From BS to BMP- Using Biosolids for Taconite Tailings Reclamation

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Outline

- Background
- History of research
- Development of new Best Management Practice
- Agricultural practices
Background

- Standard mineland reclamation practice (inorganic fertilizer, seed, mulch)
- Works well on fine tailings
Background

- Coarse tailings are difficult to revegetate
- Standard mineland reclamation practice not successful
  - Typical cover 30-50%
  - Repeated applications improves cover to a maximum of ~70%
- Mineland reclamation rules require:
  - 90% cover after 3 years (5 years on south or west slopes)
  - Self sustaining vegetation after 10 years
Coarse Tailings
New Paradigm Needed

Organic amendments
- Peat
- Yard waste compost
- Municipal solid waste compost

Series of studies conducted
- Percent cover increased with increasing organic matter
- Cost effective rate was about 20 dry tons/acre
  - Vegetation met 90% cover standard
Standard mineland reclamation

MSW Compost
Problem

• Availability
  – Small amounts of yard waste produced used by public
  – Plans for nearby large-scale municipal solid waste composting facility never materialized
  – Other MSW Compost facilities closed
• No nearby source
Readily available source of nutrients with enough supply to meet mineland reclamation needs

Biosolids!
What really are Biosolids?

• Solid residuals from wastewater treatment plant
  – Treated to reduce pathogens and meet EPA standards
• Previously known as “Sludge”
• Now called a “slow release nitrogen fertilizer” (USEPA)
  – Nutrient-rich organic product of wastewater treatment
Biosolids application rate

• Biosolids quality has generally improved over time
  – Better treatment, lower metals
• Main concern is nitrate leaching
• Agronomic limits
  – Apply only as much nitrogen as the plants growing on the site can use
  – Typical is about 100 lbs N/acre
    • Type of plants
    • Amount of anticipated plant growth
EVTAC, 1997

• First large scale test with biosolids
  – 5 acre demonstration plots
Results, EVTAC (1997 application)

- 100 lbs N /acre improved vegetation but did not meet cover standard
Results, EVTAC (2000 application)

- Top dressing with an additional 100 lbs/N
- Generally improved vegetation
Goal

• Determine an optimum one-time biosolid application rate that will
  – produce vegetation that will meet the reclamation requirements
  – Will not adversely impact water quality
  – Will be cost-effective
Experimental Design

• 5 acre demonstration plots
• Small bin studies to look at the effect of biosolids on water quality
• Treatments
  – Standard mineland reclamation
  – Biosolids
  – Biosolids + paper mill residue
  • Add high carbon material to tie up extra nitrogen
Experimental Design - Details

• Treatments
  – Standard mineland reclamation
    • Seed; grass, legume mix
    • 500 lbs/acre, 18-46-0
    • Mulch, 2 tons/acre
  – Biosolids
    • 100 lbs N/acre (3.1 dry tons/acre)
    • 200 lbs N/acre (6.2 dry tons/acre)
    • 400 lbs N/acre (12.4 dry tons/acre)
  – Biosolids + paper mill residue
    • 200 lbs N/acre + 28 dry tons/acre
    • 400 lbs N/acre + 56 dry tons/acre
Results, Water Quality

• Total dissolved solids
  – Increased with increasing application of biosolids
  – Decreased with time
• Trace metals
  – Low levels associated with paper mill residue
  – Decreased with time
• Nitrate
Water Quality Results, Nitrate

Water quality standard
3 year cover, lower slopes
Conclusions

• Biosolids at 200 lbs N/ acre
  – Suitable vegetation
  – Minimum impact on water quality

Standard mineland reclamation  Biosolids, 200N
New Best Management Practice

• In 2005, PCA approved the application of biosolids to provide 200 lbs N/acre for coarse tailings reclamation

• Applications
  – UTAC
  – Keetac
  – US Steel

• Vegetation has met standard
Biosolids and Fine Tailings

• Standard mineland reclamation
  – Successfully meets mineland reclamation standards

• Can we do better?
  – Biomass crops
  – Forage
  – Soil development
Hybrid Poplar
Forage Production

- Takala Farms wanted to expand dairy herd
- Needed more forage
- Biosolids
  - Provide Nitrogen and Phosphorus
- Tailings
  - Naturally high in Potassium
  - Suitable pH
Forage Production

- St Louis County Extension organized partnership
- Takala Farms/UTAC/ DNR/PCA/ Extension Service
- Agreement
  - Alfalfa for Takala
  - Hay mulch for UTAC
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<td>Typical yield, unmanaged fields</td>
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Got Soil?

Organic Content of Tailings

% organic matter

Year
Better Living Through Biosolids

• Successful BMP for coarse tailings
  – Meet reclamation standards
• Successful forage production on fine tailings
  – Production as good or better than typical fields
• Increases in organic content of tailings with repeated applications
  – Increased soil development
Questions?
Costs

- Initially no cost
- Today
  - $19/acre for application
  - $13/acre to incorporate
  - ~ $1/ton surcharge (over 40 mile haul)
- Total ~ $50/acre