An Introduction to Phosphate Supply, Demand & Opportunity

phosphorous 15

P
30.974

potassium 19

K
39.098

nitrogen 7

N
14.007

Qualified Person: Under the terms of NI 43-101, David Cass, B.Sc., M.Sc., P.Geo., President, of Focus is the Qualified Person responsible for the technical information given in this presentation.
Phosphate: What is it, and why is it so important?

• Phosphorus: P on the Periodic Table of Elements is essential to all life forms

• Nitrogen, Phosphorus (from phosphate rock) and Potassium (from potash) are the three primary macronutrients in fertilizer

• Only Phosphorus is absolutely essential - only phosphorus can make crops thrive

• Fertilizer directly linked to 40% of global food production

• Phosphate rock supply is unstable: geo-politics, economics and distance impact supplies

Photo: Tennessee Valley Authority – Phosphate Demonstration 1942
Phosphate: What is it used for?

Phosphate rock is mined to obtain phosphorus for use in agricultural fertilizers (90%) and industry (10%).

Modern Agriculture and Global Food Security

↑ food crisis + ↓ supply of arable land = global dependence on phosphate fertilizers to

- maximize yields
- accelerate maturity
- increase disease resistance

Projected 200% increase in meat consumption globally, pressures supply of phosphate supplemented feed.

Growing bio-fuel sector requires phosphate fertilizers.
Phosphate: Where do we find it?

**Sedimentary Phosphate deposits** represent approx 80% of the world’s phosphate. Deposits are formed primarily from the deposition of shells and dead organisms in ancient sea and lake beds, presenting in multiple layers over expansive areas. Typically much larger and easier to mine (if unconsolidated) than igneous deposits. **Grades typically range between 10% - 30% P₂O₅**

**Igneous Phosphate Deposits** comprise the balance, and occur mainly in Brazil and Southern Africa. **Grades range between 4% - 15% P₂O₅**

*Phosphorous Pentoxide*

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Phosphate beds in outcrop, Bayovar, Peru
Inset – close up showing fossil fragments and P₂O₅ pellets
Phosphate Facts: Processing and Products

• Commercial grades of phosphate rock concentrate vary from about 27% to 36% P$_2$O$_5$.

• The grade of most mined ore is below the commercial-grade range; requiring processing or beneficiation (separating minerals from waste) before it can be used or sold.

• If ore is of high enough grade it requires only crushing before being sent direct to market (referred to as Direct Ship Ore or DSO)

• 80% to 85% of phosphate rock is consumed in vertically integrated fertilizer production which typically manufacture phosphoric acid, used to produce fertilizer end products such as:
  - DAP (diammonium phosphate)
  - MAP (monoammonium phosphate)
  - TSP (triple super phosphate).
Phosphate Fertilizer Flowsheet

- Phosrock is mixed with sulphuric acid to make phosphoric acid for use as feedstock for upgraded products.
- Phosphoric acid can be combined with ammonia and granulated to produce dry solid fertilizers (DAP and MAP) or concentrated to produce merchant grade phosphoric acid (MGA) or further concentrated to produce super phosphoric acid (SPA).
- DAP and MAP are the most widespread products sold to farmers.

**Phosphate Deposit**

5 – 30% P$_2$O$_5$

**Phosphate Rock Concentrate (PhosRock)**

28 - 32% P$_2$O$_5$

**Beneficiation**

**Phosphoric Acid**

Add Sulphur

Mix with Ammonia

**MGA – Merchant Grade Phosphoric Acid**

**MAP – Mono-ammonium phosphate**

**DAP – Di-ammonium phosphate**

**TSP – Triple Superphosphate**

**SSP – Single Superphosphate**
Supply and Demand Imbalance of Phosphate

Globally, the **demand** for phosphate grows in tandem with urbanization.

**Key factors affecting demand**

- Population growth: mouths to feed
- Wealthier populations want to eat better; - Shift to protein and dairy based diets in emerging economies
- Livestock displaces food crops & requires feed crops
- Demand for biofuels: Algae displaces food crops and consumes phosphate fertilizer
- Loss of and stresses on arable land
- Government policies to enhance farm yield
**Global Supply and Reserves**

**World Phosphate Reserves**

- **Morocco and W. Sahara**
- **China**
- **United States**
- **Russia**
- **Syria**
- **Jordan**
- **South Africa**
- **ROW**

**Mine Production by Country**

- **China**
- **United States**
- **Morocco and W. Sahara**
- **Russia**
- **Jordan**
- **Brazil**
- **Tunisia**
- **Israel**
- **Egypt**
- **Australia**
- **Peru**
- **Syria**
- **South Africa**
- **ROW**

**Supply** is unstable and reserves are inequitably distributed geographically

**Key factors affecting access**

- Finite reserves: diminishing supply
- Geo-politics: conflicts and instability at source. Sanctions, export tariffs and quotas
- Geography: distance to market
- Domestic need at source

- China, Morocco and the USA account for 2/3rds of World Production
- Most of China’s production is used domestically
Mine Production in 000’s tonnes phosphate rock

Demand for Phosphate Rock
Imported tonnes shown as a % of tonnes produced regionally

India and Europe very dependent on imports for their phosphate supply

Source: IFA 2011
Through 2018 South America will lead global demand for phosphate, driven by strong growth in Brazil...followed by China, N America and India.

Forecast increase in global phosphate ($P_2O_5$) demand 2009 – 2018E = 14 million tonnes ($P_2O_5$) expressed as a % for each region.

Source: Deutsche Bank/British Sulphur
...but 96% of global phosphate rock reserves are located in the northern hemisphere, in geographical clusters, with 85% in Morocco, Western Sahara and Algeria.

• Source: USGS, 2012
Latin America: Crop Rich, Phosphate Poor

One of the fastest growing markets for phosphorus is Latin America, thousands of kilometres away from 96% of world supply. Latin America grows **11% of the world’s food** yet only **2% of global phosphate reserves** are located in Latin America.

Due largely to Brazil, Latin America will account for **over a quarter** of total increase in world phosphate consumption from 2009 – 2018E*

Latin America requires new domestic phosphate reserves to lessen dependency on imports.

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**Current world fertilizer trends and outlook to 2016, Food and Agricultural Organization of the United Nations, Rome 2012**  
* Deutsche Bank/British Sulphur
Outlook for Phosphate

• Phosphate prices recovered quickly after the 2008 recession; Short supply and rising grain prices were key drivers

• China’s 12th Five Year Plan calls for increased foreign investment in modern agriculture to combat food shortage. Current high phosphorus export tariffs to continue

• Phosphorus demand forecast to rise steadily over next 10+ years alongside explosive global urbanization

• Offshore and underground mining costs will pressure prices and demand
Some factors affecting Supply Instability

- Economic development in India and Africa, rising demand of arable land and fertilizer driving up prices of phosrock
- China’s activity in Africa intensifies competition to secure supply, China becoming net importer
- Export limitations e.g. China, political turmoil e.g. Syria, dwindling reserves in the US, all lead to tighter supply
- Plans by major producers such as Morocco and Saudi Arabia to become more and produce higher value fertilizer products will affect vertically integrated importers of phosrock
- Moral rights of Morocco over Western Sahara disputed territory, more land and benefits to local indigenous people and affect of UN / Europe
- Scarcity of water
- Tighter restrictions by governments on sources of high cadmium phosphate e.g. from Morocco
Fertilizers are essential to creating and maintaining global food security.

Growth of new markets such as Latin America and India will result in demand for rock phosphate outgrowing supply (“Peak Phosphate”)

Morocco controls approx. 35% of seaboard trade of rock phosphate and plans to increase its production of chemical phosphates

Large integrated producers (e.g. Mosaic) will turn to sources other than Morocco for supply resulting in increased demand for alternative sources of rock phosphate

As such, demand for phosphate in Latin America will be fueled by Asia, North America and its own domestic markets e.g. Brazil
Phosphorous: a key ingredient in fertilizer and an essential nutrient for plant life

Phosphate is naturally occurring, found mainly in sedimentary and igneous deposits

>40% of world food production uses fertilizer

Major consumers of fertilizer: China, India, Brazil

Major phosphate producers are Morocco, China and the US

Food security is second only to national security

“Another food crisis could be looming”*