Yielding Bolt Test Trial

A Milestone in Industry Cooperation

Underground mining involves creating tunnels deep underground and the stability of those tunnels is critically important for the safety of the workers and the business. One means of stabilizing underground tunnels is to use rock bolts. Rock bolts, which can be several meters long, are installed in holes drilled around the perimeter of a tunnel, through unstable layers (such as layers of clay) to attach to stronger, more stable rock. The engineering team at Cameco Corporation, Saskatchewan's largest uranium mining company, was interested in trying a specific new rock (yielding) bolt at their Cigar Lake Mine. Mosaic, one of Saskatchewan's major potash producers, had just completed an IMII/NSERC sponsored project (*Shear Behavior of Resin-Grouted Rebar Rock Bolts in Saskatchewan Potash Mines*) to assess strain measurements in rock bolts used to stabilize underground tunnels in potash mines. Given the similarities of the issues that both the hard-rock (Cameco (uranium)) and soft-rock (Mosaic (potash)) companies face in underground mining, they decided to collaborate on the ***Yielding Bolt Test Trial*** project. Aside from assessing a new bolt for use in their operations, Cameco was interested in determining if the fiber-optic strain measurement system that Mosaic used in their project would be viable in an underground uranium mining environment; Mosaic was interested in determining if the new yielding bolts would work in potash facilities. This project marked a milestone – it was the first technical collaboration between a hard-rock and a soft-rock minerals company within IMII's membership.

One of the main objectives of the project was to assess the installation and performance of the new yielding bolt. In order to properly characterize its performance, the yielding bolt would need to experience a minimum amount of tunnel movement (deformation). The project team also installed a set of rock bolts used in the Mosaic project to calibrate its performance in a hard-rock mine. The other main objective was to assess the installation and performance of a fiber-optic strain measurement system. The advantage of using fiber-optics is that strain and deformation can be measured to a higher resolution and continuously along the length of the bolt, whereas traditional strain gauges can only measure strain where the gauges are installed, and the measurements are coarser.

The project team successfully installed the new yielding bolts and the bolts used by the Mosaic team. Unfortunately, the tunnels where the bolts were tested did not undergo enough deformation to allow for complete characterization of the new yielding bolts and a proper comparison to the currently- used bolts. The fiber-optic strain measurements provided high-resolution data along the length of the bolts but were hampered by the high equipment costs and temperamental behavior due to the harsh underground environment. The fiber optic measurements were limited by length and, confirming a finding from the Mosaic project, the fiber optic instrumentation was limited to a maximum 1% strain – which was insufficient for this application. These results, which confirmed a different path for rock bolt selection for Cameco and Mosaic, were achieved quickly and prevented spending more time and money assessing technology with may not be the best fit for both companies.

Project Proponents:

- **Cameco Corporation**
- **The Mosaic Company**
- **New Concept Mining**

Project Duration: April 2017 – June 2019

Project Cost:	**$170k**
IMII (cash):	$ 98k
Industry (in-kind):	$ 72k

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