Exposure of Time and Temperature Effects on HMX Explosive Powders

OWEN OIL TOOLS

Core Lab RESERVOIR OPTIMIZATION

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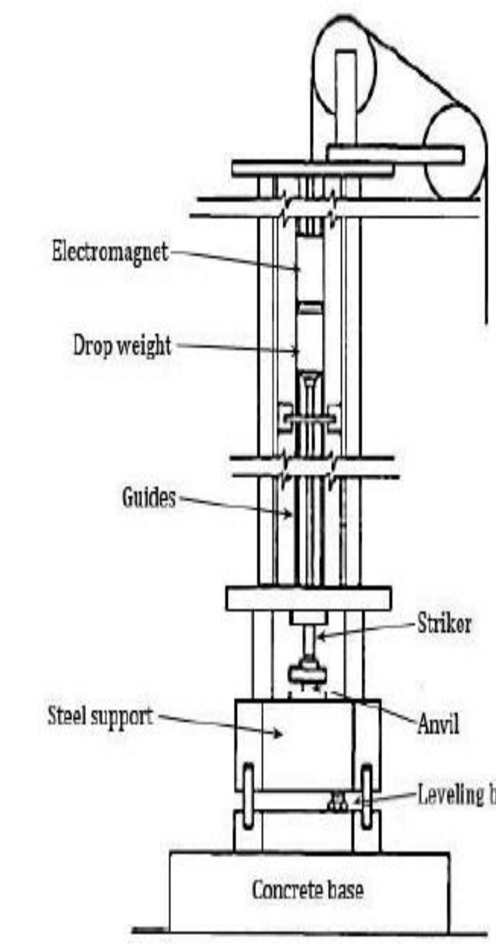
Background:

It is common practice to measure the impact sensitivity of explosive materials through a range of test methods. The primary value obtained is a H_{50} value, which is determined from the test results to be the height at which the material has a 50/50 chance of reacting. The focus of this research was to determine how the sensitivity changed for HMX powders as they were exposed to elevated temperature for a variety of time durations



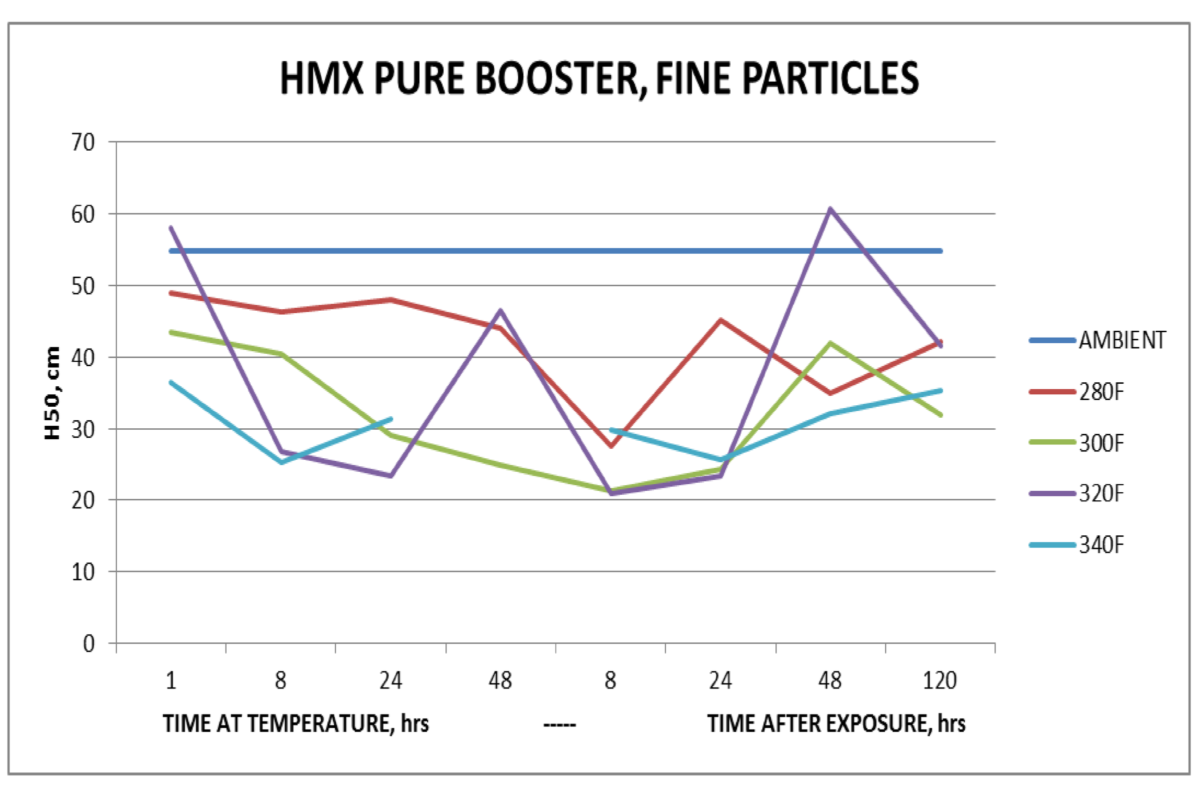
Test Apparatus and Setup:

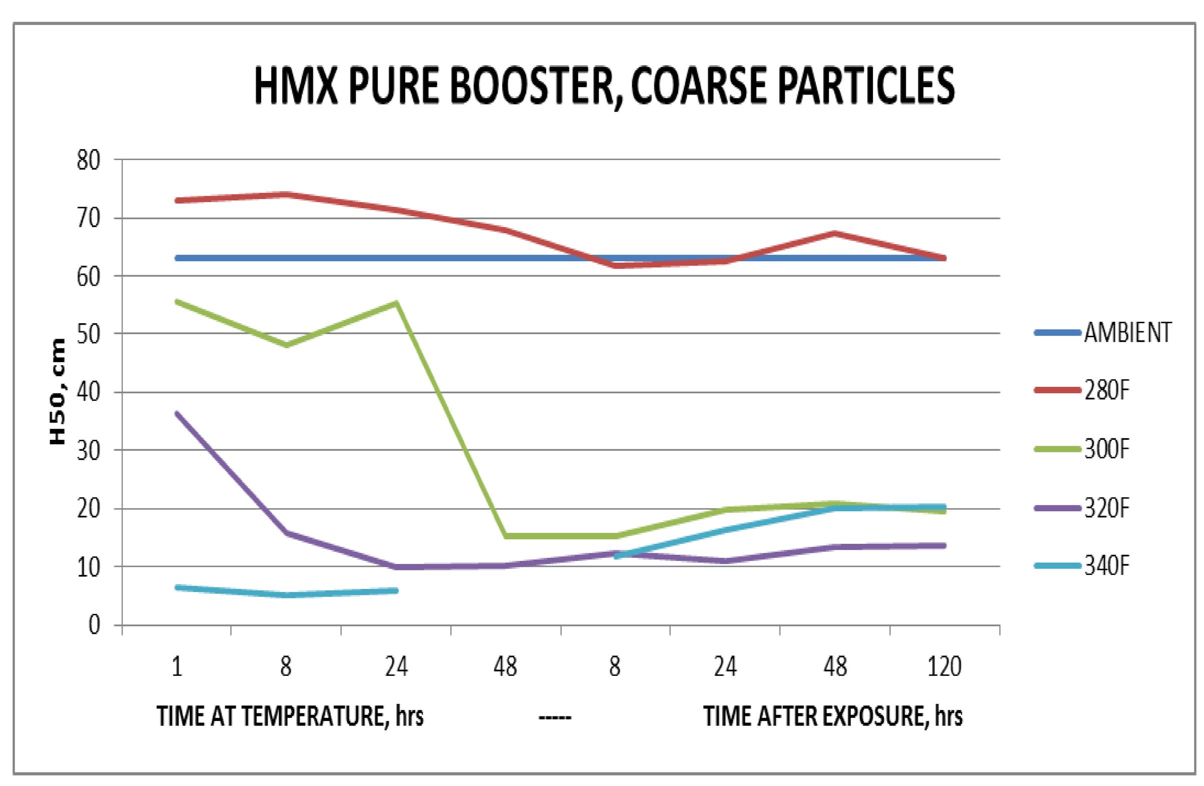
For the testing conducted here an ERL Type 12 Impact Test Apparatus was used. Three different types of HMX were tested: a Class 1 Booster, a Class 5/7 Booster, and a Mainload type HMX with binder materials.

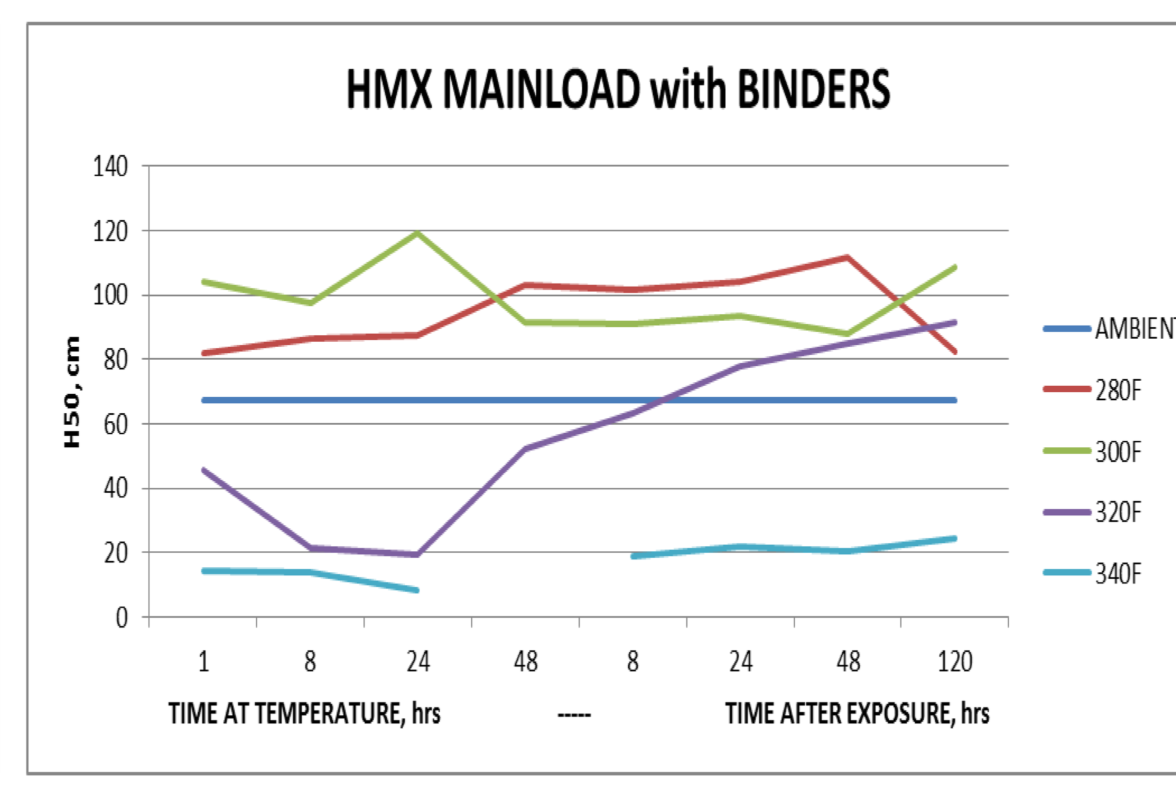
Test Method and Results:

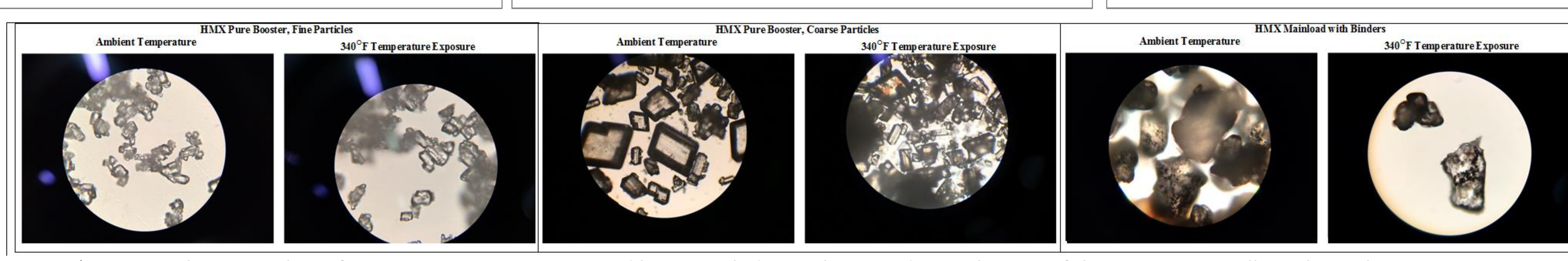
The test samples were placed in a controlled oven at 280F, 300F, 320F, and 340F for time periods of 1hr, 8hrs, 24hrs, and 48hrs. After each condition was met a sample was taken out and tested while at temperature, a minimum of 20 drops were conducted at each condition.

Additionally, after the 48hr temperature exposure the powder was allowed to cool back to ambient temperatures and tested at 8 hrs, 24 hrs, 48 hrs, and 120 hrs.









*Micrographs were taken after temperature exposure and being cooled to ambient and it can be seen if there was a crystalline phase change occurring.

What was found during testing is that the different powders saw changes in sensitivity at different rates, which was attributed to their particle sizes and purities. All powders saw increased levels of sensitivity as the time and temperature increased. The three graphs show when the sensitivity changed. The Booster, Coarse Particles, for example shows at 280F no change, 300F@24hrs, 320F@1-8hrs, and 340F@ <1hr.

Impact Sensitivity Drop Height Test Results			
HMX Boost, Fine Particles			
Temperature, °F	Ambient Sensitivity, cm	Highest Sensitivity, cm	% Change
280	54.83	27.51	66%
300	54.83	21.30	88%
320	54.83	21.00	89%
340	54.83	25.27	74%
HMX Boost, Coarse Particles			
Temperature, °F	Ambient Sensitivity, cm	Highest Sensitivity, cm	% Change
280	63.14	61.73	2%
300	63.14	15.18	122%
320	63.14	10.00	145%
340	63.14	5.05	170%
HMX Mainload with Binders			
Temperature, °F	Ambient Sensitivity, cm	Highest Sensitivity, cm	% Change
280	68.20	81.91	-18%
300	68.20	88.10	-25%
320	68.20	19.33	112%
340	68.20	8.18	157%

Conclusions:

- It appeared that it was not solely a variable of temperature that drove the change in sensitivity, but also time.
- The particle size had a drastic effect on the level of sensitivity.
- Even before the HMX may fully be in a Delta Phase Polymorph there is still an increased level of sensitivity.
- HMX perforating products need to be handled with care after temperature exposure because they may be more sensitive to initiation.

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