Storage of LDS Sludge in a Flooded Underground Mine

Tracer Tests and Water Quality Development

13th BC/MEND Workshop Vancouver, November 30 2006
• Geographical overview
• Some mine details
• Sludge disposal
• Tracer test
• Results
• Conclusions
• Acknowledgements
Siptenfelde valley to Harzgerode
L234
B242
Selke → shaft mine entrance
Glasebach shaft
No 530 shaft
Biwender adit
Brachmannsberg adit
Glasebach adit
new Glasebach adit
Fluor shaft
Siptenfelde brook
Uhlenbach →
No 539 shaft
Straßberg/Harz
B242
to Harzgerode
0 200 400 600 800 1000 m

shaft
mine entrance
## Mine Details

- **Largest Flourite Mine in (Eastern) Germany**
- Flooding started in 1994
- \[ \text{Discharge: } \approx 7.5 \text{ m}^3 \text{ min}^{-1} \text{ (max: } 18 \text{ m}^3 \text{ min}^{-1}) \]

<table>
<thead>
<tr>
<th>Mine field</th>
<th>Total volume, m³</th>
<th>Flooded, m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straßberg</td>
<td>182,000</td>
<td>178,300</td>
</tr>
<tr>
<td>Brachmannsberg</td>
<td>43,400</td>
<td>42,500</td>
</tr>
<tr>
<td>Glasebach</td>
<td>57,400</td>
<td>56,250</td>
</tr>
</tbody>
</table>
Conventional Treatment (Straßberg Plant): Mine Water Inflow
Conventional Treatment (Straßberg Plant): Liming
Conventional Treatment (Straßberg Plant): Settling Pont 3
Conventional Treatment (Straßberg Plant): Settling Pont 1
Conventional Treatment (Straßberg Plant): Sludge Storage
Übersichtsskizze Hohlräume Straßberg
(vereinfacht)

WNW
Westfeld
450
Ö 206 a
Kiesgrube
Zentralwetter überhasen

(Schnitt)

Zentralteil

OSO
Ostfeld

(Schnitt)

350
2. Sohle

250
5. Sohle

6. Sohle

7. Sohle

150
8. Sohle

9. Sohle

größere freie Hohlräume
versetzte Abbau
vertikale Verbindungsgrubenbaue
Strecken in den Sohlenfarben

offene Strecke: 129400 m³
offene Abbaue: 11800 + 40700 + 0 = 52500 m³,
Sludge Transport

Particle size, mm

Water velocity, m min⁻¹

Erosion

Transportation

Sedimentation

After Hjulström 1935
Demands

- As deep as possible
- Injection without contamination
- More than one injection point
- Suitable tracer for mine water
- Tracer test must be repeatable
- Cheap and easy to handle

Dyed spores

Microspheres
The “LydiA” Technique

- Injection system “LydiA”
- Filter system
- Probe with chemical lock
- Coarse and fine filter meshes
- Probe with soluble chemical lock
- Probe tracer filled in laboratory
- No contamination of mine water by tracer
- Tracer released in predetermined depth
- Probe can remain in mine water throughout the test
Filter System

- Coarse and fine plankton filter meshes
- Separate high suspension load of mine water
- Regular sampling intervals possible (0.5—99 hours)
- Minimisation of contamination
- Suitable for rough underground conditions
Microspheres
- 4 × 40 mL
- No 539 shaft
- No 530 shaft
- Flour shaft
- Glasebach shaft

Lycopodium
- 544 g
- Flour shaft
Sampling point: Microspheres Fluor shaft

3219 microspheres

No 539 shaft
No 530 shaft
Fluor shaft
Glasebach shaft
Injection point: *Lycopodium Fluor shaft*

Spores, total:

- No 539 shaft
- No 530 shaft
- Fluor shaft
- Glasebach shaft

Graph showing spore count over time.
Velocities: 0.01…0.2 m min$^{-1}$
Sludge Transport

Particle size, mm:
- 0.001
- 0.01
- 0.1
- 1
- 10
- 100

Water velocity, m min⁻¹:
- 0.1
- 1
- 10
- 100

- Erosion
- Transportation
- Sedimentation
IR Spectra of Flocculent and Fe-Flocks in Mine Water
• investigated area hydraulically well connected
• contaminated mine water from deeper parts of the mines is transported to higher levels
• LDS sludge buffers the mine water pH
• No additional metals are released to the environment
Thanks to everybody!

- TU Bergakademie Freiberg
- Technische Universität Clausthal
- BST Mansfeld GmbH, Rottleberode
- GVV – Gesellschaft zur Verwertung und Verwahrung stillgelegter Bergwerke mbH, Sondershausen
- EU Project PIRAMID (contract no. EVK1-CT-1999-00021)
- You – for coming and listening