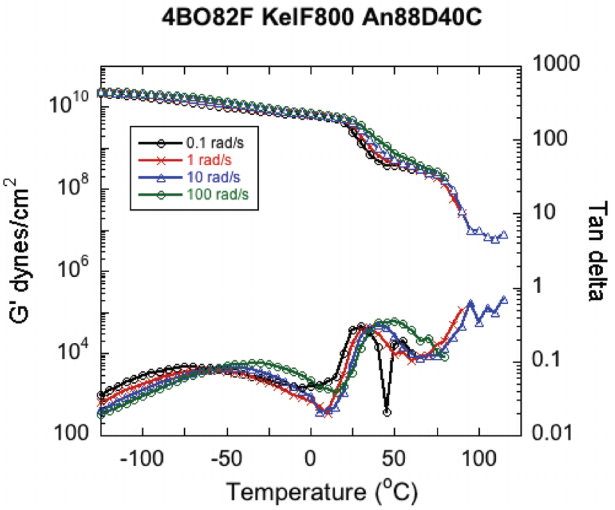

Fig. 2.
Storage modulus measurements from B. Orler from MST-7. These measurements give information on the viscoelastic response of Kel-F 800.

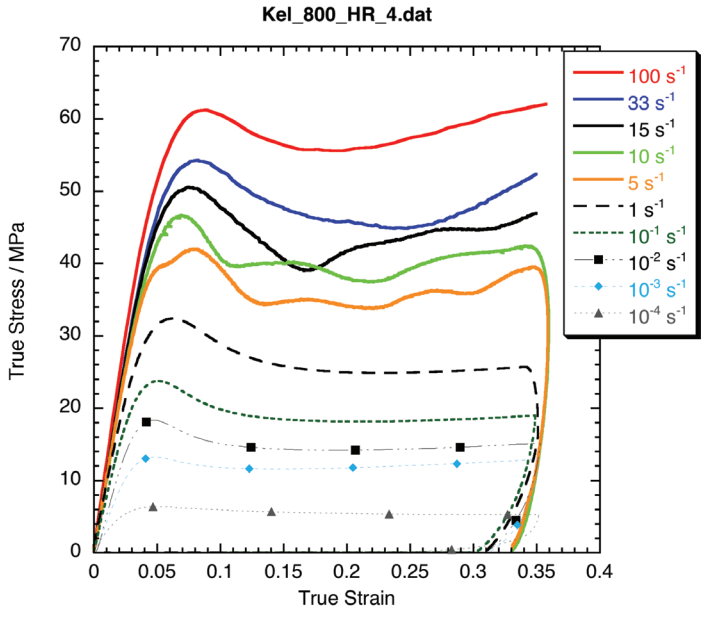

Fig. 3.
Stress-strain measurements from P. Rae and E. Brown of MST-8.