THE DEPENDENCE OF THE SOUTH AFRICAN FERTILIZER INDUSTRY ON IMPORTED STRATEGIC RAW MATERIALS

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Raw materials form an important part in the make-up of chemical fertilizers. Presently in South Africa raw materials account on average for about 62% of the sales value of fertilizer products. While most materials nowadays are of local origin some still have to be imported. All potassic materials and some fifty seven per cent of the sulphur required for the solubilization of rock phosphate are imported. South Africa has become less dependent on imported oil-based products for the manufacture of ammonia, since most plants now employ coal gasification as a source of hydrogen. Despite the fact that South Africa has become a fertilizer exporting country it is nevertheless still to some extent dependent on imported raw materials.

Importation history

South Africa first imported chemical fertilizers in 1890. The market for these products were situated in the coastal regions. Superphosphate was the first fertilizer product to be manufactured locally, when Safco in 1904 treated bone meal with lead-chamber process sulphuric acid. Production ceased in 1910 because of cheaper imported products. During World War I the importation of fertilizer was seriously restricted and the need for local production was again stimulated (Webb, 1972; Van der Merwe, 1983).

In 1919 African Explosives and Chemical Industries Limited commenced with the production of superphosphate from imported rock phosphate and sulphuric acid derived from the manufacture of explosives. This initial development in the local fertilizer industry was therefore a direct offspring of the explosives industry, which in turn owed its existence to the fast developing mining industry. Local superphosphate was mixed with imported ammonium sulphate and potassium chloride in the production of low-grade compound NPK fertilizers. A further development in the industry came when Iscor provided ammonium sulphate, manufactured as a by-product in the steel works (Webb, 1972).

The import-orientated fertilizer industry was hard hit during the depression of the early thirties and World War II. Shortages and high prices caused the State to intervene by the introduction of price control, quotas and subsidies. The Korean War saw the reduction of sulphur import permits. These facts emphasized both the strategic importance of the fertilizer industry to the country and its dependence on importation of raw materials (Webb, 1972). The threat of the possibility of politically-based sanctions added to the urgency of the matter.

The first operation to find alternatives to imported materials occurred in 1951 with the formation of the Union Phosphate Development Company (now Foskor). Processes for the mining and beneficiation of the igneous phosphate deposits at Phalaborwa was developed and in the early sixties the importation of Morroccan rock phosphate was reduced and later ceased. In addition to Iscor, Sasol in the mid fifties also started production of by-product ammonium sulphate and later limestone ammonium nitrate, all from ammonia, based on the gasification of local coal (Webb, 1972).

Locally produced raw materials were used to better advantage when sulphuric acid plants at the goldmines were further improved and larger fertilizer factories were erected in the interior where the main market had now been established. In the early eighties South Africa became self-sufficient with respect to nitrogenous fertilizers. Capacity is more than sufficient and oil-based ammonia plants were either closed down or partially converted to a coal-base.

Present dependence

Presently the South African fertilizer industry's dependence on imported raw materials has been reduced to potassic fertilizers and part of the sulphur requirements. Nevertheless imports in 1985 still amounted to about 27% of the total fertilizer sales value.

Sulphur

On average about 2,12 tons of sulphur is required for the solubilization of each ton of phosphorus contained in all fertilizers. This ratio is different for each specific phosphatic product, but it clearly shows the indispensibility of sulphur in conventional fertilizer manufacture, even if it is not included in the final product.

Much of the sulphur goes to waste in the form of gypsum, which cannot at this stage all be re-used economically.

The dependence of the South African fertilizer industry on imported sulphur is shown in the sulphur balance sheet in Tables 1(a) and (b).

In 1984 just less than half of the sulphuric acid was produced from imported sulphur, and of the total of 1 232 tons sulphur in the form of sulphuric acid (The British Sulphur Corporation, 1985), 52% was used in the fertilizer industry. While less than half the sulphur requirements for sulphuric acid are imported, the fertilizer

TABLE 1. *Sulphur Balance Sheet for the RSA (all figures in '000 tons* **S** *p.a., and approximate)*[1].
(a) 1984 (British Sulphur Corp 1985)

Source		Processing into —		Sulphuric acid (S): RSA production	Sulphuric acid (S): Usage in fertilizers	Sulphuric acid (S): Marketed in fertilizers
Elemental:						
● Imports	**649**		**649**			
		H_2SO_4	543	**543**	**370** (58%)	
		Non-acid	35			
		Other	71			
Sulphides (ex mines):				**629**	**205**	
● Gold & Uranium	**529**		**529**			
		H_2SO_4	468	468		
		Other	61			
● Basic metals	**161**	H_2SO_4	**161**	161		
Other:*						
● Fertilizer industry	**60**	H_2SO_4	**60**	**60**	**60**	
Total:	**1 399**		**1 399**	**1 232**	**635** (100%)	**635**
				(100%)	(52%)	
						Local 385
						Exports 250

Note: 370/649 = 57% imported S in fertilizers
* Coal gasification; coking of coal; phos gypsum

(b) 1985 (Preliminary values) (IFA, 1986)

Source			
Elemental: 360,2	● Imports:	207 (44%)	
	● Local:	265	
		472 (100%	**472**
			Local 332
			Exports 140

Note: 207/360,2 = 57% imported S in fertilizers

1) Personal communication: N Sutherland, Anglo American Corp of SA Ltd

industry in 1984 and 1985 imported 57%, of its requirements. In the latter case it amounted to nearly 200 million Rand. This is approximately 19% of the fertilizer sales values.

Potassium

South Africa is virtually completely dependent on importation for its potassium requirements. Except for a very small quantity of potassium chloride by-product from the Vanderbijl Park works of Iscor, some 295 000 tons of potassium products are annually imported[2]. Of this approximately 125 000 tons K, is used by the fertilizer industry, mainly as potassium chloride, potassium sulphate and potassium nitrate (IFA, 1985). About 80% of this is used in compound fertilizers as NPK mixtures.

2) *Personal communications: Customs & Excise; Department of Finance*

The 1985 value of the K imports was approximately 75 million Rand, which amounted to approximately 8% of the sales value.

Potassic fertilizers are imported from Israel (46%), Canada (18%), West Germany (17%), France (16%) and Britain (3%) (IFA, 1985).

Nitrogen

The dependence of the industry on imported oil-based fuel and feedstock (naphtha and refinery tail-gas) for the production of ammonia was materially reduced from about 50 per cent in the mid seventies to just over five per cent (46 000 tons N p.a. equivalent) of a much increased capacity. Only about half the requirements (just the feedstock) for one of the plants are still dependent on imported oil. This does not pose a strategic threat since at present only about half the total ammonia capacity in the country is being utilized. Instead of hydrocarbons from naphtha and tail-gas the gasification of coal is used as a source of hydrogen for ammonia production.[1]

Implications

The combined contribution by potassium and sulphur in the cost structure of fertilizers is in the order of 20 to 25 per cent of total manufacturing cost. That of potassium is 5 to 10 per cent and that of sulphur 10 to 20 per cent.

Not only are they strategically important components, but they are also subject to price changes and especially sensitive to changes in parity. Price indices showing actual changes in the USdollar values of imported sulphur and potassium as well as the aggravating effect of the rand/dollar exchange rates are given in Table 2.

While USdollar price of sulphur increased by about 50 per cent over three years the Rand price more than trebled. The small increase in USdollar price of less than 20% for potassium over the same period nevertheless meant an increase of more than 150% to South Africa. This has an important effect on the cost of fertilizer production. Each 10% increase in the sulphur price could raise the price of fertilizer by one per cent, and each 16% increase in the price of potassium could raise the price of fertilizer by one per cent.

In these times politically-based economic sanctions and rumours of possible sanctions are real and need to be taken seriously. Such a threat was recently (1985) made with regard to Canadian sulphur sales to South Africa. One of the small Canadian suppliers of sulphur, a semi-government organisation, announced that they will no longer export sulphur to South Africa. Although this will not materially affect the South African position it is well to remember that in 1984 Canada exported over 60 million CDN dollars worth of sulphur to South Africa[3].

[1] *Personal communication, B L Drake, AECI Limited*

TABLE 2. Price indices of imported sulphur and potassium products (1st quarter 1983 = 100) [2]
(US Gulf prices — cheapest for K)

Year	Quarter	Sulphur prices		Potassium prices	
		US Dollar value	Rand value	US Dollar value	Rand value
1983	1	100	100	100	100
	2	90	90	100	100
	3	86	87	100	102
	4	100	108	107	116
1984	1	110	132	107	129
	2	110	158	107	153
	3	129	194	107	160
	4	145	238	107	175
1985	1	135	253	116	218
	2	135	243	113	205
	3	145	344	113	270
	4	145	327	113	255
1986	1	136	262	113	219

2) Green Markets, *various recent issues*

Alternatives

South Africa will not in the foreseeable future be able to provide in all its needs of sulphur and potassium. Because sulphur is a strategic raw material in the mining and fertilizer industries, it is nevertheless important to investigate and develop alternative sources of sulphur and procedures for the suitable processing of it. This is being done. Investigations into the possibility of local production of potassium has been and is being conducted.

Sulphur

(i) *Reclamation* of sulphur in the fertilizer industry presently amounts to about 60 000 tons S, with a foreseeable capacity of nearly 200 000 tons. This is all processed into sulphuric acid. Details are given in Table 3.

The reclamation from coal gasification is the result of processes to combat air pollution. Phos gypsum is a waste product in phosphoric acid production. Part of it is used as such as a soil ameliorant, and part is roasted in the process of cement production,

[3] *Letter, Department of Trade and Industry, quoting information from the Canadian Ministry of Commerce.*

TABLE 3. Reclamation of sulphur in the fertilizer industry, 1985 (all in '000 tons S [1]

Company	Source	Reclaimed S
Iscor	Coking of coal	5
Fedmis	Phos gypsum	20
Sasol	Coal gasification	35*
Total		60
* Expected to increase to 160 000 tons S by end 1986		

1) Personal communications: L Rapp, Iscor; A G de M du Toit, Sasol Ltd; J Geldenhuys, Fedmis Div of Sentrachem Ltd

yielding sulphur dioxide, which is converted to sulphuric acid.

(ii) *Sulphides* in the mining industry accounted for nearly half the sulphur requirements in 1984, viz 690 000 tons S (see Table 1). This was all processed into sulphuric acid. Pyrometallurgical oxidation of iron sulphide ores to yield soluble metal oxides also yields sulphur dioxide, which is further processed into sulphuric acid. This sulphuric acid is used in gold and uranium mines mainly for the leaching of uranium. Excess acid is sold to the fertilizer industry. Sulphides of zinc, nickel and iron in the basic metal mining industry are also converted to sulphuric acid (Botha, 1986).

(iii) *Investigations* to reclaim sulphur from other sources are being conducted. The National Institute for Water Research of the CSIR is doing research on water pollution. This research includes the investigation of methods for the removal sulphate from mine and other industrial water in order to reuse the water. It is estimated that mine waste water carries some 50 000 tons S p.a. into streams and rivers. This may be reclaimed economically by biological processes (Maree, 1983 & 1985).

(iv) *The saving* of sulphur resources by alternative procedures for the solubilization of rock phosphate is also being investigated. Nitric acid is indeed already being used to produce nitro phosphate slurries. It is not processed into conventional nitro phosphate granular fertilizers as in Europe, but used as an ingredient for liquid fertilizers in suspension form.

Potassium

There are no deposits of water soluble potassic minerals in South Africa. Several other minerals containing potassium are, however, to be found in sufficient supply. The economics of potassium extraction from these ores is the deterrent factor preventing its exploitation (Botha, 1985; Botha & Russel, 1977; Basson 1985).

(i) *Phlogopite (Phalaborwa):*
A substantial deposit of this mica is found in the northern pyroxenite section of the Phalaborwa complex. It contains 8% K. The underlying pure deposit amounts to 1 000 million tons and is readily accessible. This source of potassium has received most attention. Investigations and research on its economic exploitation as a source of potassic fertilizer has been in progress for more than a decade. Joint and separate investigations were carried out by Palabora Mining Company, Fedmis Division of Sentrachem, and Mintek. The pyrometallurgical process involves the calcination of phlogopite with gypsum and calcite, followed by leaching of the formed potassium sulphate. While it was found uneconomical to extract potassium alone, it may prove economical if the co-extraction of other materials such as aluminium, magnesium and silver is considered.

(ii) *Syenite (Phalaborwa):*
The area surrounding the carbonatite complex contains several dykes of nepheline syenite. This source contains 8 to 10% K and 7 to 9% Al. The extraction of both K and Al from this hard rock was considered, but it has proved uneconomical.

(iii) *Alkaline complexes (Pilansberg and Spitskop):*
The most important mineral here is ijolite, an alkali syenite, with 3,5% K and 10% Al. This rock is also too hard for economic exploitation.

(iv) *Sericite (Witwatersrand):*
This mineral occurs in the Dominion Reef System and contains 6 to 8% K and up to 16% Al. The deposit is small, however, — only some 1,2 million tons — and hence is not a viable proposition for industrial development.

(v) *Glauconite (continental shelf):*
This hydrated silicate of potassium, iron and aluminium occurs as sedimentary beds off the coast of Northern Kwa Zulu-Natal, it is highly concentrated on the outer shelf of the South Africa West Coast, and on the middle shelf West of Port Elizabeth. Deposits near Cape Town are some of the richest marine deposits in the world, but occurs at a depth of 200 to 500 metres, precluding for the present any mining operations.

(vi) *Sea water:*
In order to reclaim economically viable quantities of potassium chloride from the sea, it would necessitate the co-reclamation of table salt to the tune of eight times the local consumption. This avenue is therefore not viable.

Conclusion

The present slump in the South African fertilizer sales, caused by successive years of drought, may have somewhat eased the seriousness of our dependence on imported raw materials, because less such materials were required. This was, however, largely offset by the adverse economic situation, which caused the costs of the imported sulphur and potassic fertilizers to soar.

Except for the planned increase in the recovery of sulphur by Sasol, there is no immediate prospect of increased sulphur reclamation or potassium extraction. If needs be potassium can be extracted from phlogopite since a process has been developed. At this juncture, it does not seem likely, though, that it will become necessary.

The need for sulphur may be reduced by increased use of nitric acid to solubilize rock phosphate. This may, however, be offset by increased local demand when climatic conditions improve and by increased exports of fertilizer.

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