Analyzing Production Processes of Energetic Materials using Ultrasound Technology-13805

Rajen Patel, Sean Swaszek, Paul Lucas, Brandon Quesenberry, Wes Cobb-NDIA IM/EM Symposium, Las Vegas, NV May 16th 2012
Introduction

- 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
Solvent/Anti-Solvent Determination

- 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
• 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
Melt Cast Analyzer

• 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

![Graph showing ultrasound velocity vs. time after shell fill for different locations, indicating bottom location solidifies before middle and top due to heat at top.]

Velocity (Density) stops increasing once solidified
• Conical geometry adds extra challenge

• New sensors will be mobile allowing for imaging and targeted investigation

• Will attempt to detect defects
120 mm Mortar Readings

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

• 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
References


Acknowledgements

- Erik Boykin
- Christina Shank
- Kerry Henry
- John Blackmer
- Benjamin Call
- Krishna Jyothi
- Carol L’Hommedieu
- Mike Getz
- Dennis Loudon