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High Surface Area Oxidation – Development of an Improved Open Cup ARC Vessel and Validation

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Abstract

Easily oxidized, low volatility organic liquids absorbed/dispersed on inorganic solid materials such as insulation, absorbents, and molecular sieves can result in spontaneous ignition incidents. This is due to increased rates of oxidation of the organic when it is spread out over the very high surface area inherent in these types of solid materials. Similarly, high surface area organic solids that are either self-reactive or oxidizable may self-heat when accumulated in a pile of sufficient size, resulting in thermal runaways, gas generation, and/or fire. Understanding and quantifying this behavior is critical to identifying hazards and developing appropriate mitigative measures. Previously, an Open Cup Accelerating Rate Calorimeter technique was developed at Dow using an open, stainless steel container, purged with air heated to testing temperatures to maintain adiabaticity. This method has been used for many years to understand the reaction kinetics of "auto-oxidation" reactions and high surface area runaway reactions. While the method has been shown to be reliable and able to accurately predict large scale hazards, the exposure of the gaseous decomposition and oxidation products of the reactions is destructive to the ARC calorimeter. The open-cup system vents directly into the ARC, resulting in accelerated corrosion or potentially exposing the internals to fire. A new ARC container design has been developed that has been demonstrated to produce comparable results and removes the concerns associated with damaging the equipment. The new design of the Open Cup ARC test cell, validation, and discussion of the data application will be included in this article.