Problems with Acid Rock Drainage at the Skytop Interstate-99 site in Central Pennsylvania

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Information Sources

- Personal observations
- Consultant on move to Indiana County
- PENNDOT public releases
- PENNDOT website (Public meeting 2006 ppt)
- Newspaper articles on PENNDOT meetings
- Discussions with PENNDOT personnel and consultants
- I have no official status on the project.
- PENNDOT has been very helpful
PRE-1998

- Route Selection across Bald Eagle Ridge
- Environmental challenges – wetlands, bats, weather on ridge, ……
- Pyrite mentioned, but no attention paid
- Further environmental challenges precluded by Congressman Shuster in 1998 Highway Bill
- The author and others knew of pyrite in old 322 roadcut, but no realization of amount
Discovery of Acid Rock Drainage (ARD)

2002-3  Major cut excavated in ridge
Waste rock placed in 2 large piles, 10 other sites including “Buttress-Bifurcation”
11/03  Red water flows from waste piles
4/04  Work stopped on section; being completed end of 2008.
Aerial view of big cut and waste piles
Red water seeping from Skytop pile
Cut face on big cut
Brownish=weathered, gray=pyritic
Some bad seepage water

<table>
<thead>
<tr>
<th></th>
<th>Skytop seep</th>
<th>Seibert</th>
<th>Arbogast Pile</th>
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<tr>
<td>pH</td>
<td>2.2</td>
<td>2.7</td>
<td>2.1</td>
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<tr>
<td>Cond uS/cm</td>
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<td>3560</td>
<td>11340</td>
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<tr>
<td>Acidity mg/L CaCO₃</td>
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<td>Alkalinity mg/L CaCO₃</td>
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<td>Fe mg/L</td>
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<td>Mn mg/L</td>
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<td>SO₄ mg/L</td>
<td>13491</td>
<td>2519</td>
<td>14507</td>
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</table>
Geology and sampling of cut
Sulfur in 30-ft rock composites
Average = 2.4% S = 4.5% pyrite
Pyrite is hydrothermally introduced on a network of fractures

- Closely spaced veinlets

Pyrite veinlet <1 mm thick

2 inches
Pyrite veins in sandstone (white streaks) (courtesy PENNDOT website)
Addition of Lime

- Pyrite was observed in drillholes and in the broken rock
- Baghouse Lime ($\text{Ca(OH)}_2$, waste product from nearby) added to broken rock piles.
- Added generally at 400 lb/yd3, as layers (lifts)
- Why didn’t this solve the problem?
Lime Layers in Skytop Pile
Impermeable, little neutralization, armored
Bifurcation-Buttress

- On a large cut on the west slope of Bald Eagle Mtn., hillside started to slide into road.
- Slope laid back, uphill lane raised 20 ft, and buttress placed on toe of slide to weight it.
- Much of rock was from the big cut (pyritic)
- Lime added in layers.
- Monitoring wells show very acid water.
Bifurcation-Buttress
Remediation Considered

- Treat at site
- Dispose in abandoned strip mines
- Inject Bauxsol (alkaline waste product)
- Move to Indiana Co. (80 mi.) and mix with alkaline ash
- Lined Landfill 3 miles from site, cover “immovable material”
“Immovable Material”

- Rock Cut Faces (Big cut and a small cut with pyrite veinlets)
- Bifurcation-Buttress
- One Major Fill
- Covered with HDPE liner, geotextile and geoweb filled with gravel.
Cover on “Immovable Material”

GEOWEB COVER SYSTEM FILLED WITH GRAVEL

CLASS 4 GEOTEXTILE MATERIAL (Dashed lines)

40 MIL TEXTURED HDPE LINER

CUT FACE SLOPE
“Movable Material”

- 2 Major Piles and 6 other fills and piles.
- Moved to Lined and Capped Landfill about 3 miles away, mixed with lime.
Conclusions

- Acid rock drainage can be a major problem in highway construction – Must be alert.
- Cost about $80,000,000 on I-99.
- This was an unusual vein-type occurrence
- Adding alkaline materials can neutralize, but layering not effective - Must mix in.
- Injection of alkaline solutions/slurries is channeled by layering in pile; incomplete neutralization.