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MAXIMIZING THE SHARE OF DOMESTIC RAW MATERIALS IN DEVELOPING THE PHOSPHATE FERTILIZER INDUSTRY*

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Summary

Phosphate rock accounts typically only for 10 to 50 per cent of the total raw material costs of compound and phosphate fertilizers. The rest is due to sulphur, nitrogen and potash.

As the international raw material prices often fluctuate quite independently from the final product prices, it is natural for any phosphate fertilizer producer to try to avoid too heavy dependence on imported raw materials. In the opposite case, an increasing foreign currency expenditure might jeopardize the total economy of a phosphate fertilizer project.

The raw material cost structure varies widely between different products and processes. In this paper the primary raw material costs of the following products are broken down:

- TSP
- DAP
- NPK

Moreover, regarding the manufacture of NPK fertilizers, the following three processes are compared:

- nitrophosphate NPK process
- urea-based NPK process
- phosphonitric NPK process.

The raw materials of compound and phosphate fertilizer production are very seldom found all in one country but, fortunately enough, the variety of fertilizer processes available today enables the maximization of the share of domestic raw materials in each particular case.

Contents

1 INTRODUCTION

Phosphate rock accounts typically only for 10 to 50 per cent of the total raw material costs of compound and phosphate fertilizers. The rest is due to sulphur, nitrogen (mostly ammonia) and potash (potassium chloride or potassium sulphate).

As the international raw material prices often fluctuate quite independently from the final product prices, it is natural for any phosphate fertilizer producer to try to avoid too heavy dependence on imported raw materials. In the opposite case, an increasing foreign currency expenditure might jeopardize the total economy of a phosphate fertilizer project.

2 BASIS OF PROCESS COMPARISON

The raw material cost structure varies widely between different products and processes. In this paper the primary raw material costs of the following products are broken down:

- TSP (triple superphosphate 0-46-0)
- DAP (diammonium phosphate 18-46-0)
- NPK (compound 15-15-15)

Moreover, regarding the manufacture of NPK fertilizers, the following three processes are compared:

- nitrophosphate (Odda) NPK process (plus CAN as by-product)
- urea-based NPK process
- phosphonitric (mixed acid) NPK process.

The following raw material prices are used in this paper:

		USD/t
-	Phosphate rock (33 % P_2O_5)	33
-	Sulphur	150
-	Ammonia NH_3	180
-	Urea	120
-	KCl	90
-	K_2SO_4	180

3 COST CALCULATIONS

The indicative raw material consumptions and costs are as follows:

		Raw material consumption t/t of product		Raw material unit price USD/t		Total raw material costs USD/t	%
TSP							
===	P	1.48	x	33	=	48.84	51
	S	0.318	x	150	=	46.8	49
						95.64	100
DAP							
===	P	1.49	x	33	=	49.17	31
	S	0.44	x	150	=	66	42
	NH_3	0.23	x	180	=	41.4	26
						156.57	99

NPK 15-15-15 KCl-based

	Raw material consumption t/t of NPK (plus CAN)	Raw material unit price USD/t	Total raw material costs USD/t	%
Odda + CAN				
P	0.464 x	33 =	15.312	14
NH_3	0.408 x	180 =	73.44	66
K	0.205 x	90 =	22.5	20
			111.252	100
Urea-based				
P	0.489 x	33 =	16.137	16
S	0.145 x	150 =	21.75	22
N { NH_3	0.044 x	180 =	7.92 }	38
N { Urea	0.247 x	120 =	29.64 }	
K	0.250 x	90 =	22.5	23
			97.947	99
Phosphonitric (Kemira)				
P	0.470 x	33 =	15.51	18
S	0.095 x	150 =	14.25	17
NH_3	0.187 x	180 =	33.66	39
K	0.250 x	90 =	22.5	26
			85.92	100

NPK 15-15-15 K_2SO_4-based

	Raw material consumption t/t of NPK (plus CAN)	Raw material unit price USD/t	Total raw material costs USD/t	%
Odda + CAN				
P	0.464 x	33 =	15.213	11
NH_3	0.408 x	180 =	73.44	51
K	0.300 x	180 =	54	38
			142.752	100
Urea-based				
P	0.489 x	33 =	16.137	12
S	0.145 x	150 =	21.75	17
N { NH_3	0.044 x	180 =	7.92 }	29
N { Urea	0.247 x	120 =	29.64 }	
K	0.300 x	180 =	54	42
			129.447	100
Phosphonitric (Kemira)				
P	0.472 x	33 =	15.576	13
S	0.106 x	150 =	15.9	13
NH_3	0.188 x	180 =	33.84	28
K	0.300 x	180 =	54	45
			119.316	99

...

In accordance with the above calculations, the shares of P, S, N and K raw material costs are graphically shown in Figure 1:

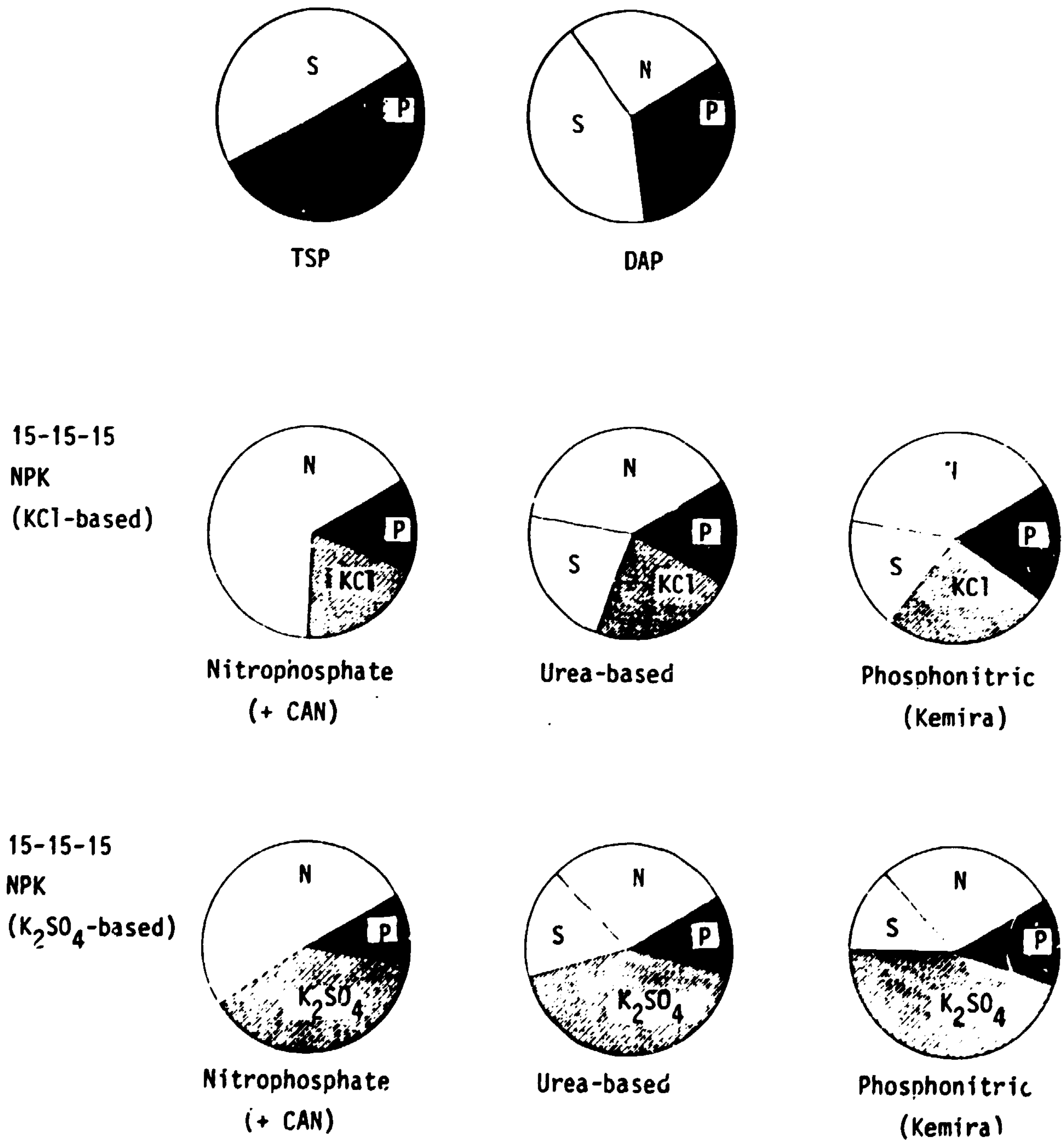

FIGURE Shares of P, S, N and K raw material costs in various fertilizer processes

It is to be noted that in this paper the potassium sulphate costs have not been broken down further into potassium chloride and sulphur costs. Thus the approach adopted here corresponds to a case where potassium sulphate can be produced directly at the potash brines deposit site without using sulphuric acid.

4 Maximizing Domestic Share

In case phosphate rock is the only domestic raw material of a country, there are not too many possibilities to diversify phosphate fertilizer production while maintaining an essentially domestic raw material basis. TSP will here be the product least dependent on imported feedstocks.

Much wider perspectives open up in cases where several domestic raw materials are available in the same region, e.g. P+S, P+N or P+K.

TSP and DAP productions will result in high domestic shares in a "P+S" region, while nitrophosphate (Odda) NPK production seems the most attractive in a "P+N" region.

5 Special Case: Countries with Domestic Phosphate and Potash (P+K regions)

We shall now take a closer look at an example where a country possesses both phosphate rock and potash resources. The potash salt may be either potassium chloride or potassium sulphate (but produced without using sulphuric acid). In such conditions the share of domestic raw materials in the 15-15-15 grade NPK fertilizer production easily exceeds the corresponding share in DAP production, and might exceed even the figure attainable in TSP production if domestic potassium sulphate is available. The results of this approach are graphically shown in Figure 2.

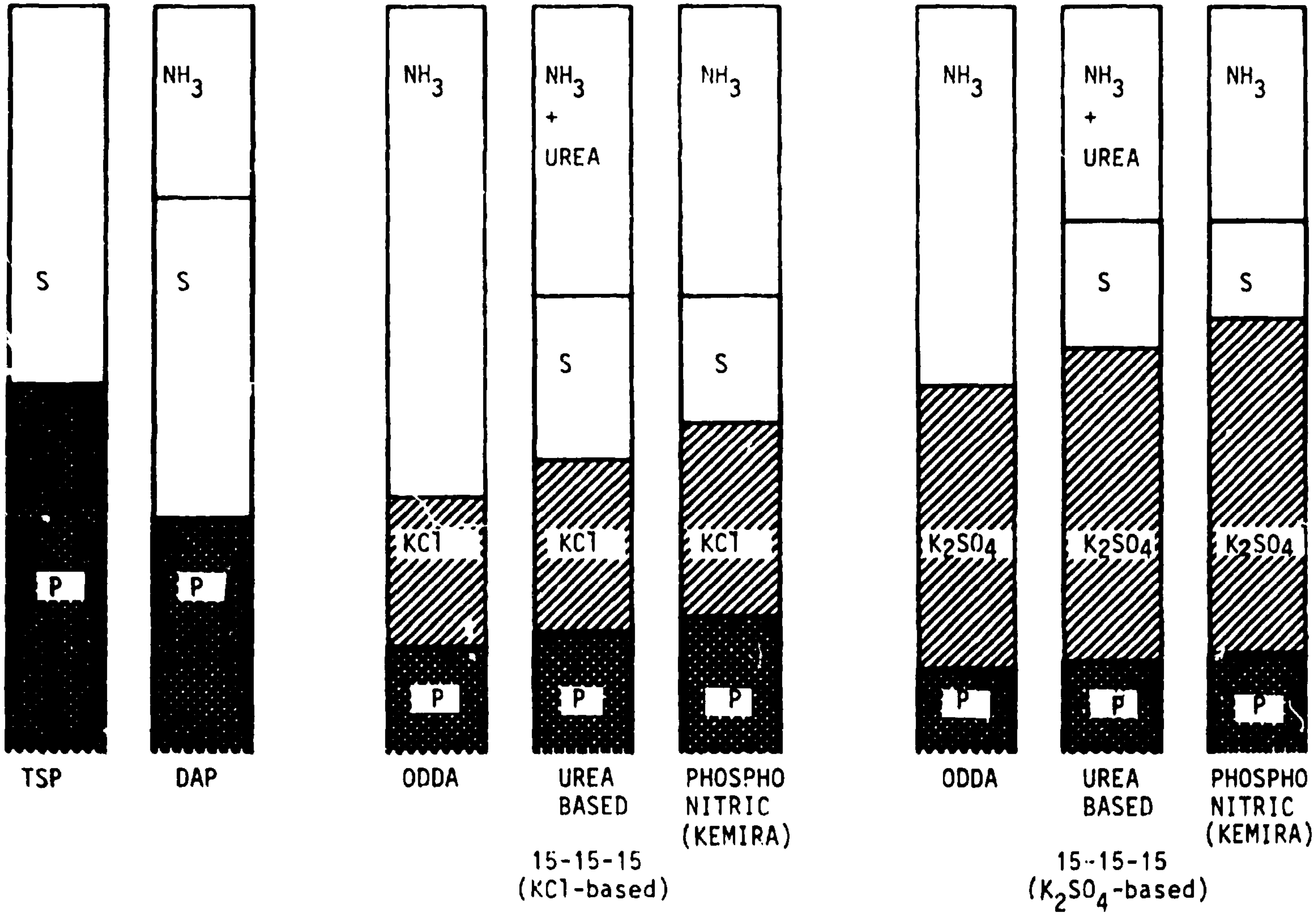

FIGURE 2. Domestic shares in "P+K" cases

When comparing various NPK processes in a country with P+K resources, the target of maximizing the domestic share can also be formulated as follows:
"How to decrease the need of sulphur imporation?"

In this respect, the urea-based NPK process is the least attractive, because all phosphate rock must be converted into phosphoric acid by means of sulphuric acid.

On the contrary, the Odda NPK process avoids totally the importation of sulphur, but this advantage is more than offset by the fact that this process needs huge amounts of nitrogen raw material (ammonia) for the production of NPK's and by-product CAN. Moreover, as also CO_2 gas supply from ammonia plant is needed for CN conversion, the Odda process can hardly turn out feasible without an adjacent ammonia plant, and hence domestic nitrogen source.

Finally, the phosphonitric NPK process offers a fully realistic alternative of decreasing the importation of sulphur, although, unlike the Odda process, the need of sulphur is not totally eliminated, In this process a part of the phosphate rock is directly digested by nitric acid at the NPK plant, while another part of the phosphorus must still be introduced as phosphoric acid. In any case, for countries with phosphate rock and potash resources, the phosphonitric NPK process offers an attractive way of developing such downstream production which is still essentially based on domestic raw materials.

6 CONCLUSIONS

The raw materials of compound and phosphate fertilizer production are very seldom found all in one country. Careful planning is therefore needed to find out a production scheme which is best suited to the natural resources of each country. The variety of fertilizer processes available today enables the successful maximization of the share of domestic raw materials in each particular case.

Before the establishment of fertilizer industry, various processes and configurations shall always be compared in respect of several criteria, like:

- production costs
- investment costs
- product quality
- process flexibility
- environmental aspects
- etc.

Nevertheless, it is remarkable to see how often the simple maximization of the domestic share also leads to the optimal solution. In short, a predominantly domestic raw material basis gives a good guarantee for economical fertilizer production irrespective of international commodity price fluctuations.