A SUSTAINABLE AND GLOBAL APPROACH TO R&D

Dyno Nobel overviews how effective explosives research and development can improve safety, productivity, and sustainability in mining.

Research and development (R&D) in the explosives sector plays an essential role in making mining safer, as well as more productive and sustainable. As the readily available, easy-to-access ore bodies have been identified and mined out, new opportunities require working in deeper, more challenging areas, which in turn require new technology and solutions.

With products and services being used all over the world, commercial explosives company Dyno Nobel has taken a global approach to its R&D.

Balancing global solutions with site-specific needs

What does it mean to have a global approach to R&D? For Dyno Nobel, it is a careful balance between creating solutions that are impactful around the world, while simultaneously devising new approaches for individual sites based on their unique requirements. Some problems can only be solved by an explosives manufacturer. A complete understanding of the product and the ability to adapt to key problems mean that a sector expert can produce products that no one else can.

Dyno Nobel has a global technology programme with R&D facilities in countries around the world – including the US, Australia, France, Turkey, Indonesia, and South Africa. Having facilities in different areas of the world helps maintain region-specific solutions. Dyno Nobel's R&D facilities and network around the world enable the development of unique solutions in each different region. This helps the company cater to specific market needs and provide technical support for both its plants and customers.

Figure 1. Principal Research Scientist Jordan Arthur works at Dyno Nobel's Utah testing site.

Figure 2. The Simsbury, Connecticut, manufacturing facility supports global R&D.

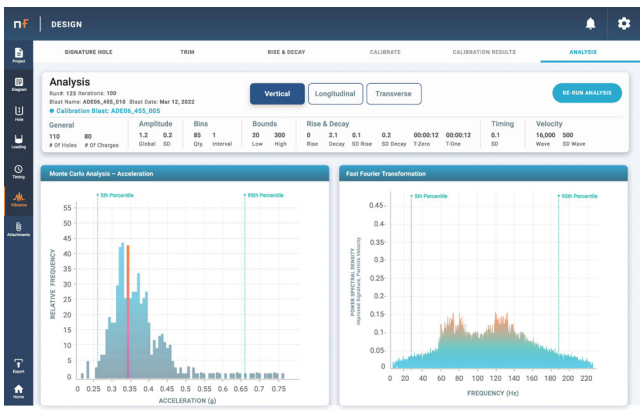

Figure 3. Dyno Nobel's Nobel Fire digital platform models key blasting outcomes.

Mining geology, weather, language, raw material supply chain, legislation, and culture are just a few of the many factors that differ between mining operations within and across borders. Developing and implementing new technology require a deep understanding of the specific customer challenges to find fit-for-purpose solutions to deliver safety, operational efficiency, and environmental benefits.

Dyno Nobel's testing site in Utah is one of the many facilities that supports global R&D. Because it has a world-class laboratory, pilot plant, and test site all in one facility, the site supports R&D for Chile and the Asia Pacific region, in addition to North America. Each region, and even each mine, has its own environment, strengths, and challenges. To maximise its efficiency, the company needs to be able to adapt its existing technology and products to site specific needs.

For example, one customer had issues with sulfides and pyrites in the ground reacting with ammonium nitrate-based emulsion explosives, generating excessive heat that led to smoking and burning holes. Dyno Nobel had formulations designed to counter that reaction, but the site's emulsion plants were not designed to make these products. Working with its engineering and product management teams, the company was able to create a solution that could be injected right off the mobile processing unit (MPU), creating the inhibited product as needed with greater flexibility than if the site's plant had manufactured it.

At Dyno Nobel's Simsbury, Connecticut, manufacturing plant, the importance of developing solutions based on the unique mining circumstances in different regions is also recognised. The company's initiation systems are generally designed to meet global requirements; however, by evolving designs to suit extreme environments, it can enhance the robustness of its products globally.

The evolution of R&D

The explosives industry has made major strides in the years since William Bickford's safety fuse in 1831. Indeed, Alfred Nobel's inventions of blasting caps and dynamite in the 1860s marked a new era of safer, more controllable blasting. Dyno Nobel is proud to continue the tradition of reducing the dangers of blasting through continuing innovation. Thanks to the efforts of companies like Dyno Nobel, mines and quarries are safer, more productive, and more efficient than ever before.

Major innovations have allowed operations to move beyond simply putting rock on the ground, to fine-tuning blasts to achieve specific goals based on fragmentation, vibration, and beyond. Technology that allows operations to use data and diagnostics to optimise mining processes can increase production and efficiency, while enhancing safety. Operations today are looking for very high-fidelity digital models that can predict key blasting outcomes, including fragmentation, material movement, and vibration early in the design phase. Advances in computer processing and new

machine learning techniques are helping reach new levels of accuracy, but the best solutions still need a fundamental understanding of blasting physics and rock mechanics.

Technology has also given mines more control over their explosives as they are loaded. Innovations in bulk emulsion technology, such as Dyno Nobel's DIFFERENTIAL ENERGY® and Delta E2 (ΔE^2)® solutions give operations the ability to vary the density of their emulsion throughout the borehole, based on the unique geology at the site. By placing the energy exactly where it is needed, operations can fine-tune their fragmentation and reduce oversize and/or fines as needed, and data can easily be shared to optimise blasting outcomes. The efficiencies generated reduce both overall mining costs and emission volumes for customers, reducing Scope 1 emissions by up to 25% in normal blasting circumstances.

The means of initiating blasts have also evolved. The enhanced timing accuracy provided by electronic initiation systems allows for more precise blast designs, facilitating greater optimisation of shot patterns. These systems are becoming more sophisticated, creating opportunities for integration with drilling, hole loading, and other mining systems. This integration enhances information flow at mines, leading to increased productivity.

All of these innovations, and many more, are currently shaping the way operations approach their blasting programmes, and R&D teams throughout the industry are hard at work developing the technology that will keep the mining world moving forward.

Figure 4. DIFFERENTIAL ENERGY and ΔE^2 technology allows for targeted energy placement.

Figure 5. Electronic initiation systems allow for enhanced timing accuracy and precise blast designs.

What is next for the explosives industry?

Safety has always been the most important consideration in explosives R&D, a trend that will undoubtedly continue as the industry evolves. Allowing mining personnel to be removed from the most dangerous aspects of the industry using machines and remote-control units is one solution that is starting to become more common. Automation of equipment, such as MPUs, provides a solution where explosives delivery is completed more safely without personnel in the area, such as close to high walls. Blasting quality is also improved by automated measurements that drive explosives loading, such as dipping.

Additionally, sustainability and environmental stewardship are also key areas of focus for the industry. There is a focus on decarbonisation and investment in lower emission bulk products, with major mining houses looking for products and services that lower GHG emissions. A strong focus on developing more environmentally friendly explosives and delivery systems for both Scope 1 and Scope 2 emissions through manufacturing, delivery, and use being implemented, such as electric vehicles and heavy-metal-free detonators, is critical.

And of course, innovations that increase productivity at mine sites will also be a major focus for the industry moving forward. As improvements in digital information gathering allow operations to identify the root causes of inefficiencies, tailored solutions will be more easily developed and implemented to ensure mines and quarries are able to reach their full potential. In the future, the tools that will be employed most effectively are those where interoperability is a key part of the architecture. Miners' digital ecosystems are large and growing, and there is very little room for proprietary software that is cumbersome and hard to integrate.

Conclusion

With their global approach to mining, Dyno Nobel's R&D experts look forward to being part of the continuing innovation in the explosives industry. By focusing on delivering practical innovation and solutions, they are making measurable improvements in how the biggest challenges their customers face are tackled – namely safety, operational efficiencies, and environmental impact.

With this in mind, tomorrow's innovations are already being developed at today's R&D sites. GMR

Contributors

- Jordan Arthur, USA.
- Clint Eckhardt, USA.
- Brett Macaulay, Australia.
- Rich Michna, USA.
- Paul Terry, Australia.
- Dirk van Soelen, Australia.