Phillip Hodge

Research project description

May 5th, 2010

Updating the NFPA 704 instability parameter to include pressure hazards

The quantification and communication of chemical reactivity hazards are essential for any safety analysis involving reactive materials. One recognized approach to rank reactivity hazards is the *National Fire Protection Association (NFPA) 704 Standard for the Identification of the Fire Hazards of Materials*. One parameter specifically used to describe the reactive potential of materials is the instability ranking. Previous work by Hofelich et. al. (1997) related the instability parameter of a material to its instantaneous power density (IPD) which represents the amount and rate of energy that can be released by a material under specific conditions. IPD methodology however can only consider the affects of temperature and does not include factors such as gas production and the pressure generation rate.

While exothermic reactions account for many chemical incidents, they are not the only factors to consider. For example, a nylon material with an instability ranking of 0 due to IPD methodology led to a thermally neutral decomposition reaction resulting in three fatalities. Investigations following the incident demonstrated that gas evolution caused by polymer decomposition led to a pressure buildup inside the catch tank. The chemistry of the the nylon material indicated probable generation of CO_2, H_2O, and NH_3 at high temperatures, but the significance of this hazard was not adequately recognized.

The goal of this project is to develop a practical and effective chemical reactivity rating system based around the current NFPA instability rating including both IPD methodology and pressure effects. Extensive experimental calorimetric data will be collected for a variety of representative materials using an automatic pressure tracking adiabatic calorimeter (APTAC). Data will be examined using both IPD methodology and pressure effects. A normalized index will be developed based on the mass of the starting material and the reactor head space, and then the materials will be sorted into five categories (0-4). These new categories will then be compared to the existing NFPA standards and the more conservative value will be recommended for rating the given material's instability. This will provide industry with a broader and more complete representation of the hazards associated with reactive chemicals especially those with endothermic characteristics.