BAE Unlocks Next Gen Munitions with RAM

BAE Systems Used ResonantAcoustic® Mixing to Transform their Energetics Processing

Photo credit: BAE Systems

P: +1 (406) 497-5333 **E: info@resodynmixers.com** **W: resodynmixers.com**

OVERVIEW

BAE Systems, a global leader in advanced weapons systems, is on a constant hunt for meaningful innovation to push their capabilities forward. It was a natural fit to implement ResonantAcoustic® Mixing (RAM) to improve safety, processing speed, and material peformance.

These critcial upgrades keeps BAE at the cutting edge of energetics manufacturing, enabling advanced munitions and propellants to meet the demands of modern weapons and defense systems.

RAM mixes safely, rapidly, and repeatably at virtually any viscosity. The result is unmatched homogeneity for a higher performing energetic material capable of increased power in a streamlined production process.

The resulting achievements were game-chaning for both BAE and its customers.

Solution

- ResonantAcoustic® Technology
- High Speed Production
- Unmatched Homogeneity at High Viscosity
- Safe, Contamination-Free Mixing

Achievement

- 20% More Energetic Power
- 5X Faster Production
- Mix Time Reduced from 3 Days to 20 Minutes
- Fully Compliant with Stringent Internal Safety Standards

CHALLENGES

Mixing of energetic material has always been a challenge due to high viscosity blends that need tight process control for safety. Most manufacturers in the defense space have historically accepted this as a slow and expensive process.

Highly viscous blends are taxing on bladed mixing equipment. Sparks due to metal contact in the mixing vessel are a real threat. Additional challenges such as failure rates, expensive waste, and long cleaning times kept BAE on the lookout for improvement.

An alternative and disruptive mixing technology was desired to overcome challenges such as:

- Multi-step, labor-intensive, slow process that limits production
- Inconsistent blending of high-viscosity, multi-component materials
- Limitations to solids loading, capping energetic potential
- Potential for metal-to-metal contact, increasing the risk of ignition
- High waste and long cleaning times
- Disposal of toxic material adds overhead cost and is damaging to the environment

RAM Can Add Up to 20% More Power!

"This new explosive process means we can add 20% more power to existing product lines – both warheads and shells. Thinking about future designs, this means less explosive can be used to achieve the same effect, reducing both space and weight. You could use this space to install more tracking hardware to increase precision or increase the amount of propellant to add speed and range."

-Lee Smurthwaite, Munitions Delivery Director at BAE Systems Land UK [4]

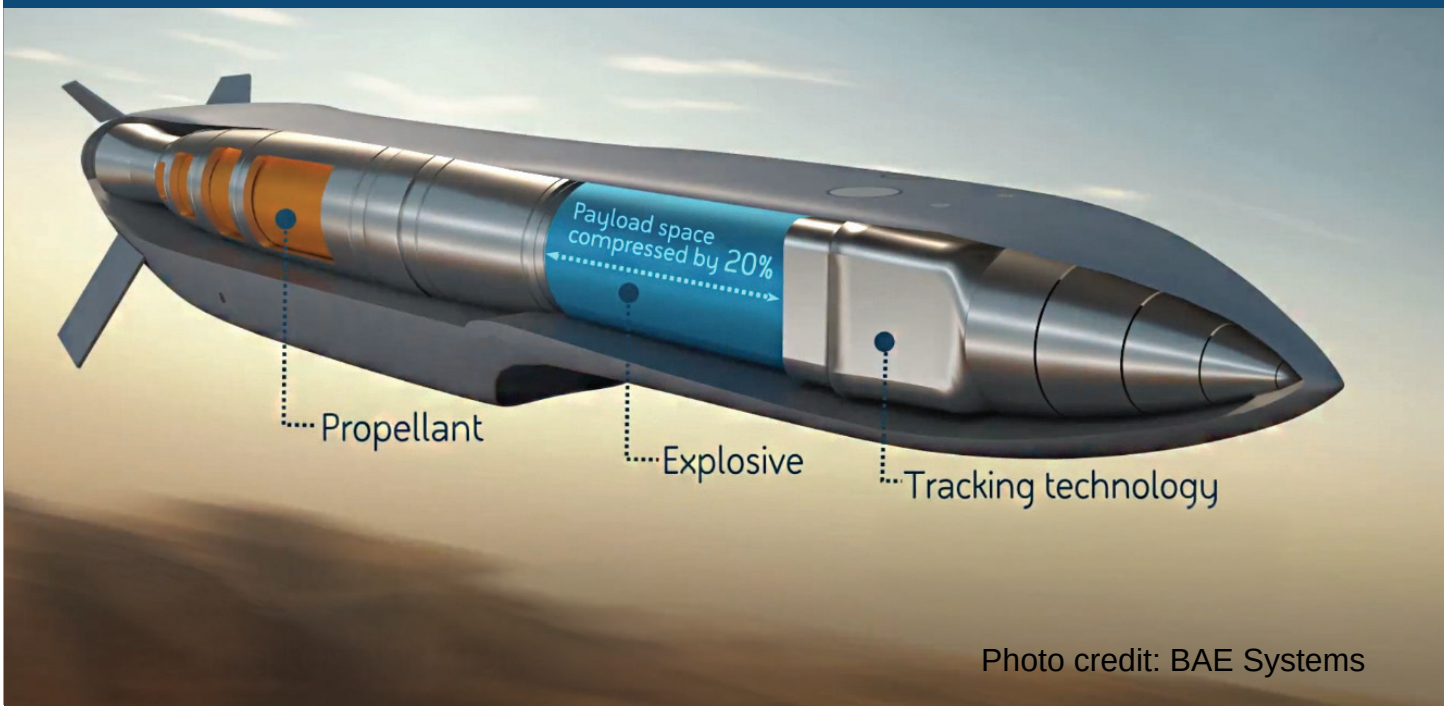


Photo credit: BAE Systems

SOLUTION

After integrating ResonantAcoustic® Mixing into its energetic materials manufacturing, BAE achieved critical improvements that rippled through the enitre process.

> *"Innovation lies at the forefront of delivering a sustainable future and our Next Generation of Explosive Mixing is the first in a line of industry-disrupting technologies that we have developed and acquired in this arena."*
>
> -Glynn Plant, Managing Director for the Munitions Business [1]

Consistent Homogeneity at Virtually Any Viscosity

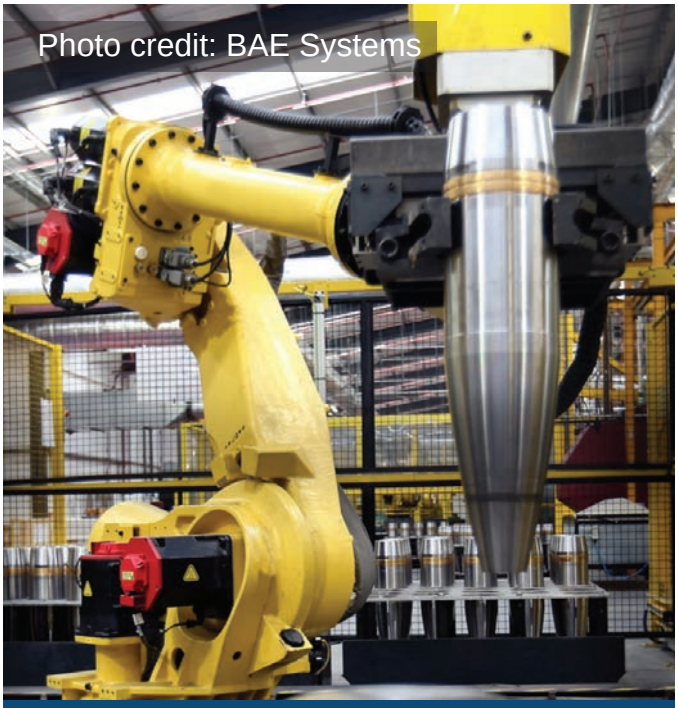
The ability to mix homogeneously at virtually any viscosity allowed BAE engineers to develop advanced energetic formulations.

> *"Our engineers have achieved a 20% increase in munition explosive mixing current polymer bonded explosives using the Resodyn Acoustic Mixer."*
>
> -Richard Brown, Head of Technology Communications [5]

The increased energy density of next-generation formulations allows a range of compact weapon systems to be developed. RAM applies energy uniformly through the entire material volume, enabling:

- Dispersion of dense powders
- Incorporation of fine energetic crystals
- Efficient energy distribution with uniform micro-mixing
- Creates several intense mixing zones [3]

These factors enable the manufacture of energetic materials to achieve higher specific energy and is precisely why BAE achieved



Robotic arm loads artillary shells in BAE Systems state of the art energetics facility.

a 20% increase in power! This also means payload space can be compressed by 20%, which provides more space within the rocket assembly for more propellant (longer range) or for enhanced tracking technology [1].

High Speed Mixing, Faster Curing, and High Capacity Manufacturing

Rapid mixing massively accelerates throughput and reduces cycle time. In one example, using RAM reduced mix time from 3 days to just 20 minutes [2]! With mixing and curing times significantly reduced, these drastic time savings allow BAE to:

- Increase production capacity and significantly lower production costs
- Support higher-volume programs without expanding facility infrastructure
- Compress development cycles for new energetics
- Enables 5x faster production and accelerates R&D timelines [1]

Fully Compliant with Stringent Safety Requirements

RAM mixes materials through low-frequency acoustic energy. There are no blades, impellers, or rotating parts, drastically reducing hazards, and the system can be operated remotely.

BAE requires stringent safety protocols in their energetics facilities and RAM enables full compliance.

Direct Scalability

The seamless scalability of RAM, from grams to multi-kilogram batches, enables BAE to maintain consistent material behavior across the entire development lifecycle, from the lab to production.

In addition, the RAM processing platform is mature, with batch, continuous, and automated semi-continuous configurations proven in the field. Advanced BAE facilities are able to leverage this platform to reduce costs and dramatically increase production capacity.

Sustainability

The unique bladeless mixing method of RAM allows the formulation to be mixed inside weapon system cases (mix-in-case), resulting in a 90% reduction in waste [4]. Curing also takes place at lower temperatures, delivering a substantial reduction in energy consumption.

CONCLUSION:

BAE Systems realized a 20% increase in specific energetic power due to RAM capability. Mixing high-energy compounds rapidly, with unmatched uniformly, and without the use of blades makes RAM perfectly suited to the stringent demands of energetics processing.

As energetics evolve to include more complex chemistries, higher reliability standards, and faster manufacturing needs, RAM provides BAE with a strategic, long-term advantage.

Contact Resodyn Acoustic Mixers, Inc. to discuss revolutionizing your mixing process for advanced material performance.

P: +1 (406) 497-5333
E: info@resodyn.com
W: www.resodynmixers.com

CITATIONS

1. Next Generation Explosive Mixing. https://www.baesystems.com/en-uk/uk-businesses/land/next-generation-explosive-mixing
2. Processing Studies of Energetic Materials, using Resonant Acoustic Mixing Technology. https://imemg.org/wp-content/uploads/2019/11/22259-IMEMTS-Pres_FINAL.pdf
3. Resonant Acoustic Mixing for Coated Explosive Material Manufacturing. https://imemg.org/wp-content/uploads/2019/11/22241-22241_Presentation-IMEMTS-2019-RAM-Technology-for-Coated-Explosives-Material-Manufacturing-FINAL.pdf
4. New mixing technology achieves more explosive power. https://www.baesystems.com/en/article/new-mixing-technology-achieves-more-explosive-power
5. Best Practice for the Development and Manufacture of Energetic Materials. https://imemg.org/wp-content/uploads/2024/05/24022_Poster-BEST-PRACTICE-FOR-THE-DEVELOPMENT-AND-MANUFACTURE-OF-ENERGETICS-REV-15-APRIL-10-24.pdf