Sullivan Fatalities Incident Technical Investigations & Findings

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Overview

- Fundamental processes driving gas transport in waste rock piles
- Evidence for these processes in Sullivan No. 1 Shaft Dump

Conclusions

- No. 1 Shaft Dump
- Other sites



- Gas flows in response to differences in:
 - Temperature
 - Pressure
 - Composition

Rate of gas flow is constrained by:

Permeability

• Temperature



Winter



(Source: SRK 1998)

• Pressure

Sustained pressure differences measured below a soil cover after sharp change in barometric pressure



Gas composition

Oxygen and carbon dioxide measured in rapidly oxidizing but neutral waste rock



(Source: Hockley et al 2000)

 Gas permeabilities (s⁻²) measured in covered waste rock in wet and dry conditions

	August 2001	May 2001
No Cover	2 x 10 -12	6 x 10 ⁻¹³
Cover 1	5 x 10 ⁻¹⁶	5 x 10 ⁻¹⁶
Cover 2	1 x 10 -15	1 x 10 ⁻¹⁶
Cover 3	2 x 10 -15	5 x 10 ⁻¹⁶

(Source: Hockley et al 2003)

Coupled Processes



physical and chemical effects leads to very complex effects

Combinations of

Best studied with help of models

(Source: Lefebvre et al 2001a,b)

- Which effects are discernible in Sullivan No. 1 Shaft Dump monitoring data?
- Modeling: Rene Lefebvre & Balkicem Lahmira



Geochemistry

- Oxidized and visible sulphides (up to 5%)
- Calcite in waste rock and in till cover
- Leachate pH 3-4.5
- Sulphate, zinc, iron





Temperature driven inflow - dry cover



Temperature driven outflow - dry cover



Temperature driven outflow - dry cover



Temperature driven outflow - wet cover



• Temperature driven outflow - wet cover







Pressure

Model response to 2 kPa pressure drop







Gas composition effect on density



Conclusions to date

- Oxygen depleted by sulphide oxidation reactions within dump
- Dominant effect controlling direction of airflow was temperature
- Barometric effect is much less influential
- Carbon dioxide production compensates for oxygen depletion and counteracts gas composition effect

Other Sites

 Technical panel recommends that all individuals responsible for safety at mine sites should be aware of the hazards associated with waste dump gases

• Risk factors include but are not limited to:

- Sulphide minerals (w or w/o carbonate minerals)
- Dump temperatures that are within range of atmospheric temperature changes
- Sharp drops in barometric pressure
- Factors that serve to concentrate air flows
- Factors that restrict dispersion of gases



