INTERNATIONAL
MINERALS INNOVATION
INSTITUTE

IDEATE 2025 Research Needs

Advanced Chemicals

Are there anti-caking and/or dedusting chemicals (not petroleum based) that are neutral to the environment/health for the potash industry?

Anti-caking agents keep minerals products flowing smoothly and prevent them from forming lumps. Performance considerations include moisture control (moisture absorption capacity in 60-70% relative humidity), coating effectiveness (layer uniformity and thickness) and method. Quality control parameters may include particle size distribution, bulk density variation and moisture uptake (for periods up to 6 months). An examples of an anti-caking agent in industrial fertilizers is kaolin or attapulgite clay.

Commercially available dedusting agents are usually based on mineral oils of petroleum origin, typically prepared as a water emulsion. They differ with respect to exact chemical composition that depends on the source of crude oil and can contain different amounts of aromatic fraction which may also be considered unfriendly to the environment. Their task is to bind together any dust or to bind it to the main matrix body physically either through film formation or surface-active properties. Alternatives – when produced, should be of low cost, on a large scale, nontoxic, and readily available. Ideally, they should also be biodegradable.

Carbon Capture, Utilization and Storage (CCUS)

Can you imagine a new way to effectively handle commercial or industrial scale volumes of carbon waste streams from emitter to full storage concept for the potash sector?

Saskatchewan's potash operations (2022) reported releases of CO2 ranging from 48,000 to 65,000 tonnes for conventional mine/mill operations, to around 115,000 tonnes for larger conventional mine/mill operations, to more than 700,000 tonnes for large solution mine/mill operations.

Industrial carbon management refers to a range of technologies used to manage and reduce carbon dioxide (CO_2) emissions from industrial facilities, including storage (CCS) and utilization (CCU). Before CO_2 can be transported and injected into geological formations, or directed to other uses, it must be filtered to remove any unwanted substances, compressed or liquified, and then transported. While these are not new processes, they are energy-intensive, expensive and not necessarily available at scale given technical difficulties.

A recent study (Carbon capture, utilization, and storage (CCUS) technologies: Evaluating the effectiveness of advanced CCUS solutions for reducing CO2 emissions - ScienceDirect) suggests that research opportunities may exist with respect to cost reduction through technological integration, efficiency of CO2 capture technologies, scalability and deployment, and transportation, storage, and effective utilization technologies.

Remote Sensing

Are there technologies from other industries that can be adapted to provide rock mechanics data and/or geophysical information of the roof or walls of drifts?

Stresses from mining activities underground lead to deformation or other failures involving the fall of rock into opening, working areas. This is both a safety and productivity concern as people can be hurt (or worse) and equipment damaged or destroyed.

Several techniques exist in the mining industry today for measuring rock stress, such as strain gauges, acoustic emissions monitoring, borehole deformation gauges, microseismic monitoring, and extensometers. In general, these methods can be divided into two main types: those that disturb the in-situ rock conditions, i.e. by inducing strains, deformations or crack opening pressures; and those that are based on observation of rock behaviour without any major influence from the measuring method.

Emissions Control

Are there new air emissions control technologies, be they abatement, scrubbers, etc., particularly that could support more efficient processes for the potash industry?

Air emissions at potash operations may originate from dryer stacks (product dryers), dust stacks (compaction, crushing & transfer), exhaust stacks (boilers, generators) and to a lesser extent mine exhaust (from shaft heating).

Emission control devices are defined as equipment, other than inherent process equipment, that is used to destroy or remove air pollutants from emission prior to the discharge to the atmosphere. Control devices that are typically used in the potash industry include wet scrubbers, baghouses (fabric filters), and electrostatic precipitators (ESPs). Since cyclones can be used to separate coarse particulate from the exhaust stream, they are often installed as a control device in series with one of the other devices, namely a scrubber, baghouse, or an ESP.

Heat Recovery

Could you develop technologies with the potential for heat recovery from low-grade sources or from "dirty" sources (e.g., potash dryer stacks which may contain dust or other particulates)?

The mining and milling industry may be considered an energy-intensive operation. This drives an industry interest in waste heat recovery systems, and the opportunity to capture and repurpose heat that would otherwise be lost to the environment. The challenge is that the waste heat streams may not always "clean" and may contain corrosive or other potentially harmful contaminants limiting their direct use.

Would it be possible to capture heat from boilers (from steam generation), dryers (natural gas fired), and possibly compressors and pumps from within mills or ventilation systems from underground mines?

Mine Planning

Are there new technologies which could be deployed easily underground at a low cost to provide geotechnical and seismic data without compromising data quality?

Proper mine planning and design is integral to the commercial success, safety, operational efficiency, and sustainability of mining operations. Exploiting a specific mineral deposit requires compiling and incorporating vast amounts of data (for example, engineering, economic, and geotechnical data) to establish the proper approach required and the best design. One of the challenges with geotechnical data is the inherent uncertainty associated with technical factors such as the natural variability in orebody geometry and grade, ground conditions and rock properties.

Geotechnical surveys involve direct sampling and testing of soil and rock at specific locations, providing detailed and accurate information about geotechnical properties at those points. However, due to site and budget constraints, geotechnical data are usually limited within a site.

By comparison, geophysical surveys (e.g., multi-channel analysis of surface waves) aim to understand the subsurface's physical properties without direct sampling, offering a non-destructive alternative that can be conducted rapidly over large areas. Since geophysical data are indirect measurements, they are less accurate and may contain significant uncertainty.

Novel Use for Potash Tailings

Can you envision technologies for salt bridging battery potential from potash processing waste (i.e., tailings)?

Have you heard of osmotic energy, sometimes called "blue energy?"

In 2022, Japanese scientists demonstrated that electricity may be obtainable from water with a high salt concentration, such as seawater (see Scientists demonstrate that electricity may be obtainable from water with a high salt concentration).

In 2024, another university reported creating a semipermeable membrane that harvests osmotic energy from salt gradients and converts it to electricity (This salt battery harvests osmotic energy where the river meets the sea - American Chemical Society).

The tailings management areas associated with potash operations contain both salt piles (tailings) and salt waters (ponds). Can these resources be used to either generate electricity (e.g., by exploiting the osmotic pressure created by the passage of water through a semi-permeable membrane to drive the rotation of a turbine) or store energy in the form of freshwater and concentrated saltwater?