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The Implications of Introducing Cryogenic Technologies to Mining Projects.

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Cryogenics is a mature industry serving a wide spectrum of industries from welding to space. In this paper a cryogenics concept, capable of providing chilling and ancillary services for deep mining is described.
As mining projects get deeper they also get hotter, a Cryogenic Energy Storage system provides the economies of scale infrastructure that allows for the cryogen supply for chilling delivered to the depth via a liquid flow. Modular compressed air supply or electrical systems are able to provide mobile on-demand services and a recent development suggests that cryogenic engines can simultaneously power large vehicles while providing chilling power; thus, large underground equipment becomes a source of cool air. By introducing a cryogenic liquid with an expansion factor of about 700 and replacing Diesel engines with Liquid Air (LA) or electric motors a substantial reduction in the ventilation required the surface is realised because the dilution of diesel and removal of heat generated by equipment is no longer part of the ventilation calculation, which accounts for a substantial energy saving as ventilation can account for more than 50% of the energy costs. An on demand modular LA based compressed air system would also absorb heat locally. Electricity generation is accomplished by expanding the cryogen through a turbine coupled to a generator; a modular system with battery storage could supply power, reducing the infrastructure from the surface. The technology prototyping, results of computer modelling and a broader discussion on the progress of the economic evaluation and technology development will be provided.
The implementation of these systems in mining relies on the physics of psychrometrics to determine chilling demand under varying atmospheric conditions; thermodynamics of heat flow and transfer from, the surrounding rock to the ventilation air flow, equipment operating at depth or various operations such as blasting; computational fluid dynamics to model the numerous thermal interactions and design new technologies; and computer coding or numerical modelling. These topics will be covered with examples from ongoing projects.

Primary author: Dr CLUFF , Daniel (CanMIND Associates)

Presenter: Dr CLUFF , Daniel (CanMIND Associates)

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