Large Scale Backfilling of Shallow High-Extraction Room and Pillar Coal Mines for Residential Development

Presented by Ray Predika, P.Eng.
Site Location
Located in Canmore, Alberta Canada
Stewart Creek Development

- Medium density Residential – 3 story Apartments and Townhouses
- 2.5 acres required Backfilling
- “Paste” was selected as the backfill material over low-strength concrete
What is Paste?

A non-segregating mixture of solids and water that possesses a yield stress, exhibits minimal water bleed when left idle and has no critical flow velocity.
Paste Feed Materials

- Inorganic soils
- Mine/Quarry waste
- Mine/Quarry plant tailings
- Mine/Quarry pre-stripping
- Screened to use the portion less than $\frac{3}{4}$"
Post-Screening Grainsize

![Graph showing size distribution of Thunderstone Till](image)

- **Date:** Dec. 10, 2004
- **Client:** Three Sisters
- **Project No:** 04-1900-029
- **Sample:** Aggregate

**Title:** Size Distribution - Thunderstone Till

**Figure:**

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*Image of a graph showing the percentage passing versus sieve size for Thunderstone Till.*
Screening Plant
Concrete vs Paste
Concrete

- Cost -- $ 65 cy
- Strength – 5MPa (700psi) minimum for a pumpable mixture
- 8 to 10 wt% cementing materials
- Max radius in rubble 2.5m (8ft)
- Max pumpable distance in tunnels 10m (30ft)
- Uses commercially available ingredients
Paste Backfill

- Cost – $43 cy
- Strength – 500kPa (70psi) to 2MPa (280 psi)
- 4 wt% cementing materials
- Slump variable between 1” and 10” with very little change in water content (or strength)
- Max pumpable radius in rubble 10m (30ft)
- Max pumpable distance in tunnels 100m (300ft) or more
- Uses locally derived materials
So where are the real cost savings?

- Drilling costs are reduced by about 75%
Stewart Creek Phase 1 Layout
No. 4 Mine, No. 4 Seam

- High-Extraction Room and Pillar
- 15 degree dip
- 2.8m (9 ft) extraction height
- Currently largely collapsed
- 8m (25 ft) high rubble pile
No. 4 Mine, No. 4 Seam
Up-dip end of No.1 Morris Seam Heading
Rubble in Borehole
Rubble in Borehole
Primary injection

- 15m (50 ft) grid – 78 holes
- Max Volume cut-off (30% X rubble thickness X area of 50 ft diameter circle)
- Max pressure cut-off (twice overburden)
- Primary Volume injected: 7596 m³ (9935 cy)
- Total duration: 60 days
Secondary Injection

- One hole for every 4 primary holes – 42 holes
- Max Volume cut-off (rubble thickness X area of 50 ft diameter circle)
- Max pressure cut-off (twice overburden)
- Secondary Volume injected: 72 m³ (94 cy) (0.9% of primary)
ReichDrill 650
Injection Plant Setup
Wellhead Setup
Mixer truck
Three stages of pressurization

- Flat-line, near zero well head pressure
- Nominal pressure maintained at well head
- Refusal
Injection time – 2 hr 40min
Volume injected – 98 m³ (128 cy)
Max pressure – 170 psi
Injection Pressure Log

- Injection Pressure Log

- Time

- Injection Pressure (psi)

- raw

- filtered
Paste flowing out of BH
Paste flowing into Borehole
Other Undermining work

- Myra Falls Crown Pillar Stabilization
- Ground deformation estimation
- AMD/ARD solutions
Who’s Golder Associates?

- Global group of consulting companies specializing in ground engineering and environmental services
- Has more than 4,500 people operating in local companies and 100 offices across Africa, Asia, Australia, Europe, North America and South America
- Golder Associates Inc. (U.S.) works out of 31 offices across the country from Anchorage, Alaska to Boca Raton, Florida
- Projects range from decontaminating and decommissioning a submarine cable manufacturing facility to investigating groundwater supplies, ensuring slope stability or conducting an Environmental Site Assessment for potential brownfield sites
Thanks to...

- Three Sisters Mountain Village Ltd. (www.tsmv.ca)
- LPR Contracting
- Beck Drilling and Environmental
- Golder Paste Technology Ltd.
- TRB Subcommittee
- ITGAUM
QUESTIONS?