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Modeling shock-driven reaction in low density PMDI foam[1]

AARON BRUNDAGE, C. SCOTT ALEXANDER, WILLIAM REINHART, DAVID PETERSON, Sandia National Laboratories — Shock experiments on low density polyurethane foams reveal evidence of reaction at low impact pressures. However, these reaction thresholds are not evident over the low pressures reported for historical Hugoniot data of highly distended polyurethane at densities below 0.1 g/cc. To fill this gap, impact data given in a companion paper for polymethylene diisocyanate (PMDI) foam with a density of 0.087 g/cc were acquired for model validation. An equation of state (EOS) was developed to predict the shock response of these highly distended materials over the full range of impact conditions representing compaction of the inert material, low-pressure decomposition, and compression of the reaction products. A tabular SESAME EOS of the reaction products was generated using the JCZS database in the TIGER equilibrium code. In particular, the Arrhenius Burn EOS, a two-state model which transitions from an unreacted to a reacted state using single step Arrhenius kinetics, as implemented in the shock physics code CTH, was modified to include a statistical distribution of states. Hence, a single EOS is presented that predicts the onset to reaction due to shock loading in PMDI-based polyurethane foams.

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Aaron Brundage
Sandia National Laboratories

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