Biological Treatment at Kinross' Kettle River Operations

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Presentation Outline

- Treatment Systems
- Treatment Goals
- Design Criteria
- Process Flow Diagrams and Photos

Results



Locations Washington-BC.dwg

Treatment Systems

Underdrain (Key Mill): Seepage from tailings impoundment at an operating mill
K2 Mine: Mine water and seepage from an operating mine
Key Mine: Seepage from waste rock piles at a closed mine

Background

 Mine water and mining-impacted GW are treated to meet State of WA antidegradation standards for GW discharge

 Treatment: Engineered bioreactors + in situ treatment

Underdrain System: Design Criteria

 \blacksquare Flow = 10 gpm

$\square [NO_3 - N] = 6 \text{ mg/L}$

$[SO_4] = 120 \text{ mg/L}$

Underdrain Process Flow Diagram



Bioreactor Site - August 2005



Bioreactor Site - Sept. 2005



Bacterial Inoculum



Distribution Piping



Collection Piping



Methanol Addition



ZVI System



December 2005



December 2005



Nitrate Concentrations in Underdrain



Sulfate Concentrations in Underdrain



Key Mill Facility (Monitoring Well TP-2)



Key Mine System: Design Criteria

 \blacksquare Flow = 50 gpm

$[NO_3-N] = 33 \text{ mg/L}$

$[SO_4] = 800 \text{ mg/L}$

Key Mine Process Flow Diagram



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Construction - October 2006



Startup - 11/08/06



Tanks 2 & 3 - 11/08/06



Startup - 11/09/06



Startup - 11/09/06



Tank 1 - 11/09/06



Nitrate Concentrations at the Key Mine



Sulfate Concentrations at the Key Mine



Key Mine (Monitoring Well KW1-A)



Cost Information

Underdrain system cost \$150,000 ≻Materials: \$80,000 >Installation: \$70,000 Key Mine system cost \$1.05 million ≻Materials: \$350,000 ≻Installation: \$700,000

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Items of Note at Key Mine

- Tanks were inoculated with water and sludge from Underdrain system
- Flow rate is significantly less than predicted (only about 3 gpm most of the year vs. 17 gpm design average and 50 gpm design maximum)
- Influent sulfate concentrations are higher than predicted
- Water temperature as low as 2°C
- Biofilm is now apparent at downgradient monitoring well

Conclusions

- Complete nitrate removal from Underdrain and Key Mine waters
- Significant sulfate removal at both sites, except after methanol flow interruptions
- Groundwater concentrations at monitoring wells are being reduced, which prevents permit exceedances
- In situ treatment may further reduce groundwater concentrations



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