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Studies of the Exhaust Products from Solid Propellant Rocket Motors

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Abstract: This study was undertaken to determine the feasibility of conducting environmental chamber tests on the physical processes which occur when a solid rocket motor exhaust mixes with the ambient atmosphere. Of particular interest was the interaction between hydrogen chloride, **aluminum oxide**, and water vapor. The program consisted of three phases: (1) building a small rocket motor and using it to provide the exhaust species in a controlled environment; (2) evaluating instruments used to detect and measure HCl concentrations and if possible determining whether the HCl existed in the gaseous state or as an acid aerosol; (3) monitoring a series of 6.4-percent scale space shuttle motor tests and comparing the results to the environmental chamber studies. Eighteen firings were conducted in an environmental chamber with the initial ambient relative humidity set at values from 29 to 100 percent. Two additional firings were made in a large shed, and four were made on an open concrete apron. Six test firings at MSFC were monitored, and the ground level concentrations are reported. Evidence is presented which shows that the larger Al2O3 (5 to 50 micrometers) particles from the rocket motor can act as condensation nuclei. Under appropriate ambient conditions where there is sufficient water vapor this results in the formation of an acid aerosol. Droplets of this acid were detected both in the environmental chamber and in the scaled shuttle engine tests.

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