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Investigation of the Reactivity of Organic Materials in Liquid Oxygen

Many materials present an explosion hazard when subjected to impact, heat, or other sources of energy while in contact with liquid oxygen (LOX). The selection of materials for safe use in a LOX environment has previously been based on an arbitrary impact test. A research program has been conducted to define improved methods of selection, based on more complete knowledge of the mechanisms of ignition of materials in the presence of liquid oxygen. The program consisted of two phases, the first concerned with measurements of impact-ignition sensitivity using a modified drop-weight tester, and the second concerned with the relative reactivity of t-butoxy and t-butyl peroxy radicals toward a variety of organic compounds.

In the first phase, for 18 of the 24 compounds tested, a positive correlation was found between ignition sensitivity and flash point. Five other compounds exhibited a correlation between sensitivity and chemical reactivity in auto-oxidation. Similar results were obtained when the same group of compounds was subjected to hot-wire ignition tests. Fire retardant compounds (e.g., dibromomethane) were shown to reduce the ignition sensitivity when added to various of the tested compounds. High-speed photography of the impact ignition of benzyl alcohol provided evidence for a point-source (hot-spot) ignition mechanism.

In the second phase, a good correlation was observed between relative reactivity of both radicals toward five hydrocarbons. However, the correlation for four aliphatic hydrocarbon derivatives was not as good, suggesting that differing electronic requirements for these compounds is the major factor governing reactivity.

Note:

Requests for further information may be directed to:
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No patent action is contemplated by NASA.

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