

# Ventilation, cooling advancements enhance efficiency

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**M**ine ventilation and cooling technologies are being advanced by energy and industrial gas solutions provider Chart Industries to meet the growing demands of deep-level mining through leveraging its global expertise to enhance safety, efficiency and sustainability in underground operations, says Chart Africa, Middle East and India mining lead Stephan Bergh.

Chart's innovations are designed to optimise airflow, improve cooling efficiency and reduce energy consumption while maintaining compliance with industry standards, Bergh adds.

In March 2023, Chart acquired air and gas handling products manufacturer Howden. Now, combining these innovative capabilities with Chart's core cryogenic manufacturing capabilities and expertise, Chart is uniquely positioned to explore cryogenic cooling solutions for deep mines.

While still in its early stages of development, cryogenic cooling technology could provide a highly efficient, low-energy alternative to conventional cooling methods, he says.

In the interim, and to support deep-level mining, Chart has developed a range of high-efficiency ventilation fans and air-handling systems that deliver reliable airflow while reducing energy use.

The company is also advancing modernised surface bulk air coolers with advanced control systems that reduce overall cooling costs.

Bergh says ice cooling technology is emerging as a more sustainable alternative to traditional chilled water systems, for ultra-deep-level mines, as the latter often results in expensive pumping costs

as mining depths increase.

"Our ice cooling technology is an energy efficient solution that helps offset the high operating costs associated with [using] conventional cooling systems. This makes ultra-deep mining more viable and contributes to long-term sustainability."

As mining operations venture deeper underground, ventilation and cooling challenges become more pronounced, cautions Bergh, with increased system resistance, auto-compression and higher virgin rock temperatures all contributing to the complexity of maintaining safe and efficient mining environments.

Once the required ventilation and cooling duties are determined, Chart provides turnkey engineered solutions, from axial flow to centrifugal, mixed-flow and auxiliary fan technologies, to suit every application.

"We also work closely with customers to assess heat loads and establish the mechanical cooling requirements needed to maintain optimal conditions underground," he says.

With energy costs a major concern for the mining industry, Chart places strong emphasis on efficiency and control systems that ensure ventilation and cooling equipment operate at peak performance.

In this regard, Chart supports mining companies through its Ventsim product suite, which enables engineers to design and optimise ventilation networks based on every mine's specific requirements.

Using Ventsim CONTROL, the company enables mines to remotely and autonomously adjust ventilation based on real-time conditions, improving energy savings and reducing operational expenses.

Further, ventilation and cooling demands fluctuate based on daily activities, and Bergh notes that automation and digitalisation play a significant role in adapting to these shifting requirements. In this regard, Ventsim CONTROL integrates real-time monitoring, asset tracking and predictive maintenance tools to enhance ventilation efficiency and ensure that air and cooling resources are directed precisely to where they are needed.

However, ultra-deep mining presents additional challenges, particularly in delivering cooling to working zones and overcoming extreme system resistance and its associated pressure requirements.

For this reason, Chart has developed specialised solutions, including large centrifugal fans, ultracold ammonia refrigeration systems and ice plants, which can handle the unique pressures and cooling demands of ultra-deep mining.

The company is also actively deploying ventilation-on-demand (VOD) systems that optimise the use of available ventilation air, directing it only to active working areas.

Bergh adds that Chart is working with several ultra-deep mines to deploy VOD systems.

He is confident that the future of mining will see a greater focus on intelligent, automated operations; therefore, Chart is investing in AI and machine learning to develop predictive control mechanisms that can automatically adjust ventilation and cooling systems based on real-time operational data.

Chart's solutions are deployed in some of the world's deepest mining operations. ■

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