Investigate the Chemistry of Paste Backfill

Objective

In paste backfill, sulphate attack can decompose the $CaO\text{-}SiO_2\text{-}H_2O$ bonding network of the cement gel phase and gradually weaken the structure. The decomposition process is accompanied by the formation of small amounts of specific deleterious phases, most notably gypsum, ettringite and thaumasite. In concrete systems, expansion can result from changes in the swelling properties of the cement gel phase. Upon decalcification, the gel phase is dehydrated serving as a source of water for ettringite formation. Large expansive pressures are then created as the gel regains water by absorption from external sources. In paste backfill, tailings particles may constrain the expanding cement gel leading to the formation of microcracking and eventual matrix disintegration.

The purpose of this project is to study the chemistry of paste backfill and in particular to better understand, and develop means to ameliorate the weakening of backfill due to sulphate attack and cement gel hydration.

Potential Benefit

Backfill plays an integral role in the operation of many underground mines where it is used for ground control, underground support in pillar recovery, and as a mining platform in cut and fill systems. Backfill also has important environmental implication as it compliments the surface disposal for mill tailings. For these reasons, backfilling has an important impact on mine economics, contributing to improved ore recovery and reducing the costs of surface disposal of mine wastes.

The initial phase of this project will provide a better understanding of the chemical factors governing the physical stability of paste backfill systems over extended hydration periods. Later phases will study paste backfill systems incorporating admixtures to counter sulfate attack. The end result will be a system in which the physical integrity of paste backfill is maintained for extended periods of time such that the ground support requirements of underground mining operations are met.

Scope of Research Activities

The project will produce samples of paste backfill and allow the material to set under controlled conditions over a period of about 6 months. The chemistry of the backfill will then be examined using modern instrument techniques including synchrotron energy

dispersive X-ray diffraction (SED-XRD) and SED-XRD tomography studies at the Daresbury Synchrotron Laboratory at Daresbury, U.K.

The first year of work will examine a generic paste backfill in three phases as listed below. Later phases will study the effect of admixtures intended to counter sulphate attack.

Phase 1 Literature survey, discussions with sponsors, experimental set-up and optimization.

Phase 2 Chemical and physical characterization studies.

Phase 3 Data analysis and reporting.

Time Frame

The project will cover three years with the first year comprising the three phases listed below. The admixture studies will require another two years of research effort.

Phase 1 One Month

Phase 2 Seven months

Phase 3 Four months

Potential Sponsors

Agnico-Eagle, Aur Resources, Barrick Gold, INCO, Noranda, Rio Tinto, Teck

Budget cost

The draft budget presented overleaf has been prepared for the first year of work. Costs during the second and third year will be approximately the same as the first year costs.

Budget cost estimate - first year

Item	Cost C$
Labour costs	$25,000
Synchrotron work at Daresbury	$50,000
Travel expenses	$5,000
NSERC Funding	($40,000)
Sponsor Funding	$40,000
CAMIRO Fee (10% of Total Budget)	$8,000
Total cost to sponsors	$48,000
Cost per sponsor (assuming six sponsors)	$8,000

Specific Deliverables

- Interim report after six months at end of hydration period.
- Report at end of first year with recommendations for year 2 and 3 .

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