Potash Development: Global Opportunities, Local Challenges

Stuart Middleton, AMEC

14th Brazilian Mining Congress and the EXPOSIBRAM 2011
Outline

1. Opportunities – Consumption
2. Opportunities - Production growth
3. Major Production areas – Current Activities
4. Challenges – Existing Production Areas
5. Challenges - New Production
6. Challenges and Advantage Brazil
What is Potash?

Potash can refer to a variety of potassium compounds:

- **Common Fertilizers**
  - Muriate of Potash (KCl)
  - Sulphate of Potash (K₂SO₄)
  - Normally sold on equivalence in K₂O
  - 0 – 0 – 60 On a bag of fertilizer means almost all is Muriate of Potash (95% KCl)

- **Industrial**
  - Industrial and Refined KCl & K₂SO₄
  - KOH

- **Granular Potash** is usually 2.0-4.0 mm with most material produced by compaction using roll presses. SGN 285 – 300 UI 60 - 50
Potassium activates more than 60 enzymes, (the chemical substances that govern life and play a vital part in carbohydrate and protein synthesis). It improves a plant's water regime and increases tolerance to drought, frost and salinity. Plants that are well supplied with potassium are less affected by disease.

(International Fertilizer Association)
World Consumption

Consumption KCl and K$_2$SO$_4$
Nutrient Tonnes

Year


Tonnes Thousands

World

Brazil

International Fertilizer Association
Consumption – Key Facts

Principal Consumers

<table>
<thead>
<tr>
<th>Country</th>
<th>Demand (thousand t/a K₂O)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>4,434</td>
<td>19%</td>
</tr>
<tr>
<td>United States</td>
<td>4,085</td>
<td>17%</td>
</tr>
<tr>
<td>India</td>
<td>3,632</td>
<td>15%</td>
</tr>
<tr>
<td>Brazil</td>
<td>3,149</td>
<td>13%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>801</td>
<td>3%</td>
</tr>
<tr>
<td>Belarus</td>
<td>733</td>
<td>3%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>700</td>
<td>3%</td>
</tr>
<tr>
<td>Poland</td>
<td>419</td>
<td>2%</td>
</tr>
<tr>
<td>France</td>
<td>416</td>
<td>2%</td>
</tr>
<tr>
<td>Germany</td>
<td>363</td>
<td>2%</td>
</tr>
</tbody>
</table>

- Nutrient value expressed as K₂O equivalent
- Muriate of Potash (KCl) = 60% K₂O equivalent
- Annual demand growth for KCL and K₂SO₄ = 500 kt (K₂O equivalent)
- Annual demand growth all K fertilizers = 405 kt (K₂O equivalent)
- Top four countries (out of 101) consume 64% of the World supply.
World Potash Production (USGS 2011) thousand tons K$_2$O

- Increasing at 520 kt/a over period since 1998
- Similar analysis in 2008 would have shown growth at 990 kt/a
World Potash Production (USGS 2011) thousand tons K$_2$O

Since 1946

Annual growth rate is 470 kt/y
World Potash Production (USGS 2011) thousand tons $K_2O$

Eleven countries currently produce all the World’s potash.

Three countries produce 62% of the World’s potash.
World Potash Reserve (USGS 2011) million tons K₂O
Current Developments in Major Producing Areas
Areas of Interest - Canada

From Halabura, Piche et. al. – North Rim
## Current Developments - Canada

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PCS</td>
<td>9.9</td>
<td>1.9</td>
<td>11.8</td>
<td>6.2</td>
<td>18.0</td>
<td></td>
<td>18.0</td>
</tr>
<tr>
<td>Mosaic</td>
<td>8</td>
<td>0.4</td>
<td>8.4</td>
<td>4.7</td>
<td>13.1</td>
<td></td>
<td>13.1</td>
</tr>
<tr>
<td>Agrium</td>
<td>1.7</td>
<td>0.3</td>
<td>2.0</td>
<td>1.0</td>
<td>3.0</td>
<td>4.0</td>
<td>7.0</td>
</tr>
<tr>
<td>New Entrants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19.6</strong></td>
<td><strong>2.6</strong></td>
<td><strong>22.2</strong></td>
<td><strong>11.9</strong></td>
<td><strong>34.1</strong></td>
<td><strong>19.0</strong></td>
<td><strong>53.1</strong></td>
</tr>
</tbody>
</table>
Cory, Saskatchewan

C$1.4B debottlenecking and expansion
Adding 1.2M tpy of red fertilizer production
Includes mining, hoisting, processing, utilities and infrastructure
Scoping/feasibility studies, cost update, and EPCM services
Lanigan, Saskatchewan

EPCM for a mill rehabilitation to increase production by 1.5M tpy,
Completed in 2008
Capital cost C$358M
Extensive studies, conceptual design and cost estimating
Underground engineering services for a new potash mine
EPCM services for surface facilities including 2M tpy concentrator, salt storage/loadout, power distribution, and brine disposal pipeline
EPCM services for expansion of the nearby Penobsquis milling operation by 1.25M tpy
Total project cost $1.7B
Rocanville, Saskatchewan

Detailed study and fast-track EPCM services of a C$127M potash mill upgrade

EPCM of the $2.8B Rocanville West expansion, including:

- new mill adjacent to the existing operation, to increase production from 2.7M to 5.4M tpy
- new 300,000-tonne storage
- warehouse/shop
- office facilities
Russian Operations

5 mines
8 ore-enrichment mills:
- 7 potash plants
- 1 carnallite plant

Licence to develop L Ist-Yavinsky block of Verkhnekamskoe deposit
Licence to develop Polavadovsky block of Verkhnekamskoe deposit
## Current Developments – Russia and Belarus

<table>
<thead>
<tr>
<th>Company</th>
<th>Capacity 2010</th>
<th>Capacity Increases</th>
<th>Capacity by 2013</th>
<th>Greenfield Projects</th>
<th>Capacity ~ 2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uralkali &amp; Silvinit</td>
<td>10.7</td>
<td>2.3</td>
<td>13.0</td>
<td>5.5</td>
<td>18.5</td>
</tr>
<tr>
<td>Belaruskali</td>
<td>9.2</td>
<td>1.8</td>
<td>11.0</td>
<td></td>
<td>11.0</td>
</tr>
<tr>
<td>New Entrants</td>
<td></td>
<td></td>
<td></td>
<td>4.3</td>
<td>4.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19.9</strong></td>
<td><strong>4.1</strong></td>
<td><strong>24.0</strong></td>
<td><strong>9.8</strong></td>
<td><strong>33.8</strong></td>
</tr>
</tbody>
</table>

Data – Fertilizer International
Challenges – Other Producing Areas

China - Limited resource

Germany – Mature industry – Increasing costs and environmental pressure

Israel/Jordan – Low cost producers with some current expansion – limited by water inflow to the Dead Sea

United States – High costs with some potential for expansion – Specialty products

Chile – Limited resource – Most potash is by product

Brazil – See later discussion

Spain – Limited resource

United Kingdom – High cost producer with limited expansion potential – possibility of production of specialty products
Challenges – New Areas

- **Thailand** – Sylvinite and Carnallite projects – Environmental challenges – Political challenges – Key market area
- **Kazakhstan and Iran** – Small deposits – Local market
- **Australia** – Remote deposits – Limited local market
- **Argentina** – Good deposit – location offers logistic challenges
Opportunities and Challenges – East Africa

• Promising Deposits
• Shallow
• Good grades
• Potential low cost producer
• Logistic and political challenges
Challenges - West Africa

- Area has a number of potential projects and one formerly producing mine.
- Typically sylvinitic overlying carnallite and tachyhydrite.
- Previous mine flooded.
- Undeveloped Infrastructure
- Major advantage is proximity to sea routes, particularly to Brazil.
Challenges – Brazil Amazon

• Conventional and solution mining are feasible
• Logistic costs are high
• Subsidence would create extensive inundation

Fazendinha Area
Challenges Brazil - Offshore

- Potentially Large Resource
- Technology exists but requires considerable adaptation
- Costs may be higher than for shore based solution mines
Challenges Brazil – Coastal Area

- Existing Taquari Vassoros conventional mine
- Proposed Carnalita Project
- Potential for other Solution Mines
Brazilian advantages

- Strong domestic market reduces risk of market fluctuation
- National advantage for reduction is currency outflow
Acknowledgements

• Thanks to Steve Halabura and Lola Piche of North Rim for letting me use their diagram
• Mark Evans of fertilizer International for the FSU statistics
• MbAC for permission to use the Illustration of offshore mining
• Thanks to my colleagues at AMEC for contributions, proof reading and all round support.
The End

Thank You