Report R69/2008

OVERVIEW OF SOUTH AFRICA'S MINERAL BASED FERTILISER INDUSTRY, 2008

DIRECTORATE: MINERAL ECONOMICS

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

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Cover picture: Different types of apatite by courtesy of Dr. Gert van der Linde.

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1. INTRODUCTION

Mineral fertilisers, either natural or manufactured are materials that contain nutrients for the normal growth and development of plants. Most minerals used as fertilisers are industrial minerals and serve many agricultural uses, from soil amendments (lime, potash, perlite, vermiculite), animal feed supplements (magnesia, salt) to micronutrients (calcium borates, sulphur and magnesia). The three primary nutrients of fertilisers are nitrogen, phosphate and potash.

2. HISTORY OF THE SOUTH AFRICAN FERTILISER INDUSTRY

The local fertiliser industry dates back to 1903, when the South African Fertiliser Company (SAFCO) began production of phosphate, using animal bones. The development of the South African mining industry in the 20th century necessitated the production of explosives resulting in the production of larger quantities of by-product sulphuric acid. The by-product sulphuric acid, and imported phosphate rock, formed the basis of a viable fertiliser industry. Some explosives producers including Kynoch (Umbogintwini) and Cape Explosives (Somerset West) began fertiliser production in 1919 and 1920, respectively. The original Kynoch and Cape Explosives joined forces in 1924 as AE&E, which later became AE&CI (i.e. African Explosives and Chemical industries, at present AECI Limited). AECI continues to produce both explosives and fertilisers among other product ranges.

Local fertiliser products were blended with imported fertiliser products up until the Second World War, when imports dried up. Price control was introduced by the government of the day as a war measure during the early 1940s and continued until the early eighties. The industry flourished under this environment and led to the development Foskor in the early 1950's – Sasol and Iscor were also established during this time. As a result, the Fisons and Windmill (Sasolburg) and Bosveld (Phalaborwa) fertiliser factories were established. By 1969, these factories, together with Fisons factory at Milnerton, became part of Fedmis. Other companies such as Omnia and Triomf started up during this time.

The liberalisation of trade policies, abolishment of price control, and the opening-up of the South African economy that started around 1984, which gained momentum during the 90s, led to consolidation and restructuring of the fertiliser industry.

Sasol Limited, which previously had been a supplier to other fertiliser manufacturers only, established its own fertiliser company (Sasol Fertilisers) and started marketing directly to farmers in 1984. Triomf and AECI separated their interests. Triomf kept the factories at Potchefstroom and Richards Bay, whilst AECI revived the name Kynoch Fertilisers with their factories at Somerset West, Umbogintwini and Modderfontein which they repossessed from Triomf. In 1986, Kynoch took over the local interests of Triomf. At about the same time an overseas consortium (Indian Ocean Fertiliser, IOF) took over the Richards Bay plant. IOF produced phosphoric acid and soluble phosphates mainly for the export market.

In 1988, the operational interests of Fedmis, a division of Sentrachem, were taken over by Sasol Fertilisers, Kynoch Fertilisers and Omnia Fertilisers. During 1990, Foskor became a shareholder in IOF. In 1992, Sasol fertilisers decided to cease its direct marketing to farmers. In 1993, Kynoch Fertilisers took over the nitrogen interests of AECI. Chemfos (a subsidiary of Samancor), which mined phosphates at Langebaan and which was also a fertiliser blender, ceased its activities towards the end of 1993. In the period 1999-2004, Foskor obtained the entire shareholding of IOF. Norsk Hydro obtained the controlling interest in Kynoch. Sasol obtained a 100% interest in Fedmis of Phalaborwa, which had been operated as a 50-50 joint ventures by AECI-Kynoch and Sasol Fertilisers. Sasol Agri was renamed Sasol Nitro and Kynoch became known as Yara SA. The Industrial Development Corporation (IDC) remains the majority (97,5%) of Foskor, with Coramandel Fertilisers from India having taken up a 2,5% stake in the company in 2005.

3. PRIMARY NUTRIENTS

3.1. PHOSPHATE

Phosphorous (P), which is present in every living cell, both plant and animal, is a primary nutrient (along with potassium and nitrogen) and converts energy to a usable form for food and fibre. Phosphorus is the second most widely used fertiliser nutrient after nitrogen. Phosphate fertiliser demand is the most important factor in the demand for phosphate rock. Almost 90% of annual phosphate rock production finds its way into chemical fertiliser products. Industrial end-use sectors consume around 6% of phosphate rock produced, with animal feed additives making up about 4%.

Phosphate rocks are a primary source of phosphorous. Apatite, the most common igneous source of phosphate is a colourless, glassy and crystalline mineral when fresh. In weathered surface deposits it is mostly green or pale blue in colour. It has a hardness of 5 on the Moh's scale and a relative density of 3.2, noticeably greater than quartz which it occasionally resembles. For use in the fertiliser industry, a phosphate rock or its concentrate needs to contain at least 30% phosphorous pentoxide (P_2O_5) and reasonable amounts of $CaCO_3$, whilst having less than 4% combined content of iron and aluminium oxides.

The P_2O_5 content in phosphate rock typically varies from 4 – 42% P_2O_5, with the term phosphate rock generally applied to any rock containing more than 20% P_2O_5, the content of which is the main method of quantifying grade; BPL (bone phosphate of lime) may also be used. These terms are related as follows:

$$\%P_2O_5 \times 2.1853 = \%\ BPL$$
$$\%\ P_2O_5 \times 0.4364 = \%\ P$$
$$\%\ P_2O_5 \times 1.381 = \%\ H_3PO_4$$

3.1.1. Occurrence of Phosphate

Phosphate is extracted from three main types of deposits; marine phosphorites, apatite-rich igneous rocks, and modern and ancient guano accumulations. Though all three types occur in South Africa, the igneous deposit at Phalaborwa is the major one currently being exploited.

Approximately 30 countries produce phosphate rock and most commercial producers exploit sedimentary sources. However, igneous rocks containing phosphate in the form of apatite are exploited in South Africa, Brazil, Russia, Finland and Zimbabwe (Figure 1). Sedimentary sources are characteristically soft and cheap to mine and process, as well as being of high grade, though they often contain impurities, especially cadmium and arsenic, which are carried over into downstream products and waste products. Igneous ores are hard and low grade, but relatively free of impurities and are ideally suited to froth flotation.

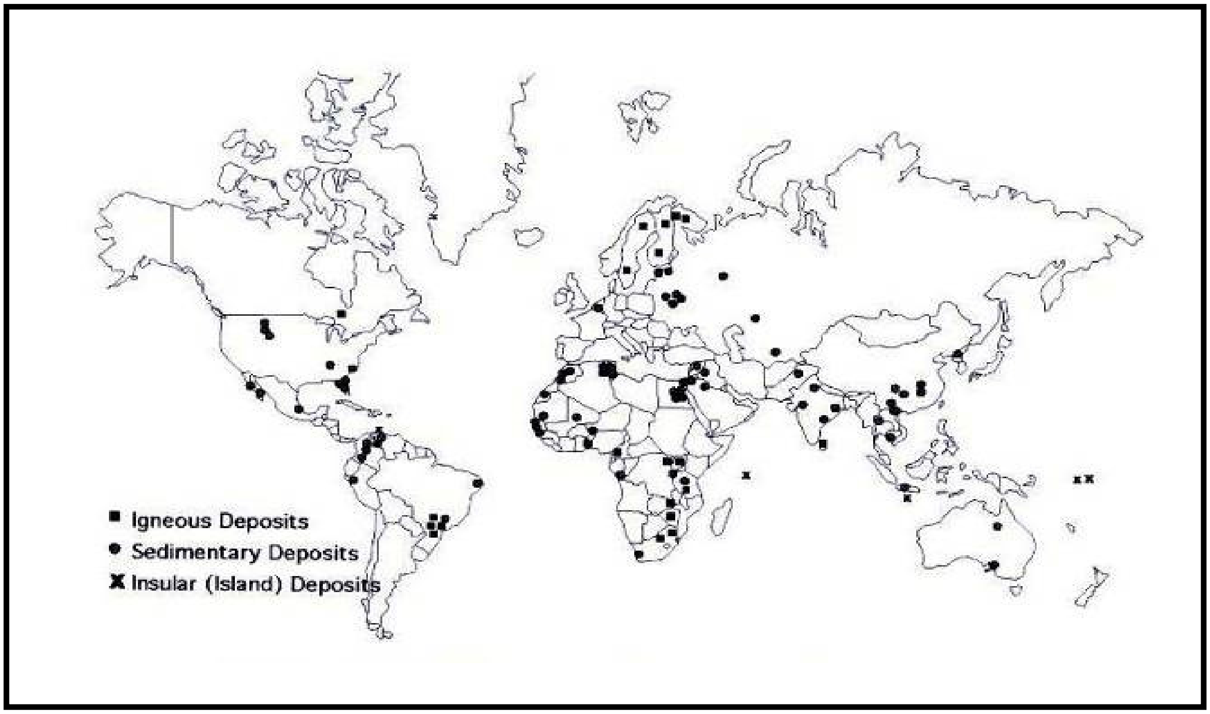

Figure 1: Global location of phosphate rock deposits

(Source: Potash and Phosphate Institute)

3.1.2. Phosphoric Acid Process

Phosphate rock plus sulphuric acid produces phosphoric (orthophosphoric) acid, H_3PO_4, a clear green viscous, oily liquid which is miscible with water in any ratio (Figure 2).

There are a number of commercial grades of phosphoric acid depending on the manufacturing process, P_2O_5 content, impurity content and end use. In the WET PROCESS, finely ground phosphate rock is mixed with water and a recycled stream of phosphoric acid to form a slurry that is treated with sulphuric acid (93%) to form 28% P_2O_5 dilute phosphoric acid plus gypsum solids (filtered by-product phosphogypsum). The phosphoric acid is concentrated to 42% by evaporation, for use in granular phosphorous fertilisers, or merchant grade acid (52 – 54%) or via further evaporation and filtering to clear green superphosphoric acid (68% - 72%).

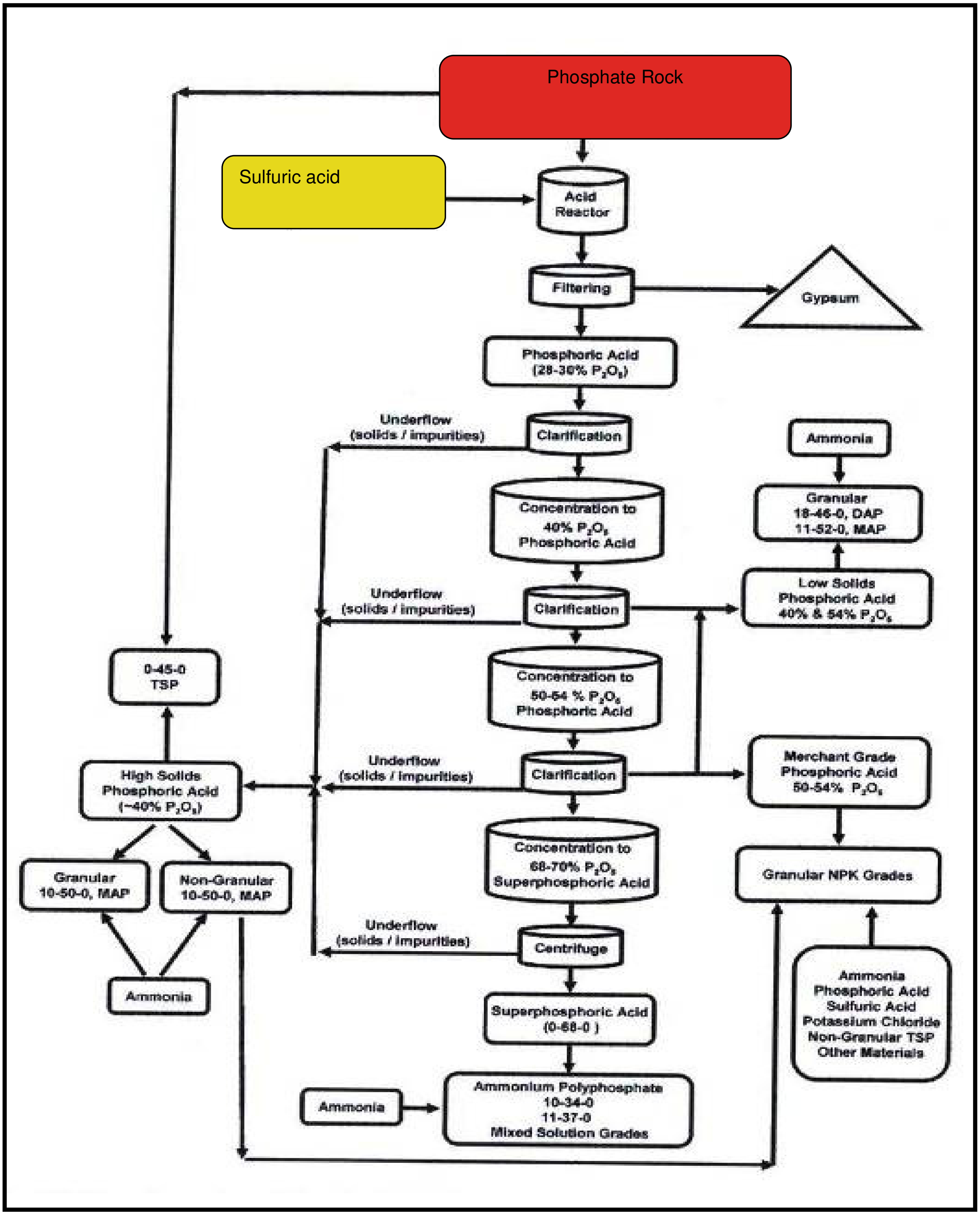

Figure 2: Phosphoric Acid Production Process

(Source: Potash and Phosphate Institute)

The basic reaction is:

$$Ca_{10}(PO_4)_6F_2 + 10\ H_2SO_4 \longrightarrow 10CaSO_4 + 6H_3PO_4 + 2\ HF$$

phosphate rock **sulphuric acid** **gypsum** **phosphoric acid**

Phosphoric acid is the largest inorganic acid produced and consumed in terms of value, and is second only to sulphuric acid in terms of volume. The major uses of phosphoric acid include fertilisers, food additives, detergent additives, acid cleaners, water treatment and cement processing. Agricultural grade acid is used in the manufacture of liquid fertiliser and can also be applied as a fertiliser (phosphate fertiliser solution) for alkaline and calcerous soil areas by injection into the soil or irrigation water.

3.1.3. Phosphate Fertiliser Process (MAP/DAP)

Phosphoric acid plus ammonia produces monoammonium phosphate, $NH_4H_2PO_4$, or MAP, used in fertilisers and speciality fertilisers, animal feed, specialised industrial uses, fire-fighting chemicals and diammonium phosphate, $(NH_4)_2HPO_4$, or DAP (fertiliser).

Food grade MAP and DAP are used as a buffer and nutrient in processed cheese, as a nutrient source and dough strengthener in bakery products and as a processing aid and ammonium fortifier in the manufacture of dairy cultures. Anhydrous technical grade is used as an additive in liquid and dry speciality fertilisers, as a fire and afterglow retardant, and as a bonding agent in ceramics.

3.1.4. International Phosphate Production

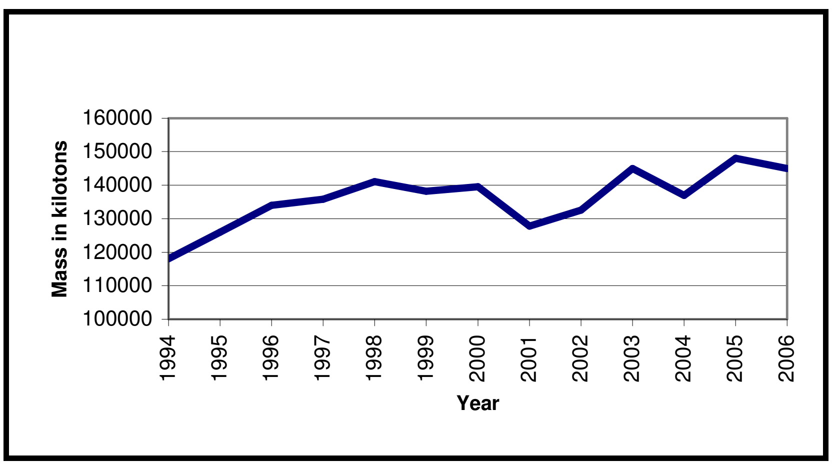

Figure 3: World Production of Phosphate Rock, 1994 – 2006

(Source: USGS)

World production followed an increasing trend from 1994 to 1998 as a result of increasing demand for fertilisers. Between 1999 and 2001, there was a downturn in the phosphate industry which was triggered in 1999 by falling demand. This in turn was a result of poor weather conditions, higher fertiliser prices and less planted acreage. Production has fluctuated between 2003 and 2006 as a result of strong demand and production shortfalls in key producing countries

China (29 percent) has overtaken the USA (27 percent), as the world leader in phosphate production, followed by Morocco (23 percent) and Russia (10 percent). South Africa is ranked ninth with 1.8 percent of world production.

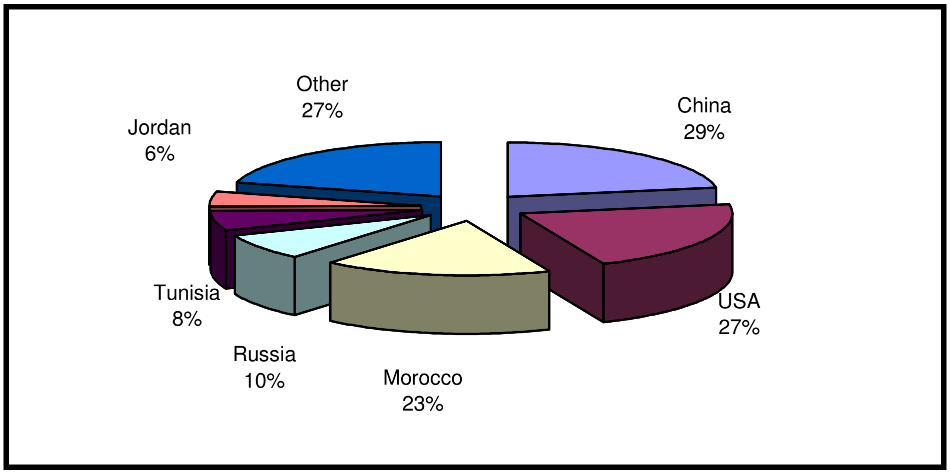

Figure 4: World production of phosphate rock by country, 2006

(Source USGS)

3.1.5. South Africa's Phosphate Industry

3.1.5.1. Reserves and Resources

The 2 billion year old (Archean) Palaborwa Carbonatite Complex in Limpopo Province contains apatite bearing zones which are the major source of South African phosphate production. The apatite is relatively coarse grained, with a well developed crystal structure, is hard and practically insoluble in water and weak acids such as citric acid. It is unsuitable as a direct application fertiliser and must first be treated with strong acids. The total radioactivity of the Palabora apatite is characteristically lower than other igneous phosphate minerals in the world. The Palabora carbonatite contains two types of apatite ores: foskorite and pyroxenite.

The foskorite embodies some 20Mt of ore for each 30m of depth, and has a mean phosphorous pentoxide (P_2O_5) grade of 8.6 percent, at a cut-off grade of 6 percent. Borehole results indicate that mineralisation persists to a depth of at least 1000m below surface. The pyroxenite contains 486 Mt of ore grading 6.9 percent P_2O_5 for each 30m of depth. A cut-off grade of 5 percent P_2O_5, to a depth for 600m, was used in calculating the reserve base of some 2 500Mt, which represents the third largest in the world.

The Glenover phosphate deposit, located north of Thabazimbi, in Limpopo, occurs in a smaller carbonatite pipe. High-grade phosphate ore from Glenover was mined out in the past and its dumps are currently being re-worked to recover phosphate.

Sedimentary phosphates are "soft" as compared to the igneous phosphate of the Palabora Igneous Complex. As a result, sedimentary phosphates are suitable for direct application onto soil. Some sedimentary phosphate deposits occur along the western seaboard e.g. (Langebaan, Langfos) but are currently not being exploited. This is a potential opportunity for small scale miners and warrants further investigation.

3.1.5.2. Mining

Foskor started mining the foskorite ore zone in 1954. Palabora Mining Company (PMC) was formed in 1957 to exploit the non-phosphate minerals i.e. copper and vermiculite in the carbonatite complex, while Foskor retained the rights to the phosphate minerals in the entire Phalaborwa Complex. Until recently, as a result of the various agreements between the two companies, Foskor recovered phosphate from a portion of PMC's tailings (40 percent). Now the only foskorite from PMC is contained in a stockpile. Foskor also has an opencast mine in the north-western part of the pyroxenite region from which it mines pyroxenite for the production of high-grade phosphates (20 percent). Foskor's extension 8 project has increased plant capacity by 750 kt per annum. The new plant has advanced Foskor's capacity to a combined 3,85 Mt of phosphate production per annum from both old and new plants. At this rate, proven reserves in the existing mine will last at least another 18 years, and total ore resources extend a further 75 years.

3.1.5.3. Processing

Foskor's phosphate mine was resized to cater for internal demands from Foskor Richards Bay and domestic customers, which collectively consume less than one million tons per annum (i.e. Sasol Nitro and Omnia, which operate phosphoric acid and fertiliser plants). An expansion project at Foskor Richards Bay, with a R1,5 billion price tag, was completed in June 2003. Plant capacity was increased from 450 kt to 780 kt per annum and 85 percent of production is destined for export. Foskor has captured 25 percent of the Indian phosphoric acid market and, based on capacity, is the second largest supplier of phosphoric acid to world markets.

3.1.5.4. Phosphate Rock Production

South Africa's production of phosphate rock has varied between 2500 and 3000 kt since 1994 (Figure 5). .

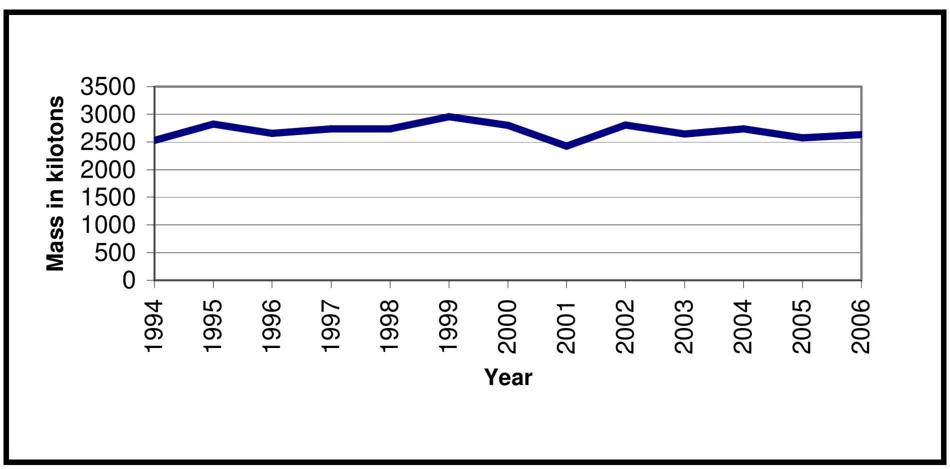

Figure 5: South Africa's production of phosphate rock, 1994 – 2006

(Source: Directorate Mineral Economics)

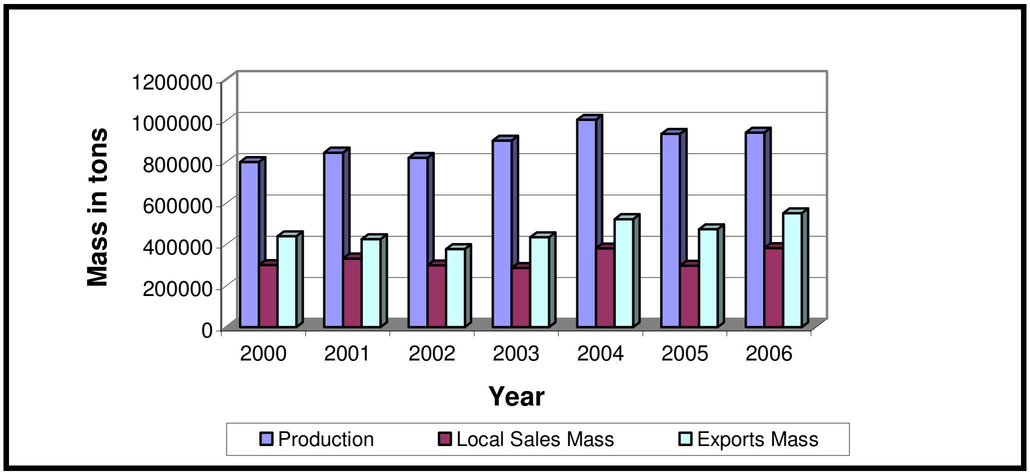

Figure 6: Phosphoric acid production and sales, 2000 – 2006

(Source: Directorate Mineral Economics)

South African production of phosphoric acid was stable at 800 kt between 2000 and 2002. Production increased steadily since then as Foskor ramped up to its capacity of 725 000 tons P_2O_5. Local sales of phosphoric acid were at 400 kt from 2000 – 2002 but increased to 500 kt over the last three years, probably as a result of the tolling agreement between Sasol Nitro and Foskor, where Sasol Nitro produces phosphoric acid for onselling to Foskor's customers. Export sales have grown steadily.

3.1.6. Downstream phosphate fertiliser products

3.1.6.1. Single superphosphate

Apart from monocalcium phosphate, single super phosphate also contains gypsum ($CaSO_4$). Superphosphate contains three plant nutrient elements, viz phosphorus, calcium and sulphur.

3.1.6.2. Enriched superphosphate

This product is manufactured by treating phosphate concentrate with a mixture of sulphuric acid and phosphoric acid, in a process similar to manufacturing single superphosphate, and contains 10,5 percent water- soluble phosphorus. Additional soluble phosphorus is provided by the extra phosphoric acid and the product contains less $CaSO_4$ than the single superphosphate.

3.1.6.3. Double superphosphate (also called triple superphosphate)

Double superphosphate is manufactured by treating phosphate concentrate with phosphoric acid in a process similar to that used in the manufacture of superphosphate. It contains approximately 19,6 percent water-soluble phosphate. The main difference in this case is that no, or very little gypsum is formed, with the result that the monocalcium phosphate is not diluted with gypsum, and the P content is therefore high. With no gypsum the sulphur content is negligible.

3.1.6.4. Nitro phosphate (NP)

Phosphate concentrate can also be made soluble by treatment with nitric acid, HNO_3. Usually too much acid is used and the excess is then neutralised with ammonia. The result is that the nitro phosphate consists of dicalcium phosphate, monocalcium phosphate and ammonium nitrate, therefore a NP-product. This was manufactured as a suspension in South Africa in the past.

3.1.6.5 Mono-ammonium phosphate (MAP) and di-ammonium phosphate (DAP)

These are the important phosphate fertilizers, and are manufactured by the neutralisation of phosphoric acid with ammonia. MAP contains 11 percent nitrogen and 22 percent phosphorus, whereas DAP contains 18 percent nitrogen and 20 percent phosphorus.

3.1.7. Phosphate supply chain

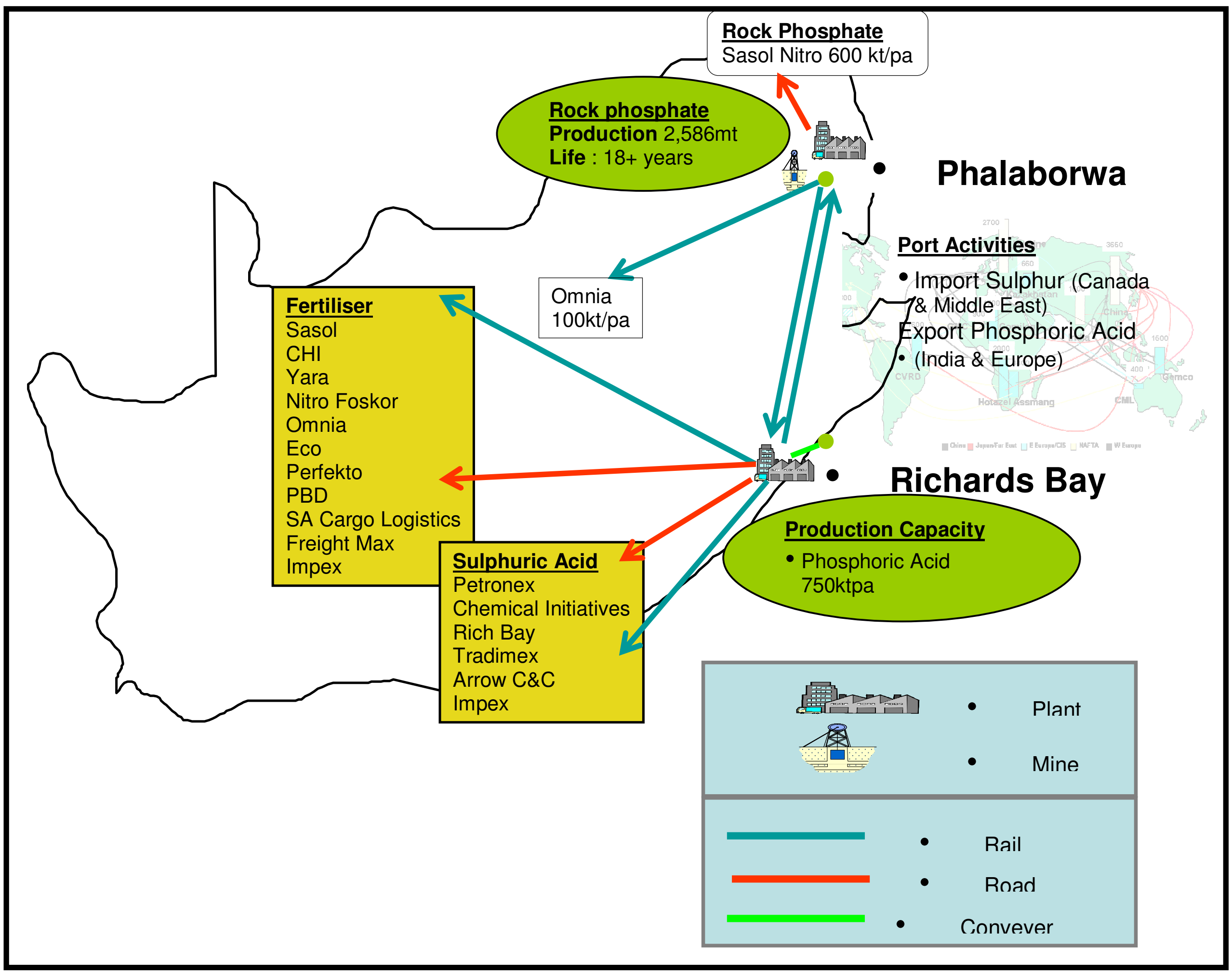

Figure 7: Adapted phosphate supply chain

(Source: Transnet Freight Rail)

- Phosphate rock is mined at Phalaborwa, with 700 kt being sold to inland customers (Sasol Nitro and Omnia). Approximately 2 Mt is railed to Foskor's phosphoric acid plant in Richards Bay.
- Sulphur is imported, mainly from Canada and the Middle East, and is used at the Richards Bay plant. A portion is railed to Sasol Nitro.

- Approximately 80 percent of Foskor's phosphoric acid production is exported through Richards Bay.
- Sulphuric acid and fertiliser are sold to domestic customers.

3.2. POTASH

Potash is the term used for commercially supplied potassium-bearing ores and processed products. Sylvite/sylvinite, kainite, carnallite and langbeinite are the most important potassium bearing minerals. Potassium (K) is present in every living cell, both plant and animal and is a primary nutrient (along with phosphorous and nitrogen) which is necessary for virtually every aspect of plant growth. K is the third most widely used fertiliser nutrient after nitrogen and phosphorous. Fertilisers account for more than 95 percent of total potash consumption. Potassium chloride, sourced from sylvite and also known as muriate of potash (MOP), is the most common source of potassium (K) for fertilisers and has a K_2O content of 60 percent minimum. Other forms of potash include potassium sulphate with 50-54 percent K_2O content, potassium magnesium sulphate with 22-30 percent K_2O content.

Potassium regulates water balance, the activity of many enzymes, starch synthesis, nitrogen uptake and protein production. Potassium also helps to facilitate sugar movement through plants and boost resistance to stress such as drought and disease.

3.2.1. International Potash Production

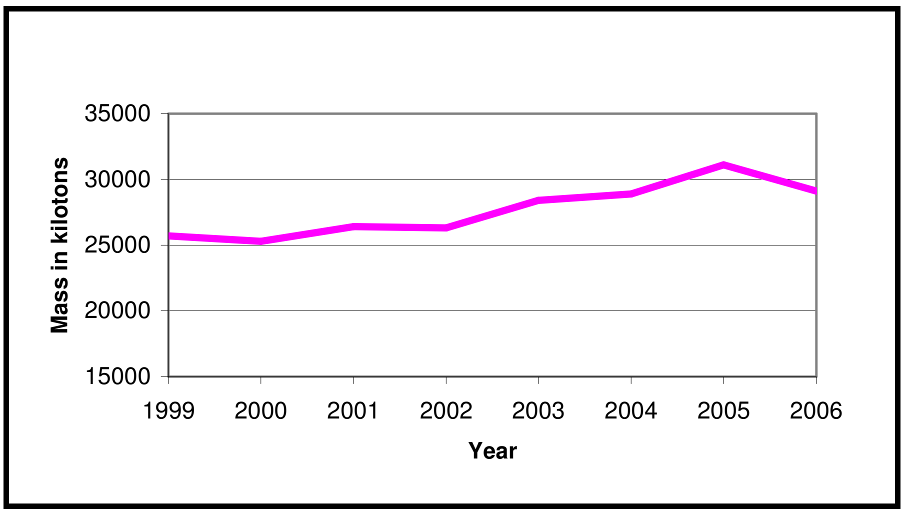

Figure 8: World production of potash, 1999 – 2006

(Source: USGS)

World production of potash has grown at an annual average rate of 2.7 percent per annum from 1999 to 2006. This is attributed to huge growth in demand for food and bio-fuels

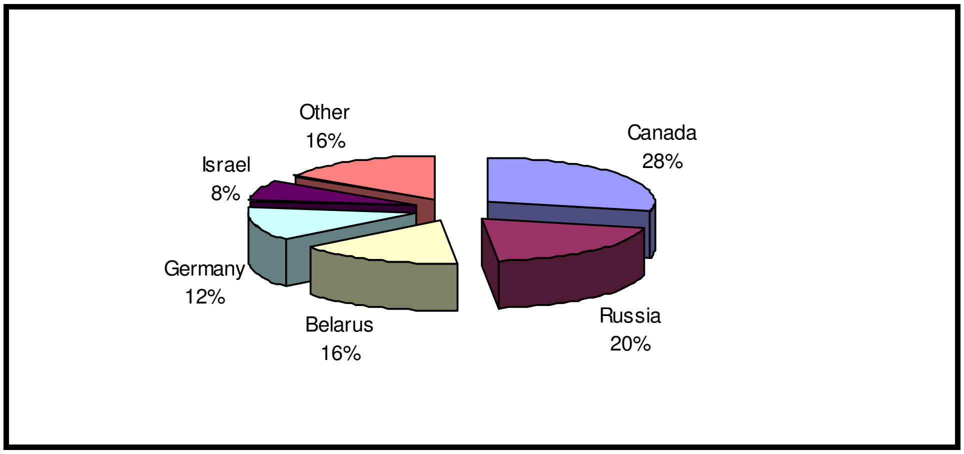

Figure 9: World Production of Potash by country, 2006

(Source: USGS)

World production of potash is dominated by Canada (28 percent) followed by Russia (20 percent), Belarus (16 percent) and Germany (12 percent). South Africa currently has no viable sources of water soluble potassium minerals and does not feature in the above graph.

3.2.2. South Africa's Potash Industry

Potential sources of potash in South Africa generally contain less potassium than the ores exploited in other countries. Sources from seawater would have to be subjected to chemical treatment to render them water-soluble. Phlogopite, occurring in association with vermiculite ore in the Phalaborwa complex is the most promising potential source in South Africa, because of its relatively high (11 percent) K_2O content. The material decomposes more easily than other silicate materials.

According to the South African Revenue Service (SARS), imports, by volume, have averaged 320 kt/annum from 1999 to 2007 (Figure 10). Germany (39%), Israel (28%) and Chile (24%) account for almost ninety percent of total imports (Figure 11). Imports, by value, amounted to R580 million in 2007, which contributes to South Africa's current account deficit and at such levels presents a case for the beneficiation of local sources.

Phlogopite, occurring in association with vermiculite ore in the Phalaborwa complex is the most promising potential source in South Africa, because of its relatively high (11 percent) K_2O content. The material decomposes more easily than other silicate materials.

Foskor commissioned a R160 million pilot plant in the early nineties to extract alumina, as well as magnesium and potassium. Calculations at the time showed that a plant to extract alumina would cost R12 billion and the project was abandoned. However, given the changed economic climate since then and the massive import bill, the Industrial Development Corporation (Foskor's owner) should re-consider this project.

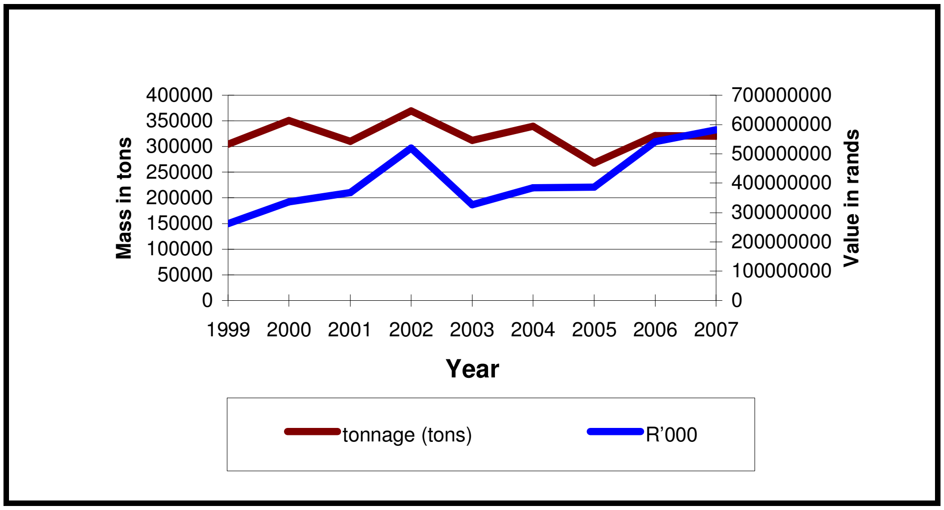

Figure 10: South African imports of potash 2007, by mass and value

(Source: SARS)

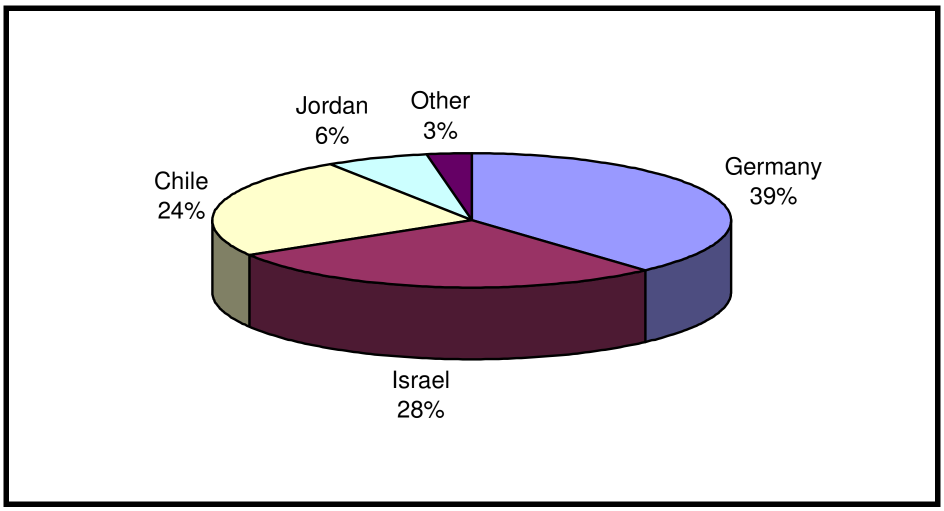

Figure 11: South African imports of potash 2007, by country

(Source: SARS)

3.3. SECONDARY NUTRIENTS

3.3.1 Agricultural Lime (Aglime)

Agricultural limestone is the principal source of calcium and magnesium, essential elements for growth of plants, and acts as a soil amendment that improves soil structure and reduces acidity. Calcium aids root development and helps the formation of healthy root walls; the transportation of carbohydrates and water, and the production of healthy seeds, and promotes biological activity in the soil. Improved soil structure and reduced acidity promotes a better uptake of the three principal fertiliser nutrients (nitrogen, phosphorous and potassium) by plants.

3.3.2 Resources / Reserves

Agricultural limestone is a cheap soil amendment, which is easily sourced from locally available limestone. South Africa has huge primary deposits of dolomitic limestone with reserves exceeding 2 000 Mt. South Africa has 30 limestone producers and 39 quarries.

3.3.3 Supply and Demand

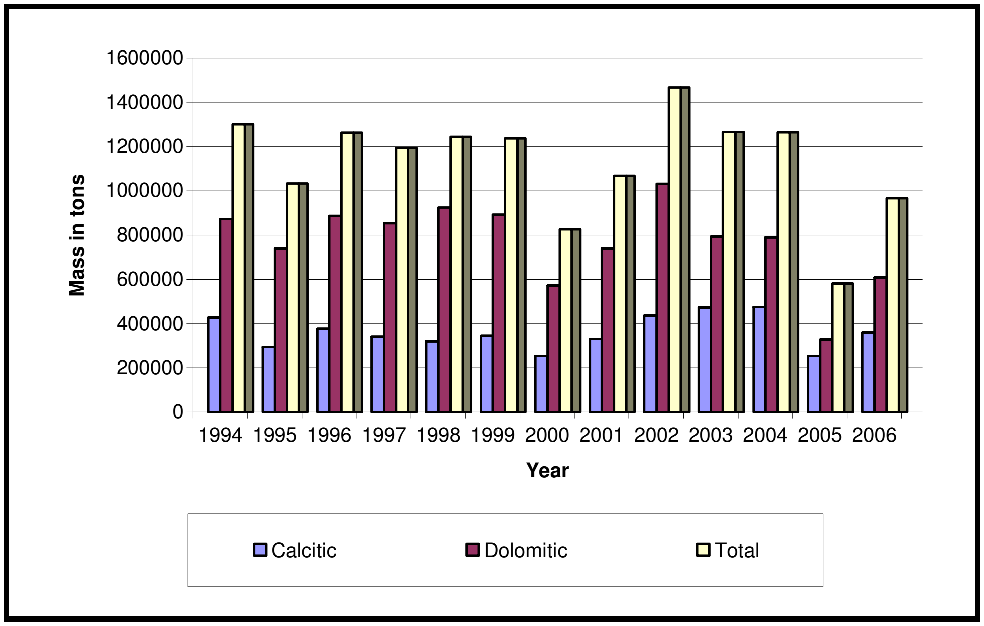

Figure 12: South African Aglime Production 1994 – 2006

(Source: FSSA)

Aglime sales averaged approximately 1,2 Mt from 1994 – 2006. The average cost of agricultural limestone and dolomite is dependent on four factors: the frequency of deposits, ore grade (purity and sizing), transport (logistics, road conditions, terrain) and grain prices. Grain prices may determine if a farmer will buy any carbonate products at all for a particular season.

3.4. SULPHUR

Sulphur serves two main functions in agriculture. By far the largest is in the form of sulphuric acid for producing phosphatic fertilizers, through a reaction with phosphate rock, sulphur is often called the fourth major plant nutrient after NPK, because most crops require as much sulphur as phosphorous, with an average removal rate by crops of between 40-75 kg SO_3/ha. Sulphur performs many important functions similar to nitrogen in plants. Sulphur is vital for the synthesis of proteins, oils and vitamins and promotes nitrogen fixation and nitrate reduction in plants; is also a key ingredient in the formation of chlorophyll, fights diseases, control pests and lowers the pH of saline and alkaline soils.

3.4.1 Resources / Reserves

NATREF, SAPREF, Engen and Caltex produce elemental sulphur, as a by-product from crude oil refining, and sulphur is also produced as a by-product of Sasol's synthetic fuels operations. Pyrite recovered by flotation as a by-product from gold mining is converted to sulphuric acid. Palabora Mining Company, Exxaro and platinum recovery plants also produce sulphuric acid as a by-product from the roasting of metal sulphides.

3.4.2 Supply and Demand

South Africa's total production of sulphur in all forms (SAF) has been on a healthy upward trend from 2001 to 2005 as oil companies moved to meet mandatory fuel specifications which came into effect on 1 January 2006. South Africa's production of SAF decreased by 17,1 percent to 643 kt in 2006, with oil refineries being the major contributor to the decline. The decline resulted from planned and unplanned plant and refinery shutdowns.

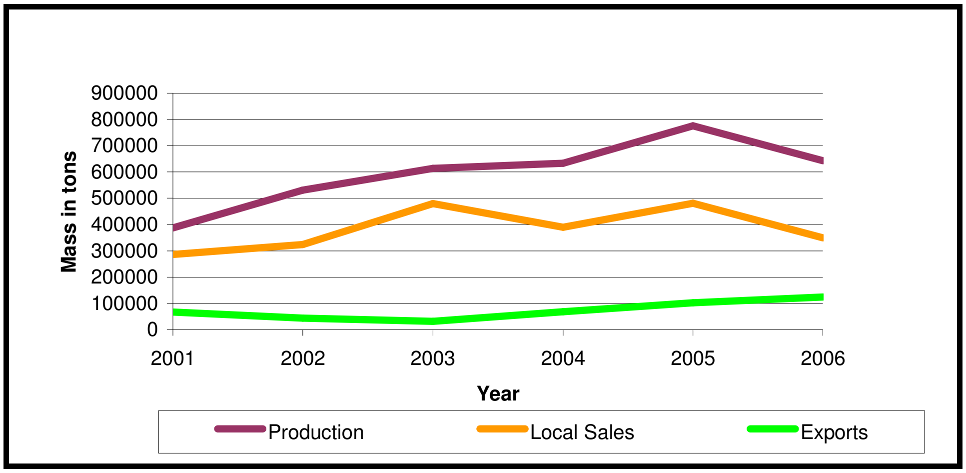

Figure 13 South African production, local and exports of sulphur 1990 – 2006

(Source: Directorate Mineral Economics)

South Africa's imports of sulphur have been consistent at 600 kt, but imports of crude sulphur increased by an estimated 28 percent to 681 kt in 2006. The increased imports were attributed to increased usage from both Foskor and Sasol Nitro.

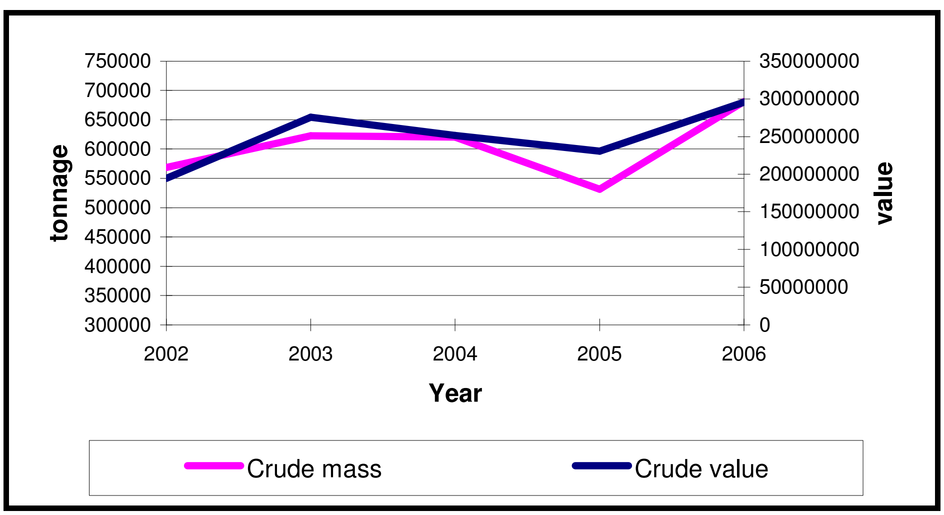

Figure 14 South African imports of crude sulphur 2002 – 2006

(Source: SARS)

3.5. GYPSUM

In agriculture, gypsum or land plaster ($CaSO_4.2H_2O$) serves similar functions as limestone both as a soil amendment that improves the structure and drainage of compacted clay soils, and it is also added to ameliorate subsoil acidity. The calcium sulphate leaches down into the subsoil where it causes a slight rise in soil pH. In addition, root growth in the subsoil is encouraged by the higher calcium concentration. Gypsum also makes available sulphate sulphur (particularly to corn, cotton, wheat and peanuts), stimulates micro organisms and neutralises sodium compounds.

3.5.1 Resource/Reserves

South Africa's gypsum reserves and production are very small by world standards, although the country is self-sufficient in most of its industrial requirements. Estimated resources in 2002 were 79 Mt.

3.5.2 Supply and Demand

Sales of agricultural grade gypsum averaged 180 kt during 2002 – 2007, and is driven by maize prices.

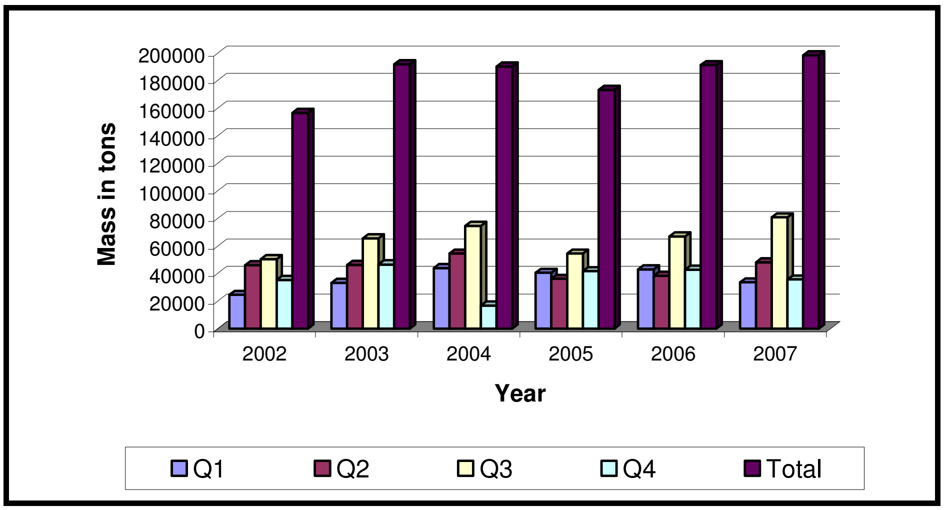

Figure 15: South African sales of gypsum 2002 – 2006

(Source: FSSA)

3.6. MAGNESIUM COMPOUNDS

Magnesium compounds are used both as fertilizers and animal feed additives. Magnesium occupies the central position of the chlorophyll molecule in plants with each molecule containing 6,7 percent magnesium. An adequate supply of magnesium enhances the photosynthetic activity of leaves. It also acts as a phosphorus carrier in plants and is essential for phosphate metabolism, plant respiration and the activation of several enzyme systems.

The main products used are caustic calcined magnesia and magnesium sulphate. Caustic calcined magnesia is a cheap magnesium fertilizer, though it is not water soluble, but because of this it will not wash off when it rains and is available to plants for a longer period. Epsom salt (Magnesium sulphate) is a fast-acting magnesium and sulphur fertilizer often used as a foliar application to crops, although its high cost is a handicap.

Epsom salt is a proven means of quickly eliminating symptoms of magnesium and sulphur deficiencies. Sulphate of potash magnesia is derived from langbeinite, which contains both magnesium sulphate and potassium sulphate. This is one of the most economical means of supplying totally water-soluble magnesium to crops.

3.6.1. Resources/Reserves

Magnesite is South Africa's major source of magnesium compounds. South Africa's economically viable deposits of magnesite occur as weathering products of rocks with high magnesium contents. The main magnesite deposits are in Mpumalanga and Limpopo provinces, i.e., the Malelane area, in the vicinity of Lydenburg, and an area to the north of the Soutpansberg and in the Burgersfort and Giyani districts. South Africa has two operating magnesite mines, Strathmore (owned by Chamotte Holdings) at Malelane, Mpumalanga and Syferfontein (owned by Syferfontein Calcite) in Soutpansberg district, Limpopo.

3.6.2. Supply and Demand

South African production of magnesite has exhibited annual average growth of 0,8 percent from 2001- 2006. Magnesite production increased from 2001 on the back of strong demand from the ferro chrome industry and demand for specialised products such as Epsom salt. Production has been on a decreasing trend from 2003-2005 as a result of increased mining costs and imports of cheap magnesite products from China.

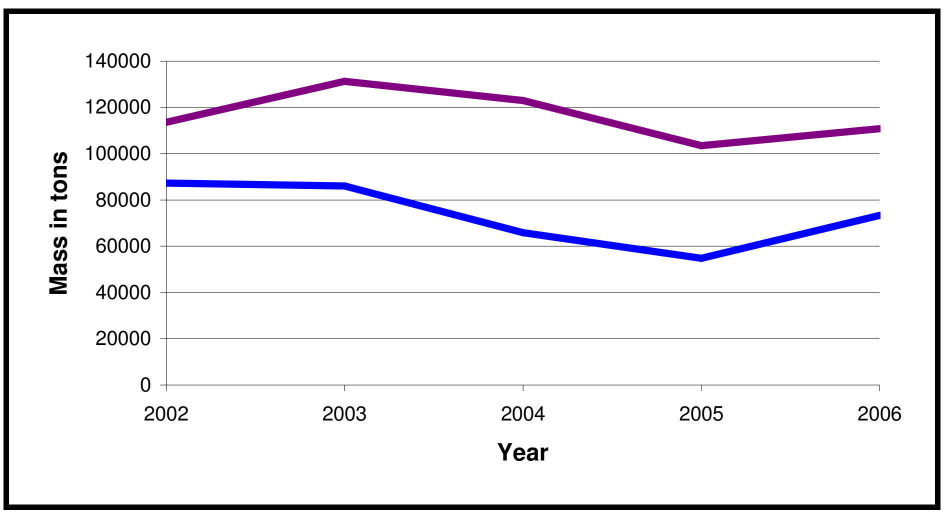

Figure 16: South African imports of magnesite 1998 – 2006

(Source: SARS)

3.7. MICRONUTRIENTS

A lesser-known group of agricultural minerals are micronutrients. These are a class of naturally occurring agricultural minerals that are essential in plant and animal nutrition, but are needed in relatively small quantities. Micronutrients are blended with primary and secondary nutrients to make a complete nutrient package for plants and animals. There are six generally recognised elements that comprise the category of micronutrients: boron (B), copper (Cu), iron (Fe), manganese (Mn) molybdenum (Mo) and zinc (Zn).

Boron occurs as the borate (B_4O_7) anion in soils. It is involved in cell division, fruit formation, carbohydrate and water metabolism, and protein synthesis and seed development in plants. Lack of boron can lead to deformed and inefficient leaves, as well as poor root development, photosynthesis, fruiting and seed production. Crops that need relatively high boron levels include cotton, peanuts, irrigated corn, root crops, soyabeans and some fruit and vegetables. Sources of boron include borax, fertilizer borate, boric acid and ulexite (crude borax ore). Borax is generally recovered by evaporation/crystallisation process from dry lake brines or salt beds, or by beneficiation of mined ulexite ores. Boric acid is made by reacting borax with sulphuric acid followed by filtration and drying. South Africa has no local sources of borates. Borates are imported from the Netherlands and re-exported to other African countries.

Molybdenum occurs as an accessory mineral in various types of base mineral deposits, but is not produced in South Africa at present. The only officially declared production of molybdenum in South Africa was 22 t in 1957/8, and one ton in 1964. Presently South Africa is dependant on imports from China, Chile and United Kingdom.

South Africa has adequate supplies of copper, iron, manganese and zinc.

3.8. NITROGENOUS FERTILIZERS AND ITS DOWNSTREAM PRODUCTS

Ammonia is the main source of nitrogenous fertilizers. Anhydrous ammonia (NH_3) is important for direct soil application in agriculture and is also the primary raw material of all nitrogenous fertilizers.

In South Africa ammonia is manufactured by the well-known Haber-Bosch process. The raw materials for manufacturing ammonia are hydrogen gas (H_2), which is obtained by the gasification of coal and coke with steam, and nitrogen gas (N_2), which is manufactured from air by means of fractional distillation. Sasol is the major supplier to the inland region. The restructuring of Kynoch (now Yara) in 2000 resulted in AECI-Kynoch plants at Modderfontein and Milnerton being closed down. The result is that all urea has to be imported. Sasol Agri and Omnia manufacture Limestone ammonium nitrate locally, while Sasol and Exxaro produce ammonium sulphate.

3.8.1. Urea

Urea (NH_2CONH_2) contains 46 percent nitrogen. The basic raw materials for manufacturing urea are CO_2 and NH_3.

3.8.2. Ammonium Nitrate

Ammonium nitrate (NH_4NO_3) contains 35 percent nitrogen. The raw materials for manufacturing ammonium nitrate are ammonia and nitrogen.

3.8.3. Ammonium Sulphate

Ammonium sulphate $(NH_4)_2SO_4$ contains 21 percent nitrogen. Ammonium sulphate is manufactured by petrochemical and metallurgical industries. It is manufactured from by-products such as coal and coke gases, as well as diluted ammonium sulphate solutions from refineries.

3.8.4. Limestone Ammonium Nitrate (LAN)

LAN contains 28 percent nitrogen. LAN is not a homogeneous salt or chemical substance but is a mixture of limestone (mainly dolomitic lime, but calcitic lime may also be used) and ammonium nitrate. The product consists of approximately 20 percent finely ground limestone and 80 percent ammonium nitrate.

3.8.5. Ammonium Sulphate Nitrate (ASN)

Ammonium sulphate nitrate contains 27 percent nitrogen. It is a physical mixture of ammonium sulphate and ammonium nitrate. The raw materials are ammonium sulphate crystals and ammonium nitrate solutions.

4. THE SOUTH AFRICAN FERTILISER INDUSTRY

4.1. Industry Structure

The South African Fertiliser Industry comprises manufacturers, importers, blenders, retail distributors and agents, fertilizer applicators, and a number of associated service industries. Foskor, Yara SA, Sasol Agri and Ominia have granular and bulk blending plants. All three also produce liquid fertilisers. Several blender companies use such granular products to supply dry bulk blended products, for example Atlas Organic fertilisers, Nitrophoska, Plaaslike Boeredienste and Nitrochem.

The industry is represented both nationally and internationally by the Fertiliser Society of South Africa (FSSA). The South African fertiliser industry is fully exposed to world market forces and operates in a totally deregulated environment with no import tariffs or government sponsored support measures.

4.2. Value to South Africa

The South African fertiliser industry annually supplies about 2 million tons of fertiliser products (750 000 tons of N + P2O5 + K2O) to the local market at a value of R3 billion ($480 million). This represents 20% of the South African chemical industry (excluding oil).

Figure 17 shows the growth in fertiliser consumption in South Africa from 1955 – 2006. Fertiliser consumption reached a peak of more than 3 million tons in 1982, when price control was in place and the industry operated in a protected trade environment. In 1982, the country suffered the most severe drought in two centuries. This coincided with the worst recession since 1930, which had a serious financial effect on both farmers and the fertiliser industry. Shortly after this, in 1984, the liberalisation of the South African trade policies started with the abolishment of price control and the opening-up of the economy. Once everything settled down, total fertiliser consumption levelled off in 1988 at around 2 million ton per annum mark where it has stayed until 2006.

Maize farming is estimated to be the largest single consumer of fertiliser, with almost 40 % of the total fertiliser market, followed by sugar cane (15%) and wheat (10%). The other crops represent approximately 35% of the total fertiliser market. The FSSA's net fertiliser price (**Figure 18**), which is a reflection of price changes in the RSA shows that the average net price has grown at 2,4 percent per annum.

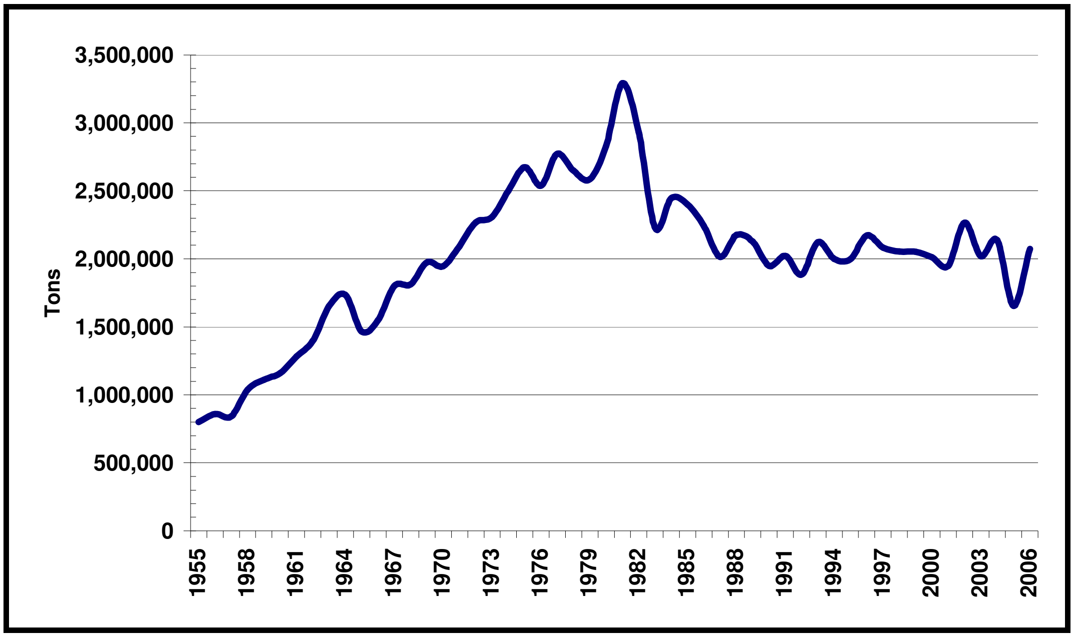

Figure 17: Fertiliser consumption in South Africa, 1995 – 2006

(Source: FSSA)

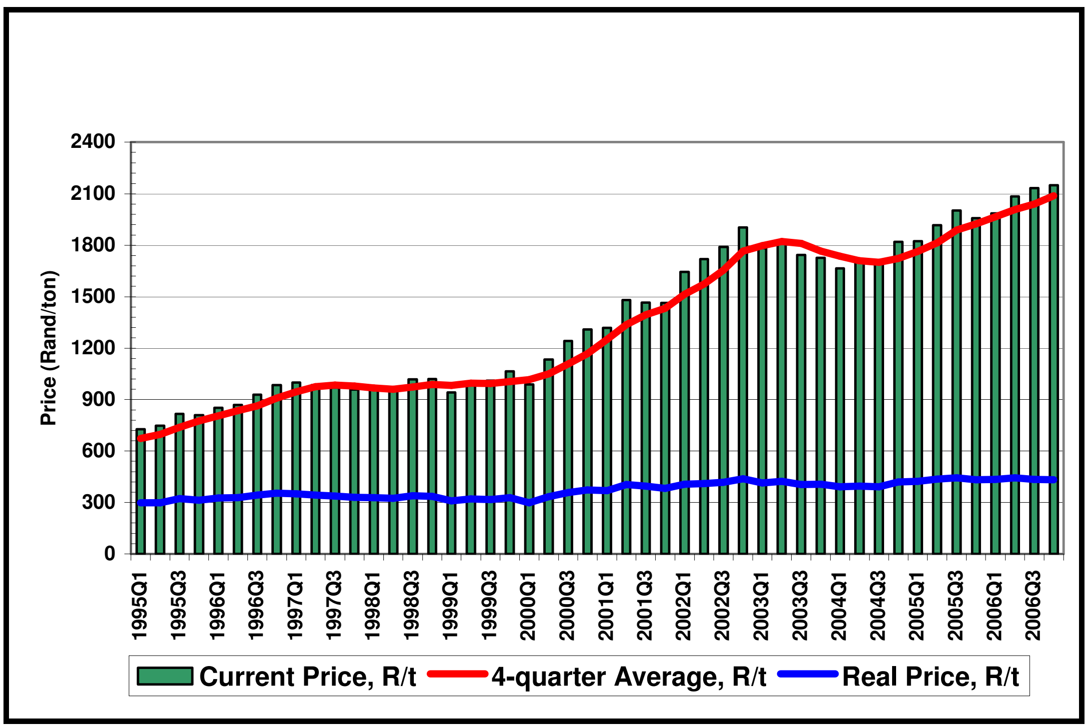

Figure 18: Net fertiliser prices 1995 – 2006

(Source: FSSA)

5. OUTLOOK

The three main drivers influencing demand and, thus, the price of fertilisers include the oil price, world cereal output and policy support for biofuel production. High oil prices, low cereal stocks and increased biofuel production are pushing up both the demand and price of fertiliser in the international market and this trend is expected to continue beyond 2008. Local prices are subject to the same supply and demand drivers as the international industry, presenting opportunities for growth in the local market.

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