



U.S. Army Research, Development and Engineering Command



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**Analyzing Production Processes of Energetic Materials using
Ultrasound Technology-13805**

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Wes Cobb-NDIA IM/EM Symposium, Las Vegas, NV May 16th
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- Ultrasound technology recently developed at ARDEC has been applied to a number of R&D facilities
- Current efforts are in transitioning technology to GOCO's to improve manufacturing parameters
- BAE Holston, Picatinny Arsenal, and Applied Sonics Inc., based on past experience, have identified one type of probe which can measure a number of manufacturing process parameters
- Ultrasound probe is ready for transition to GOCO's and industrial manufacturers
- Melt cast technology under development will soon be ready for GOCO's as well
- Funding provided by PM JS and SBIR

- Probe produced two ultrasound readings: velocity and attenuation
- At Holston, most critical area identified was HMX recrystallization
- Probe can independently determine acetone/water ratio and solids loading

Pitch-catch Probe

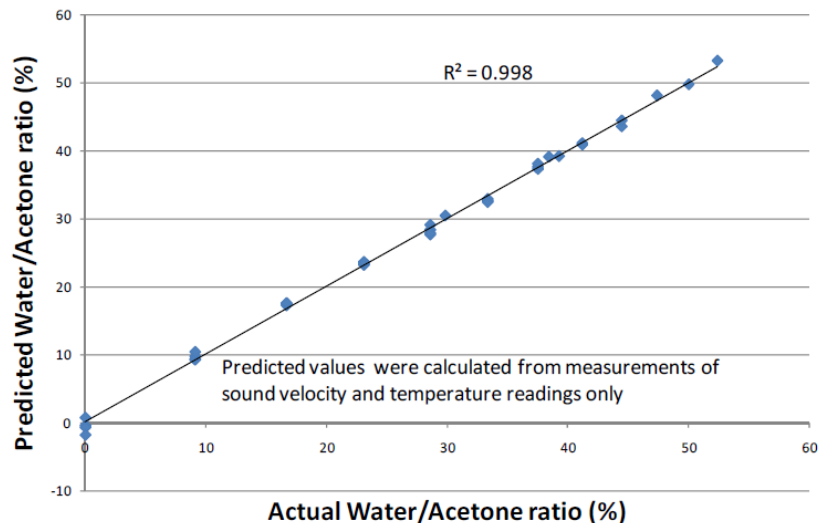


Transmitting sensors are sealed inside this side of gap

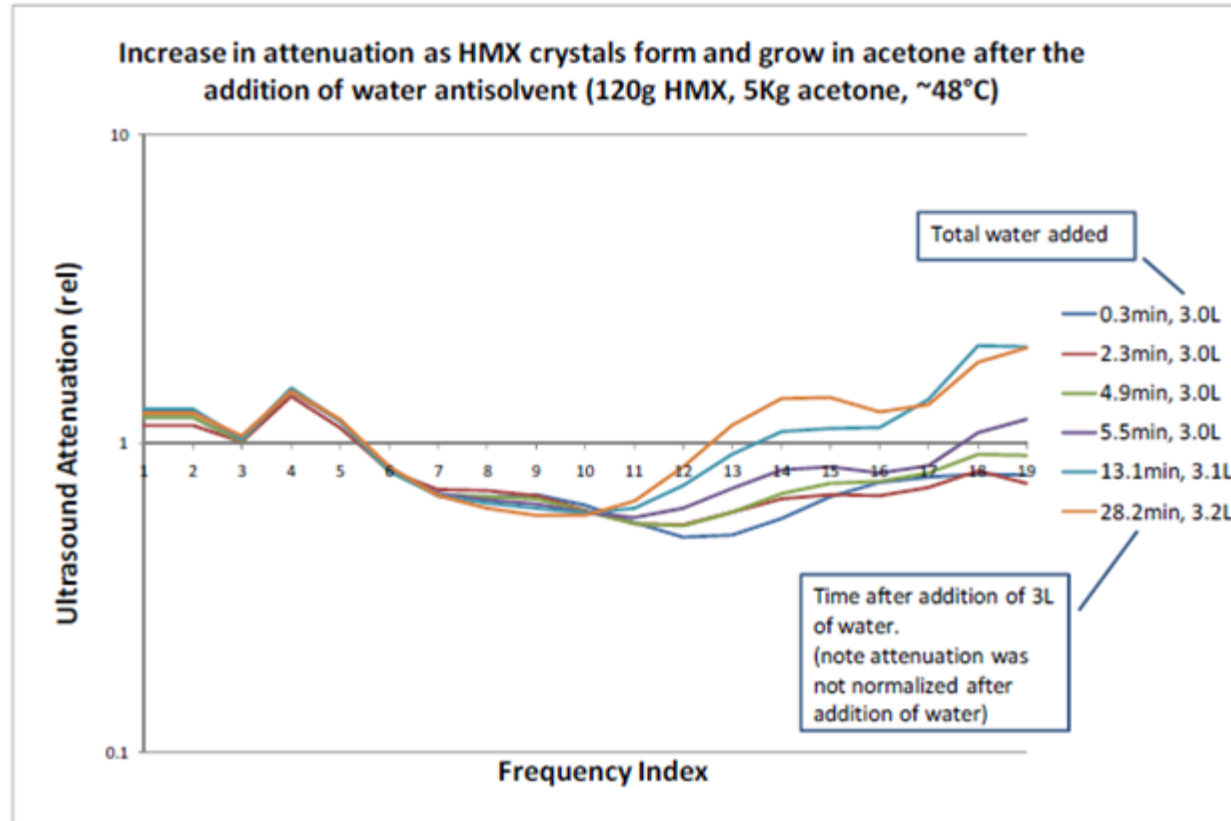
Receiving sensors are located on this side of the slurry-filled gap

- Speed of sound measurement calibrated with temperature readings
- Capable of measuring accurately up to 4 digits of accuracy the acetone/water ratio
- Could be used to replace current hot-cloudy determination with more accurate and reproducible speed of sound signal

Percent water in acetone during HMX dissolution:
Predicted Water/Acetone ratio from sound velocity and temperature measurements for HMX dissolved solids concentrations ranged from 0.8% to 3.2%



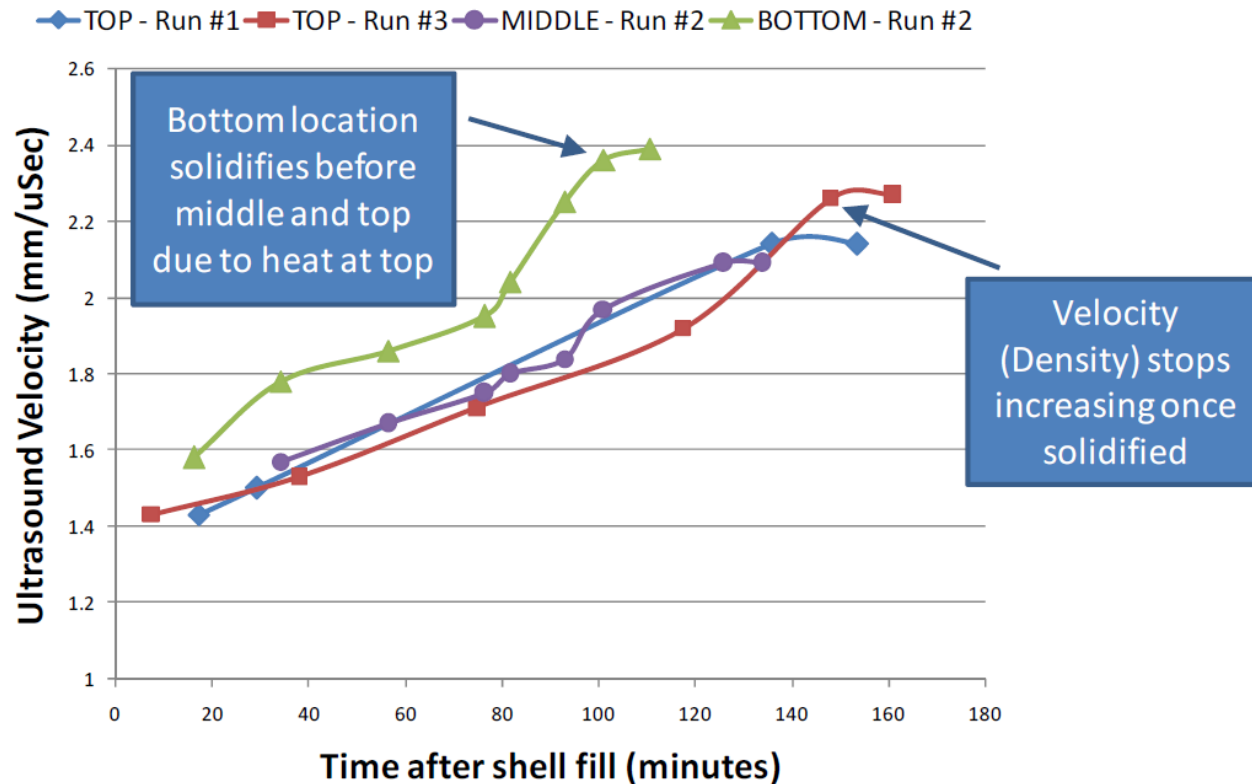
- Same probe can be used for testing of HMX crystal concentration by focusing on attenuation
- Combined with speed of sound signal provides two methods of verification of super saturation point



- Provide real time feedback on solidification
- Probes line up and down artillery shell
- Initial demonstration of melt cast analyzer was on M795 shell

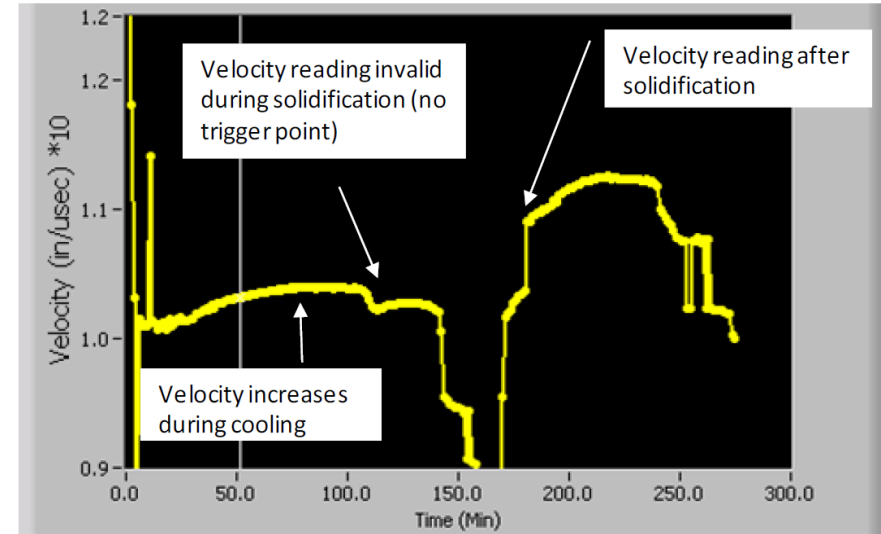
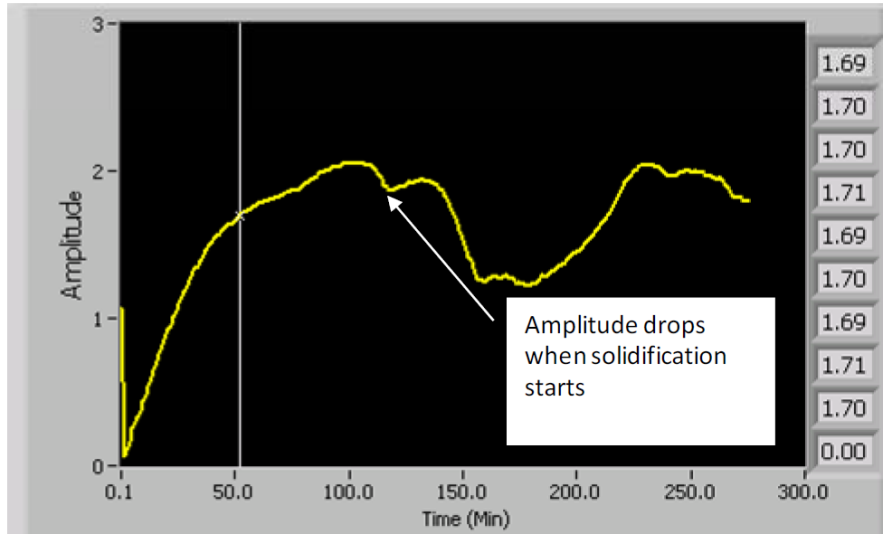


- Sensors are highly functional throughout the melt cast solidification process
- Can precisely determine solidification time at various locations



- Conical geometry adds extra challenge
- New sensors will be mobile allowing for imaging and targeted investigation
- Will attempt to detect defects





- Both amplitude and speed of sound change during solidification
- Multiple methods of measurement allow for greater reliability and precision

- Ultrasound probe has been useful in applications identified by BAE systems
- Generating interest outside of defense industry
- Use of ultrasound systems on explosive from synthesis to final processing could improve quality while decreasing costs
- Melt cast system should be ready for transition to GOCO facilities within 1 year of development. Will be able to perform analysis on nearly any munition

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- Cobb, W. N., "Demonstration of Ultrasonic Sensing for Melt-Cast Explosive Load Operations," DTIC Report, Report to Army Armament Research, Development and Engineering Center (ARDEC), Contract W15QKN-08-C-0465, February 2, 2010
- Cobb, W. N., "Ultrasonic Probe for Quality Measurement of Explosives Manufacturing, Testing Report (December 2011) - Monitoring Water/Acetone Ratios and Degree of Saturation for an HMX Explosive Simulant", Report to Army Armament Research, Development and Engineering Center (ARDEC), Contract W15QKN-10-C-0107, December 8, 2011

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