Possibilities for a Discharge Reduced Salt and Potash Production

Experience from worldwide engineering activities of K-UTEC AG

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Exchange Conference on Potash

June 2013 | Geermu, China
1. European Legislation
2. Types of Crude Potash Salts
3. Processing and Residues
4. Residue Utilization Options
   - Recovery of Saleable Salts
   - Backfilling
5. Project Examples
6. Conclusion
According to the actual European Legislation ....

... mineral deposits generally have to be used sustainably.

... aqueous systems have to achieve a good status until 2015.
Types of Crude Potash Salts

... in Europe

- Chemical Composition

- Sylvinitite
- Anhydritic Hard Salt
- Kieseritic Hard Salt
- Carnallitite
- Polyminal Hard Salt

Components:
- H2O/etc.
- Insolubles
- K2SO4
- MgCl2
- MgSO4
- CaSO4
- NaCl
- KCl
Processing and Residues

- Actual Situation

Exploitation

Crude Salt / Raw Brine

Processing

Products

Solid Wastes

Liquid Wastes

Stockpiling

Backfilling

River

Deep Underground

Percolating Brine

small mounts
Residue Utilization Options

- Recovery of saleable salts
- Backfilling (water reduced and/or solidified by additives)
- Stockpiling according to the state of the art
## Recovery of Saleable Salts

-Treatment of the Liquid Wastes Resulting from Processing

<table>
<thead>
<tr>
<th>SALT TYPE (ORE)</th>
<th>PROCESS</th>
<th>RECOVERED SALTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sylvinite:</td>
<td>Evaporation, Cooling</td>
<td>NaCl, KCl</td>
</tr>
<tr>
<td>Anhydritic Hard Salt:</td>
<td>Glaserite-Process, Cooling</td>
<td>K$_2$SO$_4$</td>
</tr>
<tr>
<td>Kieseritic Hard Salt:</td>
<td>Schoenite-Process; poss. separate MgCl$_2$-Treatment</td>
<td>K$_2$SO$_4$</td>
</tr>
<tr>
<td>Carnallitite:</td>
<td>Carnallite-Process; separate MgCl$_2$-Treatment</td>
<td>KCl</td>
</tr>
</tbody>
</table>
Recovery of Saleable Salts

End Bittern (approx. 450 g/l MgCl₂)

**Options for MgCl₂-Solution (End Bittern)**

- **Option 1**: MgCl₂·6H₂O
- **Option 2**: MgO + HCl
- **Option 3**: Mg(OH)₂ + CaCl₂ / NaCl
- **Option 4**: MgCl₂-Brine
Since 1908, hydraulic stowing for backfilling has been applied in the German Potash industry.

- Protection of the surface
- Optimized utilization of the resources
- Recycling of waste materials
Backfilling
-Backfilling in Combination with Pillar Re-mining | Mine Bleicherode

Backfilling and Pillar Re-mining (MER 80 ... 90 %)

Conventional Mining (MER 40 ... 50 %)

1000 m
Backfilling

Solid and Liquid Waste Materials from the Processing Plant

Solid and Liquid Industrial Waste Materials

Hydraulic Backfilling

storage and mixing plant

brine tank

sludge plant

sandstone

salt horizon

mine opening, backfilling required

brine drainage system
Iberpotash | Spain: Production of common salt (NaCl) based on flotation tailings

Salinen Austria | Austria: SOP and NaCl production from purges of salt winning plant

Thangone | Lao: Purge free MOP production based on Carnallite solution mining

GSES | Germany: Concept for a new Potash production in Sondershausen

Rossleben | Germany: Concept for a new Potash production in Rossleben

K+S | Germany: Proposal to avoid the discharge of waste brines
Project Examples

Salinen Austria | Austria

Solution Mining

- Purification
  - Evaporation
    - Disposal Brine
      - Discharge into River
        - Modification since 2006
          - SOP Plant
            - Reduced Effluent
              - NaCl
                - K₂SO₄
                  - NaBr
                    - Bromine Plant
                      - No Effluent

- Slugde
  - NaCl

- Backfilling

Process since 1978
Project Examples

Thangone | Lao

Processing

Carnallite Brine → Evaporation → Disposal Brine

KCl 120,000 t/a
NaCl 40,000 t/a

ca. 310,000 m³/a Volume
Backfilling Slurry

ca. 330,000 m³/a Produced Cavity

Cap Rock
Carnallitite, Deposit
Residues
Cavern Sumps
Blanket Level
## Project Examples

### Objective:
Production of KCl

### Ore:
Carnallitite with 10 % Hard Salt
1,000,000 t/a  |  525,000 m³/a

### Products:
- Kieserite: 135,000 t/a
- Anhydrite: 16,000 t/a
- KCl: 137,000 t/a
- NaCl (98 %): 350,000 t/a
- MgCl₂-Solution (ca. 450 g/l MgCl₂): 399,000 t/a
- MgCl₂-Solution for Backfilling: 198,000 t/a  |  138,000 m³/a

Density: d ~ 1.44 t/qm
Project Examples

Concept K+S | Germany

River
Deep Underground
Actual Situation

Proposed Process

Mixed Brines

Evaporation

Brine from Potash Plant
Brine from Tailings Disposal
Brine from Kieserite Plant

Cooling

Na\textsubscript{2}SO\textsubscript{4}

MgCl\textsubscript{2}

NaCl

K\textsubscript{2}SO\textsubscript{4}

Backfilling

Additives

Refining

SOP Plant
Avoiding of discharge of waste brines is possible.

Minimizing of valuables loss is possible.

Sustainable use of the deposit by backfilling is possible.

Each crude salt and each process need their specific way in order to find out the right answer.
THANK YOU!

Potash Fertilization

No Potash Fertilization