Application of FactSage in Education within Process Metallurgy at Luleå University of Technology

Andreas Lennartsson
Luleå University of Technology

GTT Annual User Meeting
Herzogenrath, Germany
28th June 2017
Luleå University of Technology

NEW YORK
9,5 tim.

Kiruna

Arctic Circle

Luleå

Piteå

Skellefteå

Filipstad

LONDON
PARIS
BARCELONA
3,5 tim.
Facts about Luleå University of Technology

- Founded 1971
- Turnover SEK 1.6 billion
- 15,000 students
- 1,700 employees
  - 255 professors
  - 824 teachers & researchers
    (professors included)
  - 361 PhD students
- 70 research subjects

57% Research
43% Education
Master Programme
Sustainable Process Engineering

• 10 - 20 students

• Two focus areas
  – Products and Renewable Fuels
    • Chemical engineering
    • Biochemical process engineering
  – Sustainable Minerals and Metals Processing
    • Process metallurgy
    • Mineral processing
How we teach/use FactSage in education

In total 32 courses in the programme Process Metallurgy gives:

- High Temperature Processes
  - Equilib
- Hydrometallurgy
  - EpH
- High Temperature Material
  - Phase Diagram
- Process Metallurgy
  - Equilib, Phase Diagram, EpH
Project in High Temperature Processes

• Gas cleaning equipment
  – Self studies

• Selective gas cleaning
  – Is it possible to obtain a selective dust separation
  – Which gas cleaning equipment is suitable (particle size, temperature etc.)
  – Use equilibrium calculations to study reactions in the gas cleaning system and the influence of temperature and composition
  – Which demands is there for recycling metals from dust
Copper converting is done in a PS-converter at 1200-1250°C with air. The off-gas contains SO₂ and N₂ but also Pb, Zn, As, Bi which are fumed off during the process.

<table>
<thead>
<tr>
<th>Element</th>
<th>Volyms%</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₂</td>
<td>0,01</td>
</tr>
<tr>
<td>N₂</td>
<td>83,75</td>
</tr>
<tr>
<td>SO₂</td>
<td>16,05</td>
</tr>
<tr>
<td>PbS</td>
<td>0,03</td>
</tr>
<tr>
<td>Pb</td>
<td>0,01</td>
</tr>
<tr>
<td>PbO</td>
<td>0,003</td>
</tr>
<tr>
<td>Zn</td>
<td>0,07</td>
</tr>
<tr>
<td>AsS</td>
<td>0,0007</td>
</tr>
<tr>
<td>AsO</td>
<td>0,03</td>
</tr>
<tr>
<td>SbO</td>
<td>0,0002</td>
</tr>
<tr>
<td>SbS</td>
<td>0,002</td>
</tr>
<tr>
<td>Bi</td>
<td>0,003</td>
</tr>
<tr>
<td>BiS</td>
<td>0,0002</td>
</tr>
</tbody>
</table>
0.01 O₂ + 83.75 N₂ + 16.05 SO₂ + 0.03 PbS +

H:\My Documents\Gasreningsproekt\FactSage\Equi0.res 19feb14
Students Suggestion
Our Experience

• Students think that FactSage is easy to use

• The threshold for using FactSage in later courses / thesis work is lowered

• It is essential to point out the importance to read the documentation
Is everything as good as it sounds?
Future
Suggestions for new ways to teach the subject
Thanks for your attention