Improving the effectiveness of wells for lignite mine dewatering

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content

1. Problem statement
2. Experimental approach
3. First results

Wells in open pit dewatering
Deep drawdown, long screens, limited life span, permanent pumping

Problem statement

Investment in mine dewatering 60 million €/a
Operating wells: ~1,400
New wells: ~180/a

Problem statement

main influencing parameters
• pH-value
• Oxygen
• (turbulent) flow velocities
• Inbuilt material
• Ground water composition
• Bedrock composition
• Microorganisms

Exaggerated by
Frequently changing groundwater level
Aeration and re-wetting of pyrite containing sediments
### Iron Oxides

<table>
<thead>
<tr>
<th>Iron Oxides</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrhydrite</td>
<td>Fe₃(OH)₄·4H₂O</td>
</tr>
<tr>
<td>Goethite</td>
<td>α-FeOOH</td>
</tr>
<tr>
<td>Lepidocrocite</td>
<td>β-FeOOH</td>
</tr>
<tr>
<td>Akaganèite</td>
<td>γ-FeOOH</td>
</tr>
<tr>
<td>Schwertmannite</td>
<td>Fe₈O₉(OH)₆SO₄</td>
</tr>
<tr>
<td>Hematite</td>
<td>α-Fe₂O₃</td>
</tr>
</tbody>
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### Formation of Different Oxides


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### Experimental Set-up

**Fe(II) solution**
- Sulfate ?
- Nitrate ?
- Carbonate ?
- Hydroxide ?

**MIYAMOTO (1976)**
Fe(II)-sulfate with NaOH to pH 8
stir 7 h at 70 °C

**REFAIT et al. (1998)**
0.23 M Fe(II)-chloride
with 0.4 M NaOH

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### Results

![Graph showing Fe(H) vs pH](image)
Preparing oxygen free water

<table>
<thead>
<tr>
<th>Method</th>
<th>O₂ [mg/L]</th>
<th>O₂ reduction [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deionized water</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>Stirring</td>
<td>2.4</td>
<td>71</td>
</tr>
<tr>
<td>Boiling</td>
<td>1.5</td>
<td>82</td>
</tr>
<tr>
<td>Vacuum</td>
<td>0.6</td>
<td>93</td>
</tr>
<tr>
<td>bubbling with N₂ 4h</td>
<td>0.1</td>
<td>99</td>
</tr>
</tbody>
</table>

Results

<table>
<thead>
<tr>
<th>Fe(II)-solution [mg/min]</th>
<th>Fe(II) concentration [mg/L]</th>
</tr>
</thead>
</table>

Summary

- actual solution to well loss and ageing
  - drill more wells
- parameters known
  - comprehensive theory not
- closed circuit experimental set-up
  - complex control
- starting solution from Fe(II)-hydroxide
  - possible, amount not sufficient
- iron hydroxide formation in the filter
  - gained

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