4.4. BLENDING AS A METHOD FOR ARD PREVENTION

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BLENDING AND LAYERING

OF

WASTE ROCK

FOR ARD PREVENTION

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Successful Blending

- a mix of potentially acidic and alkaline rocks which result in predominantly alkaline leachate throughout the waste rock dump

- nearly complete internal consumption of acidity

- internal precipitation of deleterious dissolved ions

HOW CLOSE

IS CLOSE ENOUGH?

Factors

- Reactivity
- Availability
- Relative Proportions
- Hydrology
- Dump Construction Method
- Operational Control

Reactivity

- excess acid consuming minerals to maintain neutral pH
- theoretically:

$$1 < NP / AP_{critical} < 2$$

- ideally, sulphide minerals oxidize before acid consuming minerals are exhausted (kinetics)

Availability

- encapsulation
- response to blasting
- physical breakdown
- grainsize

Proportions

- relative reactivities
- relative quantities
- filler materials
- resultant heterogeneities

Hydrology

- channelling
- relative permeabilities
- climate

Dump Construction Methods

- random end-dumping

- single lift
- multiple lifts

- random dumping within each lift

- controlled construction of horizontal layers

Operational Controls

- pre-mine evaluation (block model)
- characterization during mining
- managed and scheduled waste disposal
- monitoring to confirm blending criteria
- leachate monitoring

SAMATOSUM

CASE STUDY ON LAYERING

(Morin and Hutt, 1996, in review)

<u>Waste Dump Design</u>

- Layered Potentially Acid Generating (PAG) and Acid Consuming (MAF) Waste Rock

- Base of MAF

- Overall NP/TAP of 3.1

- Based on Column Kinetic Tests

WEIGHTED - AVERAGED ABA

(kg $CaCO_3$/t)

	NP	TAP	TNNP	TNPR
MAF	377	73	304	5.1
PAG	56	100	- 44	0.56

Construction

- MAF stockpiled for upper layers

- mixing or blending within a layer unintentional result of
  - blasting
  - loading
  - hauling
  - dumping

- uppermost MAF layer not completed

- 0.3 - 1.0 m overburden cover

Resulting Drainage

- impending net acidity
- one station shows seasonal pH fluctuating between neutral and acidic
- acidic values becoming more persistent
- increasing sulfate concentrations
- Increasing metal levels (i.e. Zn)

Column Test Results

- PAG relatively reactive (net acidity in several weeks)
- MAF contains excess NP and sulphides oxidize at slower rate
- layering on the order of 0.2 - 1.0 m did not affect reaction rates or geochemical behaviour within individual layers
- layering did affect composite drainage quality from the columns

Conclusions

- coarse PAG material preferentially channels flow
- all NP in MAF layers not contacted
- physical factors >>overall TNPR
- layering down to 0.2 m did not affect layer reaction rates
- layering could potentially control acidity
- less likely to successfully control metal leaching

U.S. S.E. Coal

- historic basis for setting ABA criteria (Brady et al)

- TNPR > 2

- TNNP > 10 kg $CaCO_3$/t

- NP > 15 kg $CaCO_3$/t

U.S. S.E. Coal

Management Plans

- based on drillcore ABA
- 1 drillhole ~1/4 - 1/2 mile (depending upon variability)
- selective handling of PAG strata to achieve criteria
- visual strata controls
- relatively small operations areas
- limited operational monitoring

Site 1

- majority of waste is competent rock, 40-60% limestone
- 120 ft wide pit working at any one time
- clean pavement
- lay down french drain
- selectively handle coaly waste between seams (down to 2 - 3 “)
- coaly waste to mill
- monitor seeps (pH 7.5)

Site 2

- blast to above coal seam
- clean by bulldozer
- selectively handle roof and floor waste
- over excavate pavement
- selective waste to co-generation plant, or covered with ash to TNPR of 1
- $ 15-20/tonne to selectively handle cleanings
- backfill with highest NP waste on pavement
- random backfill remainder of pit

Site 3

- blend waste by pulling down with shovel
- random mixing by truck dumping
- clean pit floor pavement
- lay down kiln dust or flyash
- place flyash against exposed seams
- anticipate some acid seeps
- limited ability to monitor leachate from backfilled pit

Conclusions - Blending

- reasonable in theory
- practical limitations
- ability to set criteria
- achievable degree of blending
- management effort required
- ability to monitor
- potential inability to control metal leaching
- long feedback loop

Conclusions - Layering

- reasonable in theory
- practical limitations
  - handling effort required
  - may not sufficiently effect reaction rates in individual layers
  - potential inability to control metal leaching

Requirements and Practice

- hydrology - test dumps (LEAP)

- drainage of waste dumps
- place critical (test?) dumps where drainage can be monitored

- operational monitoring
- waste handling/dump building

- long term site monitoring
- acknowledge long feedback loop

- documentation (library)