Robust, Perchlorate-Free Propellants With Reduced Pollution (PP-1404)

The Problem: Ammonium Perchlorate Groundwater Contamination

Ammonium perchlorate (AP) is a widely used solid propellant binder and oxidizer in rocket motors. AP is also used in many other military and commercial applications such as matches, fireworks, and pyrotechnics. However, AP is a significant environmental contaminant, particularly in areas where AP-based propellants have been used, such as rocket testing ranges and manufacturing sites. AP has been identified as a Priority Pollutant under the U.S. Clean Water Act, and its disposal is regulated under the Resource Conservation and Recovery Act. AP is highly soluble in water and readily degrades aerobically, suggesting that its persistence in the environment is due to anaerobic degradation processes in water. A number of studies have reported the presence of AP in groundwater in areas where AP-based propellants have been used.

Propellant Formulation

Solid Rocket Propellant Characteristics

Solid propellants contain a fuel, an oxidizer, and an elastomeric binder. Solid propellants provide energy, stability, and bonds to the binder.

Solid Rocket Propellant Characteristics

Solid propellants require a combination of an energetic binder, a common oxidizer, and a polybutadiene rubber. Solid propellants require good mechanical properties in addition to good oxidizer properties.

AP Replacement Candidates

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ADN (Ammonium Dinitramide)

ADN is a high-energy material with a low density and high pressure exponent, making it an ideal candidate for replacement of AP. ADN is stable in shipping, storage, and use, and it is compatible with conventional propellant binders. ADN has excellent mechanical properties and is an excellent energetic material. ADN is also a human health concern, but its use is less widespread than AP.

Mechanical Properties Testing With Instron Test Machine

Mechanical properties of propellant formulation must satisfy many requirements for promising performance. Propellant formulation can be tested in open-air firing tests, rocket motors firings, and rocket testing range firings. The results of these tests provide valuable information about the performance of propellant formulations. For example, the burning rate of propellants can be measured in rocket motor firings. Rocket motor firings can also be used to test the structural integrity of rocket motors.

Conclusions

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The firing of small motors or rocket testing range firings typically uses a small motor. The firing of rocket testing ranges typically uses a large motor or rocket testing range firings. Rocket testing range firings are used to test the performance of propellant formulations. The results of these tests provide valuable information about the performance of propellant formulations. For example, the burning rate of propellants can be measured in rocket motor firings. Rocket motor firings can also be used to test the structural integrity of rocket motors.

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