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# BASIC CONSIDERATIONS FOR MAKING PETROKIMIA--GRESIK A VIABLE INSTALLATION

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## BASIC CONSIDERATIONS FOR MAKING PETROKIMIA--GRESIK A VIABLE INSTALLATION

### SUMMARY

In considering construction of phosphate production facilities in Indonesia, a choice can be made between adding these facilities to an existing nitrogen production plant or creating an entirely new production facility. If phosphate production is added, for instance at Gresik, a substantial advantage amounting to 10% to 20% of the project investment cost would be realized by using existing plant facilities such as product storage, maintenance shops, mobile equipment, etc. On the other hand, creation of a new facility would cost more because all service facilities would have to be provided in total. Also of considerable importance is the advantage provided by using existing management and technical staff experienced in chemical plant operation. At the present time, the TVA team found no evidence of personnel available in Indonesia with sufficient training to start up or run a phosphoric acid-TSP complex. That training should start immediately.

A combination of Ashland Oil and Cities Service companies is in the process of developing an oil field on the north coast of the Island of Madura. Part of this development may include the flaring of natural gas. Rather than waste this gas, some effort should be made for its utilization. If Petrokimia-Gresik were to utilize the natural gas as feedstock in its ammonia production rather than fuel oil, the production cost per ton of ammonia could be reduced by $12. Also, if natural gas were available, the ease of drying ammonium sulfate, phosphate rock and TSP would be enhanced.

The existence of a phosphoric acid plant in Indonesia of the size proposed in section III would provide for selective production of a

variety of fertilizers in the future. Some of the fertilizers and fertilizer intermediates which can be produced with wet-process phosphoric acid are listed below:

| | |
|---|---|
| Monoammonium phosphate (MAP) | 13-52-0 |
| Diammonium phosphate (DAP) | 18-46-0 |
| N-P-K granular fertilizer | Multiple grades |
| Ammonium polyphosphates | Multiple grades |
| Urea-ammonium phosphates | Multiple grades |

MAP, DAP, or N-P-K granular fertilizers could be made at a future date, if desired, by installing a granulation plant. Ammonium polyphosphates and urea-ammonium phosphates are more complex processes and require different equipment.

*Installation of equipment to produce any of these products was deferred from immediate consideration because of the magnitude of the task of placing a phosphoric acid plant and companion superphosphate plant into operation successfully within a reasonable startup time. Inclusion of additional plant facilities not absolutely essential for the first few years of operation at Gresik would add unnecessary complications to the burden of initial operation of plant facilities. The bulk blending plant proposed will provide means of manufacturing a variety of N-P-K grades simply with low investment and operating costs.*

It appears likely that a demand for an ammonium phosphate such as DAP or MAP will develop in the future. At such time as the demand for ammonium phosphate would support substantial production, the quantity of superphosphate produced at Gresik could be reduced and a portion of the phosphoric acid diverted to production of an ammonium phosphate.

Another possibility for future consideration is production of urea-ammonium phosphate. Raw materials required for this production are

urea solution, phosphoric acid and ammonia. The resulting N-P grades could be sold as produced or blended with other raw materials to make N-P-K grades.

Sections III and IV establish the costs of producing 275,000 tons/year of TSP and the required raw materials handling facilities. A summary of the relevant costs of production is given below. It should be noted that all estimates are based on conditions existing in February 1973.

Table 1. Annual Costs of Production Per Metric Ton Without Investment Costs of Materials Handling Facilities

| | Original Proposal | | |
|---|---|---|---|
| | Alternative I (Local Acid), $ | Alternative II (Imported Acid), $ | TVA Proposal (Local Acid), $ |
| Cost/ton $P_2O_5$ in acid | 159.75 | 182.70 | 155.93 |
| Cost/ton acid (0-54-0) | 86.27 | 98.66 | 84.20 |
| Cost/ton TSP | 71.82 | 79.85 | 69.96 |
| Cost/ton $P_2O_5$ in TSP | 156.13 | 173.59 | 152.09 |

Table 2. Annual Costs of Production Per Metric Ton With Investment Costs of Materials Handling Facilities

| | Original Proposal | | |
|---|---|---|---|
| | Alternative I (Dock & Belt), $ | Alternative II (Dock, Belt & Acid Pipeline), $ | TVA Proposal (Barging to Plant Gate), $ |
| Cost/ton $P_2O_5$ in acid[a] | 159.75 | 182.70 | 155.93 |
| Cost/ton acid (0-54-0)[a] | 86.27 | 98.66 | 84.20 |
| Cost/ton TSP | 77.47 | 85.40 | 71.63 |
| Cost/ton $P_2O_5$ in TSP | 168.41 | 185.65 | 155.72 |

[a]The capital costs of the materials handling systems (dock and belt versus barging) were charged to the end product TSP. However, if acid production were to be considered separately, its costs are understated above. All costs above are overstated if some of the benefits of the materials handling system accrue to the nitrogen production portion of Petrokimia or if the facilities are used to load-out finished N or N-P materials for water transportation to domestic or international ports.

As illustrated in figure 4, section III, the delivered price of phosphate rock has a considerable influence on the production cost of granular triple superphosphate. Roughly for every $2/ton reduction in the cost of rock the cost of production of triple superphosphate is decreased by $3/ton. In this analysis, costs were utilized that reflect current costs of phosphate rock delivered to Indonesia from either North America or North Africa.

After leaving Indonesia, the authors visited with Broken Hill South Company, Ltd., and the Phosphate Co-Operative Company of Australia, Ltd., in Melbourne, Australia. The subject of discussion was the future potential of phosphate rock availability for Australian export to Indonesia. The following facts were established:

1. The earliest that phosphate rock would be available from Australia will be mid-1977.
2. Even if rock from Australia were available, it would probably not release the availability of Christmas Island rock because of major rock quality differences.
3. If Australian phosphate rock were available today, it would probably sell at a level competitive with or slightly higher than current world market prices. However, with a potential freight rate of only $6 to $9/ton depending on vessel size, the reduction in cost of delivered rock to Petrokimia could be approximated at $8 to $10/ton as compared with current sources.
4. The quality of Australian rock will be adequate to make a good quality acid (17% $P_2O_5$ rock concentrated to 34% $P_2O_5$ prior to shipment). The rock is relatively low in impurities and high in reactivity.

## BASIC CONSIDERATIONS FOR MAKING PETROKIMIA--GRESIK A VIABLE INSTALLATION

### I. BRIEF CURRENT AND FUTURE FERTILIZER MARKET SITUATION

Indigenous production of fertilizer is insufficient to meet the need for fertilizer in Indonesia. Approximately 140,000 mt of urea is currently being produced annually (100,000 mt by PUSRI and 40,000 mt by Petrokimia). This is scheduled to be increased to about 540,000 mt of urea by 1976, when PUSRI II becomes fully operational. Petrokimia produces up to 140,000 mt of ammonium sulfate annually. This is used mainly on sugarcane and tea. There is no phosphate production facility currently operational in Indonesia nor is one scheduled to be built before 1976. As a result, all of the phosphate, 75% of all urea, 25% of the ammonium sulfate and all of the NP and NPK fertilizers needed must be imported.

Table 3. Future Phosphate Demand and Petrokimia's Possible Market Share

| Maximum Phosphate Demand in Indonesia, 1969-80 | | | |
|---|---|---|---|
| Year[a] | MT $P_2O_5$[b] ('000) | Year[a] | MT $P_2O_5$[b] ('000) |
| 1969 | 42.8 | 1975 | 73.5 |
| 1970 | 45.4 | 1976 | 84.3 |
| 1971 | 37.2 | 1977 | 96.3 |
| 1972 | 45.4 | 1978 | 110.1 |
| 1973 | 55.1 | 1979 | 130.6 |
| 1974 | 62.7 | 1980 | 149.5 |

[a]Figures for 1969-71 are actual. Figures 1973-80 are projections based upon following assumptions: 1972-74 market will grow at overall annual rate of 10%/year, 1975-77 market growth assumed at 15%/year and 1978-79 growth rate projected at 20%/year and drop to 15% by 1980.

[b]The tonnage figures 1973-80 should be considered the maximum amounts of $P_2O_5$ that will be consumed during this period.

Areas of Phosphate Demand (percent) in Indonesia:

| Location | 1975 | 1980 |
|---|---|---|
| East Java | 20 | 22 |
| Central Java | 25 | 23 |
| West Java | 32 | 25 |
| Sumatra | 19 | 14 |
| Other | 4 | 16 |

Basic Phosphate Product Mix Needed in Indonesia:

| Year 1973-1975 | % of Market[a] |
|---|---|
| TSP | 68 |
| DAP | 4 |
| Compounds | 28 |

| 1976-1978 | % of Market[a] |
|---|---|
| TSP/DAP | 70 |
| Compounds[b] | 30 |

[a]Assume government allows for a natural evolution of the fertilizer market.

[b]NPK grades may actually be blends if sizing and compatibility problems (in tropics) can be corrected through improved technology.

The consumption of the fertilizers varies in the different areas according to the season as shown below:

Table 4. Period of Fertilizer Use (Forecast % of Total Consumed)

| Area | TSP/DAP, Per Quarter[a] | | | | Compounds[b] Per Quarter | | | |
|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | I | II | III | IV |
| East Java | 26 | 9 | 14 | 51 | 10 | 35 | 20 | 35 |
| Central Java | 25 | 10 | 13 | 52 | 12 | 30 | 10 | 48 |
| West Java | 23 | 10 | 12 | 55 | 11 | 27 | 22 | 40 |
| Other Islands | 19 | 9 | 12 | 60 | 20 | 10 | 10 | 60 |

[a]First quarter is January through March, the second April through June, the third July through September, and the fourth October through December.

[b]Assumed analysis is 40% 15-15-15; 40% 23-23-0; 6% 21-11-11; and 8% 30-15-0.

## II. PETROKIMIA GRESIK - CURRENT STATUS

The existing facilities at Perum Petrokimia Gresik consist of:

### 1. PRODUCTION UNITS

'lant for producing anhydrous ammonia = 73,000 mt/yr
'quivalent as nitrogen = 60,000 mt/yr

'perating flexibility permits conversion of the ammonia production to

| | Metric tons/year | |
|---|---|---|
| | Alternative I | Alternative II |
| 'rea | 45,000 | 61,700 |
| 'mmonium Sulfate | 150,000 | 113,500 |
| Excess as Ammonia | 7,000 | 7,000 |
| Excess $H_2SO_4$ | 14,000 | 40,000 |

b. Facilities for producing 98% $H_2SO_4$ (sulfuric acid) = 130,000 mt/yr

Facilities for additional byproducts:

Oxygen @ 99.5% purity - 500 $NM^3$/day (net Cubic Meters/day)
Argon @ 99.95% purity - 48 $NM^3$/day

A nomograph for determination of product combinations is shown in figure 1.

### 2. AUXILIARY FACILITIES

a. Existing bulk storage buildings completely modern with permanent conveyor systems and with loading dock to rail spur and to trucks.

Capacities

Bulk fertilizer 10,000 mt
Sulfur 25,000 mt

Existing bagged storage buildings with loading dock to rail spur and to trucks.

Capacity - 40,000 to 45,000 mt

Bagging Stations

Six stations each with separate storage hopper of 160 mt capacity, and a bagging capacity of 24 mt/hour (each station) or 144 mt/hour total capacity.

d. Bag Manufacturing

Facilities available to produce 75,000/day multi-wall kraft paper (and/or P.E. or asphalt impregnated paper) bags of 25 kg or 50 kg capacity.

# PROJEK PETROKIMIA SURABAJA

M TONS/DAY

| REQUIRED | | PROD. |
|---|---|---|
| OIL | $O_2$ | $NH_3$ |
| 8.2 | 9.25 | 10 |
| 16.4 | 18.50 | 20 |
| 24.6 | 27.75 | 30 |
| 32.8 | 37.00 | 40 |
| 41.0 | 45.25 | 50 |
| 49.2 | 55.50 | 60 |
| 57.4 | 67.75 | 70 |
| 65.6 | 74.00 | 80 |
| 73.8 | 83.25 | 90 |
| 82.0 | 92.50 | 100 |
| 90.2 | 101.75 | 110 |
| 98.4 | 111.00 | 120 |
| 106.6 | 120.25 | 130 |
| 114.8 | 129.50 | 140 |
| 123.0 | 138.75 | 150 |
| 131.2 | 148.00 | 160 |
| 139.4 | 157.25 | 170 |
| 147.6 | 166.50 | 180 |
| 155.8 | 175.75 | 190 |
| 164.0 | 185.00 | 200 |
| 172.2 | 194.25 | 210 |
| 180.4 | 203.50 | 220 |
| 188.6 | 212.75 | 230 |
| 196.8 | 222.00 | 240 |

MAX DESIGN PROD 220 MT/DAY

PRODUCT SPECIFICATIONS

| | |
|---|---|
| ANHYDROUS AMM | - 99.95% |
| OIL | - 5PPM MAX |
| MOISTURE | - 0.05% |
| INERT | - 0.03% |

M.TONS/DAY UREA

MAX DESIGN PRODUCTION 185 MT/DAY

0, 25, 50, 75, 100, 125, 150, 175, 200, 225, 250

PRODUCT SPECIFICATIONS

| | |
|---|---|
| NITROGEN | - 46.3% MIN. |
| MOISTURE | - 0.4% MAX |
| FREE AMMONIA | - 0.25% MAX |
| BIURET | - 0.7% MAX |
| IRON | - 0.0001% MAX |

M.TONS/DAY PRODUCED $(NH_4)_2SO_4$

480, 460, 440, 420, 400, 380, 360, 340, 320, 300, 280, 260, 240, 220, 200, 180, 160, 140, 120, 100, 80, 60, 40, 20, 0.0

← MAX. DESIGN PRODUCTION 455 MT/DAY

EXAMPLE :

| | |
|---|---|
| AMMONIA PLANT PRODUCTION | - 220 MT/DAY |
| UREA PRODUCTION | - 185 MT/DAY |
| SULFATE PRODUCTION | 344 MT/DAY |
| SULFURIC ACID PRODUCTION | - 390 MT/DAY |
| SULFURIC ACID PRODUCT | - 130 MT/DAY |

(20 T AMMONIA AVAILABLE FOR SALE AS AMMONIA @ 220 MT/DAY PRODUCTION

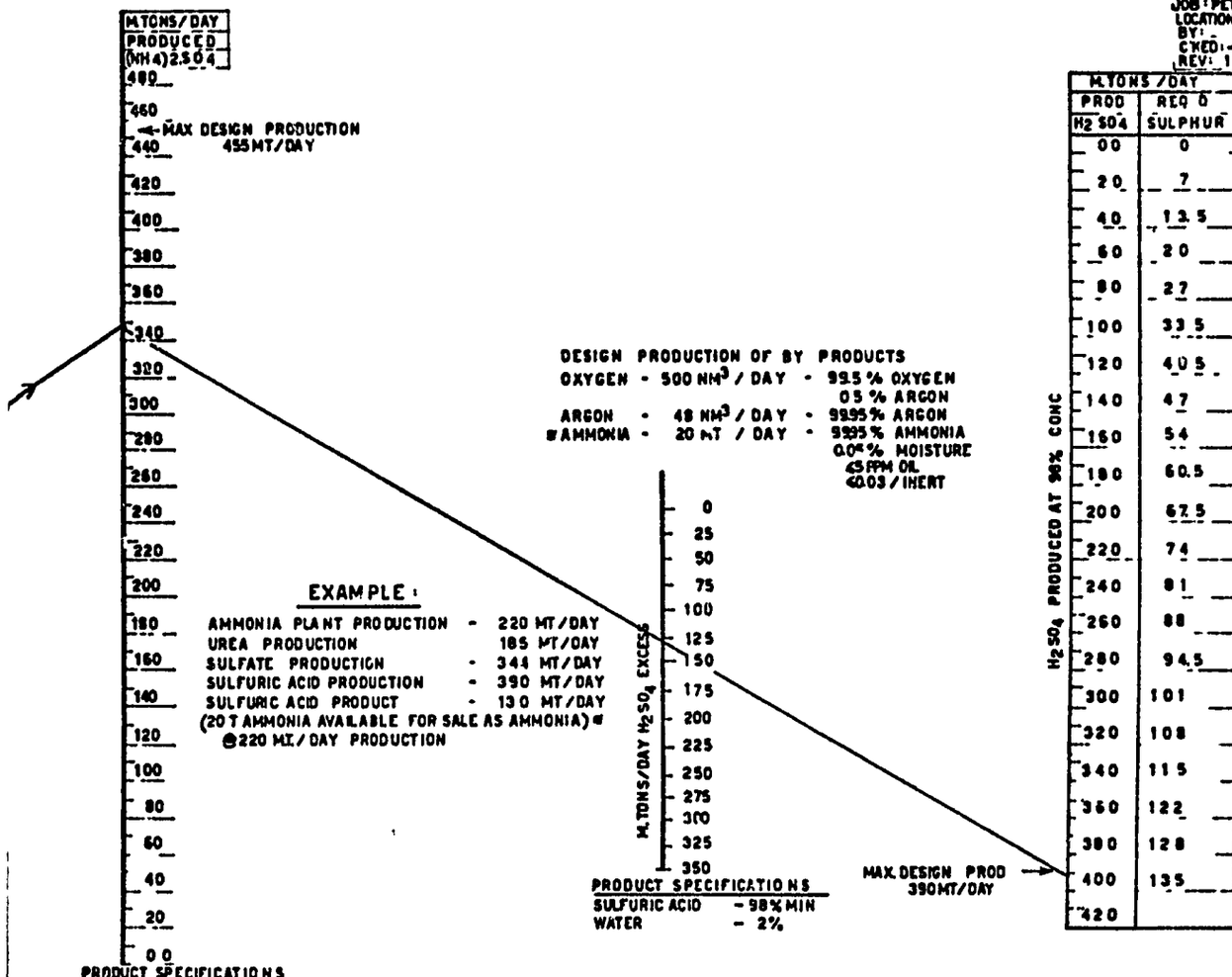
PRODUCT SPECIFICATIONS

| | |
|---|---|
| NITROGEN | - 20.8% MIN |
| MOISTURE | - 0.15 % MAX |
| ACID | - 0.1 % MAX |
| SCREEN ANAL. % IS | → 30 - 70% MIN |

| | |
|---|---|
| PROJEK PETROKIMIA SURABAJA<br>GRESIK INDONESIA | TECHNICAL ADVISOR |

# PROJEK PETROKIMIA SURABAJA

L T S
INT TECH SERV
CHART NO: C.1-4
JOB: PETROKIMIA
LOCATION: GRESIK
BY: DATE
CHKED: DATE
REV: 1 DEC 9 71




| TECHNICAL ADVISOR | TRACED BY / DATE MAY 22-1968 | PREPARED BY O.G.WOODSIDE / DATE MARCH 20 1968 | NOMOGRAPH FOR DETERMINATION OF POSSIBLE COMBINATIONS OF PRODUCTION OF AMMONIA, UREA, AMMONIUM SULFATE AND SULFURIC ACID | DRAWING NUMBER TA - 01 |
|---|---|---|---|---|

e. Pier[a] - 5.0 km from plant
200 meter berthing space
8.5 meter draft (Max)

f. Maintenance Shop and Equipment

Maintenance facilities include a modern well-equipped shop in which we can fabricate spares and do all major repairs required for a chemical plant.

g. Miscellaneous Equipment

Twenty-two 6.0-ton dump trucks equipped for bulk fertilizer or other solid handling

Eleven cranes from 7.5- to 100-ton capacity

At present, if the Gresik plant is operated at capacity, there is an excess of 7,000 mt of $NH_3$ and between 14 and 40,000 mt/year of $H_2SO_4$. The excess $H_2SO_4$ may be utilized in the proposed production of phosphoric acid. However, the investment estimates in sections II and III for phosphoric acid production assume all $H_2SO_4$ required will be provided by new facilities.

[a]This pier is the property of Cement Gresik; part-time use is allowed Petrokimia. This facility is not adequate for importation of large quantities of phosphate rock.

## III. ORIGINAL PROPOSAL - TRIPLE SUPERPHOSPHATE INCLUDING 225 TONS $P_2O_5$/DAY AS 0-54-0 PHOSPHORIC ACID

1. PRODUCTION

200,000 mt/year 0-46-0 Triple Superphosphate

2. MATERIAL BALANCE

Phosphate Rock @ 32% $P_2O_5$ = 0.393 ton/ton TSP
Phosphoric Acid @ 54% $P_2O_5$ = 0.64 ton/ton TSP
Electric Power @ 7 kWh/ton = kWh/ton TSP

3. RAW MATERIALS REQUIRED

| | |
|---|---|
| Phosphate Rock | = 78,600 tons/year |
| Phosphoric Acid | = 128,000 |
| Electric Power | = 5,700 kW (installed capacity) |

Note: Two alternatives are considered in the production of triple superphosphate and compound fertilizers:

a. Alternative I:

Install a 130,000 ton/year phosphoric acid plant and import:

| | | | |
|---|---|---|---|
| phosphate rock | = | 314,000 tons/year | 100,000 tons $P_2O_5$ |
| sulphur | = | 63,000 tons/year | |

b. Alternative II:

Import:

| | | |
|---|---|---|
| phosphoric acid - total imports[a] | | |
| phosphoric acid - | 130,000 tons/year | 70,000 tons $P_2O_5$ |
| phosphate rock - | 78,000 tons/year | 25,000 tons $P_2O_5$ |
| | Total | 95,000 tons $P_2O_5$ |

[a]difference between 100,000 and 95,000 tons $P_2O_5$ is accounted for by material losses which would be greater in manufacturing process than for importing acid.

Table 5

Investment Estimate Alternative I: Phosphoric Acid Plant Sized to Support Production of 200,000 mt/year of Triple Superphosphate (225 mt/day of $P_2O_5$ as 54% $P_2O_5$ Phosphoric Acid)

| | |
|---|---|
| Battery limits | $8,200,000 |
| Land (Plant site, cooling pond and Gypsum disposal) | 400,000 |
| Dikes | 400,000 |
| Scales | 50,000 |
| Site improvement | 56,000 |
| Contaminated Cooling Water System | 323,000 |
| Building | 70,000 |
| Power Distribution | 167,000 |
| Mobil Equipment | 144,000 |
| Pipe Racks between Plants, Steam Piping and general Piping | 290,000 |
| Subtotal | 10,100,000 |
| Engineering (20%) | 2,020,000 |
| Subtotal | 12,120,000 |
| Contractor Fee (10%) | 1,212,000 |
| TOTAL | $13,332,000 |

Table 6

Phosphoric Acid Production Costs Alternative I: 225 mt/day $P_2O_5$ as 0-54-0 Acid = 70,875 mt $P_2O_5$/year

| | Unit | Units/ton $P_2O_5$ | Cost/ Unit, $ | Cost/ton $P_2O_5$, $ | Total Cost, $ |
|---|---|---|---|---|---|
| Direct Costs | | | | | |
| Raw Materials | | | | | |
| Phosphate Rock 32% $P_2O_5$ | mt | 3.32 | 27.50 | 91.30 | 6,470,887 |
| Sulphur | mt | 0.90 | 25.00 | 22.50 | 1,594,687 |
| Water[a] | M/gal | 16 | 0.045 | .72 | 51,030 |
| Steam | M lbs | 5.06 | -[b] | - | - |
| Power[a] | kWh | 275 | .012 | 3.30 | 233,887 |
| Rock Grinding | | | | 2.42 | 171,517 |
| Operating Labor-29 men | | | | .24 | 17,010 |
| Maintenance Labor-25 men | | | | .21 | 14,883 |
| Maintenance Materials | | | | 4.00 | 283,500 |
| Supplies | | | | 1.42 | 100,642 |
| Analyses | | | | .02 | 1,417 |
| Supervision | | | | .16 | 11,340 |
| TOTAL DIRECT | | | | 126.29 | 8,950,800 |
| Indirect Costs | | | | | |
| Depreciation-Capital Investment ÷ 15 years | | | | 12.54 | 888,800 |
| Insurance .006 x C.I. | | | | 1.13 | 79,992 |
| Taxes - Personal & Property | | | | - | - |
| Plant Overhead | | | | 1.00 | 70,875 |
| Interest on the Investment - C.I. ÷ 2 · 12% | | | | 11.29 | 799,920 |
| Interest on Operating Capital = Total Direct ÷ 3 x 12[c] | | | | 5.05 | 358,032 |
| Startup losses 62% x 1.4 million ÷ 5 years | | | | 2.45 | 173,600 |
| TOTAL INDIRECT | | | | 33.46 | 2,371,219 |
| TOTAL MANUFACTURING COSTS | | | | 159.75 | |

TOTAL COST/TON ACID -- $86.27

[a]Includes operating costs and amortization of the investment in utility facilities.
[b]Steam supplied from $H_2SO_4$ plant waste heat boiler.
[c]Assuming 33% of total annual direct operating costs are outstanding at any one time.

Table 7

Production Costs Alternative I: TSP - Granular 200,000 mt/year from 0-54-0 Acid - Total Investment in TSP Unit $2.4 million

| | Unit | Units/ton TSP | Cost/ Unit, $ | Cost/ton TSP, $ | Total Cost, $ |
|---|---|---|---|---|---|
| Direct Costs | | | | | |
| Raw Materials | | | | | |
| Phosphoric Acid | mt | 0.64 | 86.27 | 55.21 | 11,042,000 |
| Phosphate Rock[a] | mt | 0.393 | 27.50[a] | 10.78 | 2,156,000 |
| Power | kWh | 5 | 0.012 | 0.06 | 12,000 |
| Rock Grinding & Handling | | | | 1.32 | 264,000 |
| Operating Labor | | | | .05 | 10,000 |
| Supervision | | | | .04 | 8,000 |
| Maintenance & Supplies | | | | .72 | 144,000 |
| TOTAL DIRECT COSTS | | | | 68.18 | 13,636,000 |
| Indirect Costs | | | | | |
| Depreciation - C.I. of 2.4 million ÷ 15 years | | | | .80 | 160,000 |
| Insurance .006 x C.I. | | | | .07 | 14,400 |
| Tax - Personal & Property | None | | | - | - |
| Plant Overhead | | | | 1.00 | 200,000 |
| Interest on Capital Investment - C.I. ÷ 2 x 12% | | | | .72 | 144,000 |
| Interest on Operating Capital = T.D.C. - Acid ÷ 3 x 12%[b] | | | | .52 | 103,759 |
| Startup Losses (38% of 1.4 million) ÷ 5 years | | | | .53 | 106,400 |
| TOTAL INDIRECT | | | | 3.64 | 728,559 |
| TOTAL COST OF MANUFACTURING | | | | 71.82 | 14,364,559 |

COST PER TON $P_2O_5$ IN PRODUCT -- $156.13

[a] Reflects operating costs of dock and belt to get phosphate rock and sulphur into the plant.

[b] Total direct cost minus phosphoric acid cost (interest) ÷ 3 x 12% - assuming 33% of direct costs are outstanding at any one point in time.

Alternative II- Importation of 128,000 tons of 0-54-0 Phosphoric Acid to Make 200,000 mt/year of Granular TSP (+ 78,600 mt of 32% $P_2O_5$ Phosphate Rock

SUMMARY OF INVESTMENT COSTS, $

Acid Unloading and Storage

| | | |
|---|---|---|
| Composed of: | | |
| $H_3PO_4$ Storage | 33,000 mt | $1,260,000 |
| Pumps & Motors | | 7,500 |
| Piping | | 170,000 |
| Power & Lighting | | 30,000 |
| TOTAL INVESTMENT | | $1,467,500 |

Alternative II- Table 8

Costs/mt of $P_2O_5$ as Imported Acid (128,000 mt/year). Assume $25.00 Freight U.S. Gulf Coast to Indonesia (69,120 mt $P_2O_5$).

| | Cost/ton Acid Delivered $ | Cost/Unit $P_2O_5$ Delivered $ | Cost mt $P_2O_5$, $ | Total, $ |
|---|---|---|---|---|
| Direct Costs | | | | |
| Imported Phosphoric Acid | 93.00 | 1.722 | 172.22 | 11,904,000 |
| Labor | | | .05 | 3,456 |
| Power | | | .02 | 2,382 |
| Supervision | | | .01 | 691 |
| Maintenance | | | .15 | 10,368 |
| TOTAL DIRECT | | | 172.45 | 11,919,897 |
| Indirect Costs | | | | |
| Depreciation C.I. 1,467,500 ÷ 15 years | | | 1.42 | 97,833 |
| Insurance .006 x C.I. | | | .13 | 9,000 |
| Taxes - Personal & Property None | | | - | - |
| Plant Overhead | | | .50 | 34,560 |
| Interest on Investment C.I. ÷ 2 x 12% | | | 1.30 | 90,000 |
| Interest on Operating Capital - Total Direct ÷ 3 x 12% | | | 6.90 | 476,795 |
| TOTAL INDIRECT | | | 10.25 | 708,188 |
| TOTAL IMPORT & STORAGE COST | | | 182.70 | 12,628,085 |

COST PER TON OF ACID (0-54-0) -- $98.66

Alternative II- Table 9

Production of Granular TSP (200,000 mt/year) from Imported Phosphoric Acid and Rock

| | Unit | Unit/ton TSP | Cost/ Unit, $ | Cost/ton TSP, $ | Total Cost, $ |
|---|---|---|---|---|---|
| Direct Costs | | | | | |
| Raw Materials | | | | | |
| Phosphoric Acid | mt | 0.64 | 98.66 | 63.14 | 12,628,000 |
| Phosphate Rock | mt | 0.393 | 27.50 | 10.78 | 2,156,000 |
| Power | kWh | 5 | 0.012 | 0.06 | 12,000 |
| Rock Grinding & Handling | | | | 1.32 | 264,000 |
| Operating Labor | | | | .05 | 10,000 |
| Supervision | | | | .04 | 8,000 |
| Maintenance & Supplies | | | | .72 | 144,000 |
| TOTAL DIRECT COSTS | | | | 76.11 | 15,222,000 |
| Indirect Costs | | | | | |
| Depreciation C.I. - 2.4 million + 15 years | | | | 0.80 | 160,000 |
| Insurance .006 x C.I. | | | | .07 | 14,400 |
| Tax - Personal & Property | None | | | - | - |
| Plant Overhead | | | | 1.00 | 200,000 |
| Interest on Investment C.I. + 2 x 12% | | | | .72 | 144,000 |
| Interest on Operating Capital = T.D.C.-Acid + 3 x 12% | | | | .62 | 123,759 |
| Startup Losses 38% of 1.4 million + 5 years | | | | .53 | 106,400 |
| TOTAL INDIRECT COSTS | | | | 3.74 | 748,559 |
| TOTAL COST OF MANUFACTURING | | | | 79.85 | 15,970,559 |

COST PER TON $P_2O_5$ IN PRODUCT --$173.59

## IV. NEW PROPOSAL FOR A TRIPLE SUPERPHOSPHATE PLANT AND SUPPORTING WET PROCESS PHOSPHORIC ACID PLANT AT GRESIK

A continuous triple superphosphate plant with supporting phosphoric acid and sulfuric acid production facilities is proposed for installation at Gresik. The plant should be of standard design for acidulation of phosphate rock with phosphoric acid and preferably of the type which makes use of the TVA cone mixer.

The initial proposal prepared by Petrokimia Gresik visualized a plant sized to produce only 200,000 mt/year of superphosphate. The size of the phosphoric acid plant required to support production of this quantity of TSP would produce only about 225 mt of $P_2O_5$/day (416 tons of 54% $P_2O_5$ acid).

It is recommended that consideration by Petrokimia be given to increasing the size of the acid plant from 225 mt of $P_2O_5$/day to 300 mt of $P_2O_5$/day (556 tons of 54% $P_2O_5$ acid) for the following reasons:

1. As shown in figure 2, the cost of producing the acid will be significantly lowered by the proposed increase in the size of the plant. The estimated costs of production for 225 and 300 mt of $P_2O_5$/day as acid, respectively, are $159.75/mt and $155.93/mt.
2. The smaller acid plant would not provide for a supply of phosphate to meet predicted increases in consumption by 1980.
3. The engineering design of the larger plant should more closely approximate the successful design of the larger plants built around the world during the past 10 years - smaller plants are not only uneconomical to operate but impose engineering compromises on sizing some major items of equipment, such as filters of the more efficient types. Such compromises often lead to difficult operating characteristics.

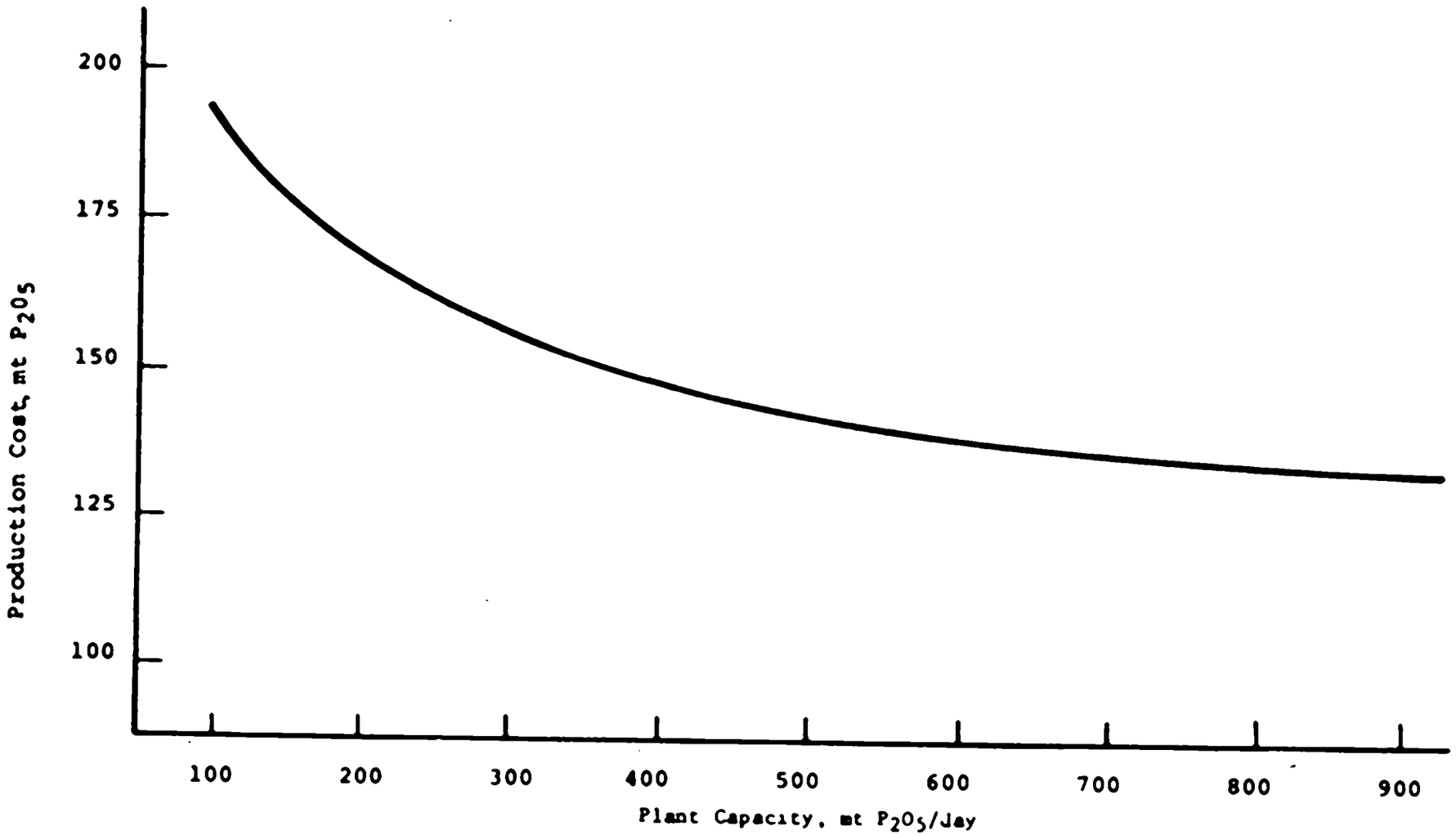



Figure 2. Effect of Plant Capacity on Production Cost - Wet-Process Phosphoric Acid - Indonesia

The proposed capacity of pulverized run-of-pile (ROP) superphosphate is 275,000 mt/year. The possible use distribution of this material for 1976 is shown below:

| | | |
|---|---|---|
| 100,000 mt | - | granulated for domestic sales |
| 44,000 mt* | - | granulated and ammoniated for domestic sales |
| 100,000 mt | - | granulated for export |
| 31,000 mt* | - | granulated and ammoniated for export |
| 275,000 mt | - | TOTAL |

*Most of this material goes into blends.

The superphosphate granulation unit will have a capacity of 275,000 mt/year.

The phosphoric acid requirement for production of 275,000 mt of triple superphosphate is 173,200 mt/year which will be produced in a 300 mt/day $P_2O_5$ plant. This size of acid plant is the smallest plant recommended for economical production of acid in Indonesia. The relationship between size of acid plant and cost of production is shown in figure 2.

The first step in the manufacturing process for triple superphosphate is the production of pulverized ROP material. The basic process flow diagram is shown in figure 3. Granulation of the ROP material is the second step in the process as illustrated in figure 4. It will be of interest in future considerations of the requirements for different types of fertilizers in Indonesia to note that any desired quantity of the pulverized ROP material may be diverted from the granulation unit and used as a phosphate raw material for granulation of NPK grades domestically or internationally.

The estimated cost of producing 275,000 mt/year of superphosphate is shown in table 10 to be $69.96/ton, or $152.09/ton of $P_2O_5$ in the superphosphate.

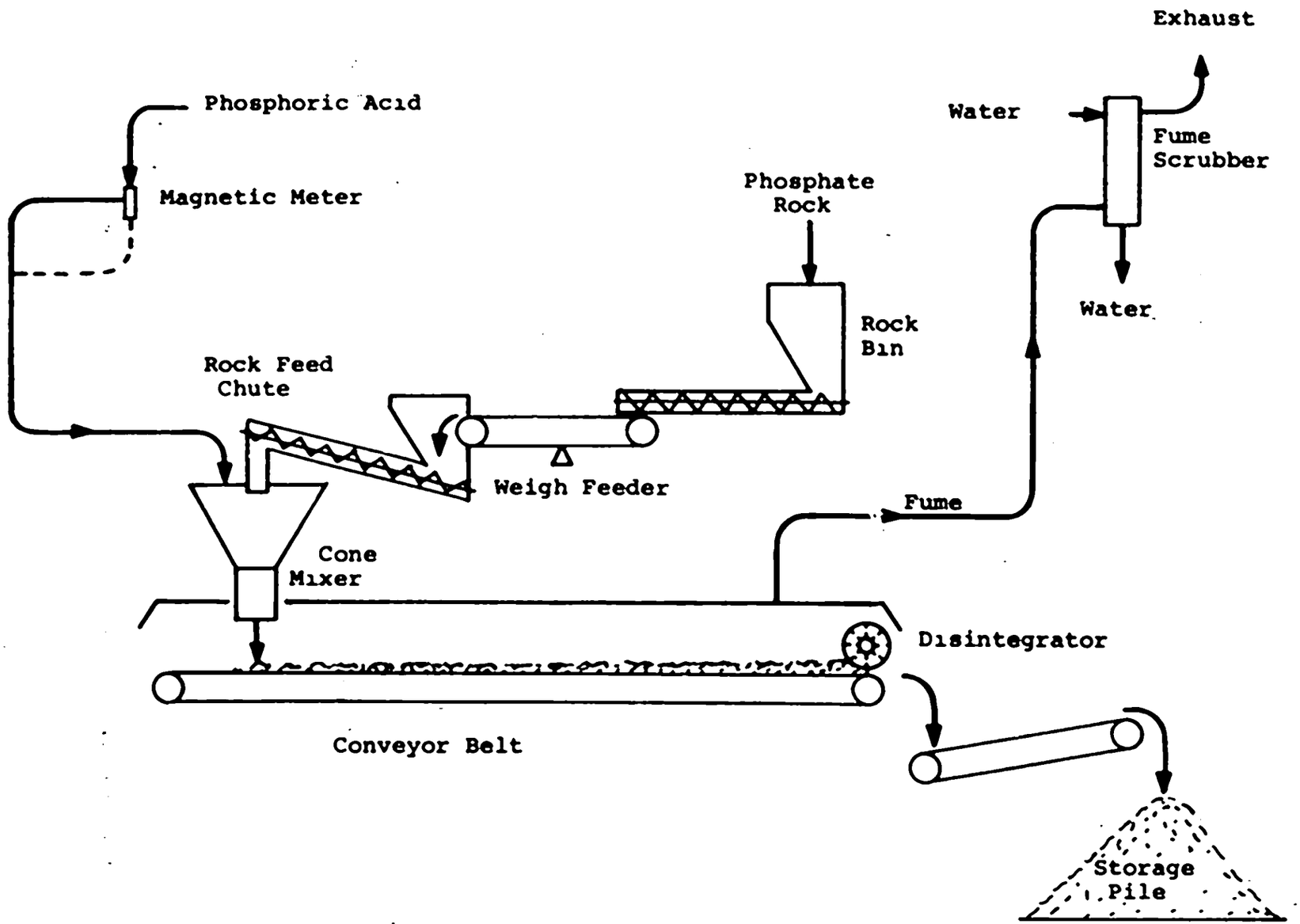



Figure 3. Manufacture of Run-of-Pile Triple Superphosphate

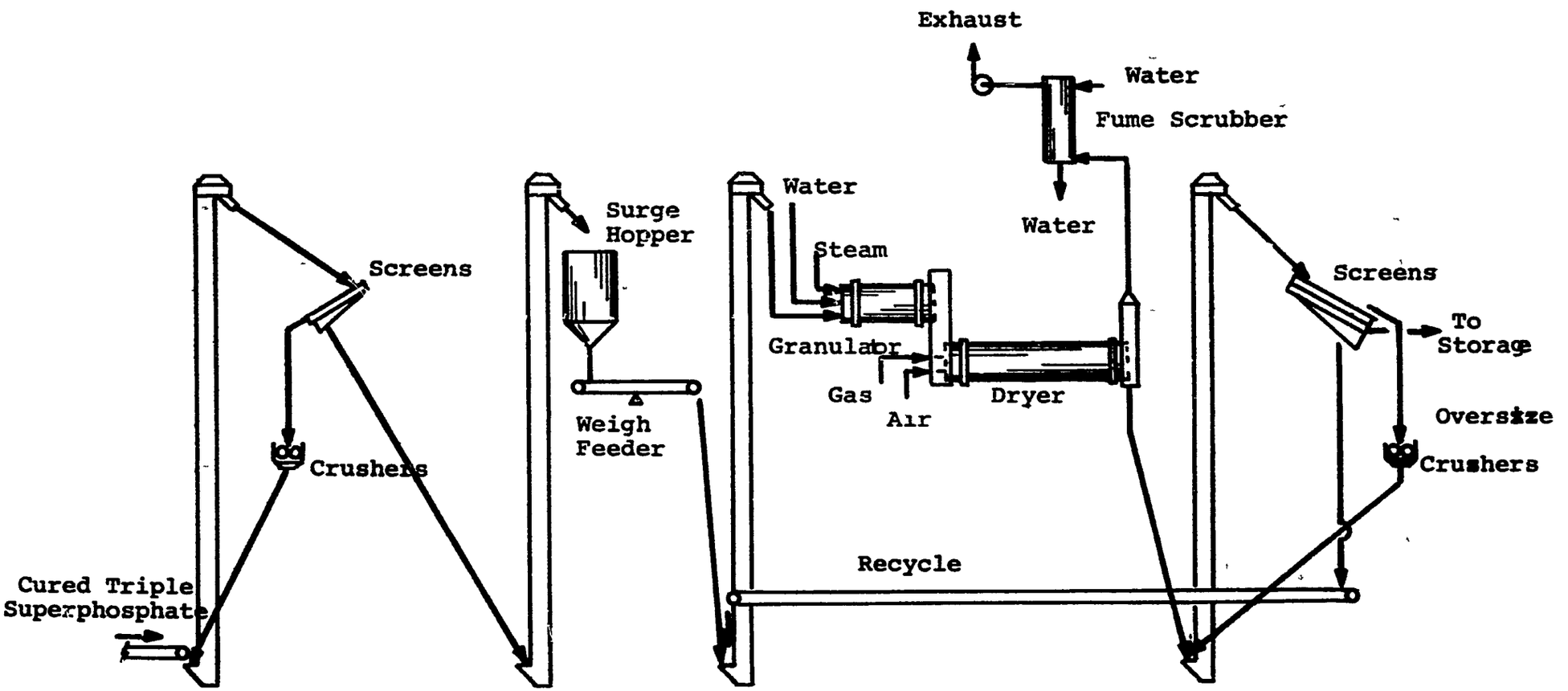



Figure 4. Granulation of Cured Run-of-Pile Triple Superphosphate

Table 10

Production Cost Granular TSP 275,000 mt/year (With Ammoniation Facilities)

Investment $2.6 million (including auxiliaries and off-sites and ammoniation equipment provided).

| | Unit | Units/ mt | Units/ Year | Cost/ Unit, $ | Cost/mt TSP, $ | Total Cost/ Year, $ |
|---|---|---|---|---|---|---|
| Direct Cost | | | | | | |
| Raw Materials | | | | | | |
| Phosphoric Acid | mt | 0.64 | 176,000 | 84.20 | 53.89 | 14,819,750 |
| Phosphate Rock | mt | 0.393 | 108,075 | 27.50 | 10.81 | 2,972,062 |
| Electric Power | kWh | 5 | 1,375,000 | 0.012 | 0.06 | 16,500 |
| Rock Grinding & Handling* | | | | | 1.32 | 363,000 |
| Operating Labor (3 men/shift) | | | | | .05 | 13,750 |
| Supervision (1 foreman/shift plus 1 superintendent) | | | | | .04 | 11,000 |
| Maintenance & Supplies | | | | | .62 | 170,500 |
| TOTAL DIRECT | | | | | 66.79 | 18,366,562 |
| Indirect Costs | | | | | | |
| Depreciation (2.6 m ÷ 15 years) | | | | | 0.63 | 173,333 |
| Insurance (.006 x 2.6 m) | | | | | 0.06 | 15,600 |
| Taxes (Personal & Property) | None | | | | - | - |
| Plant Overhead | | | | | 1.00 | 275,000 |
| Interest on Investment (2.6 m ÷ 2 x 12%) | | | | | .57 | 156,000 |
| Interest on Operating Capital Direct cost (except acid) - (3,546,812 ÷ 3 x 12%) | | | | | .52 | 141,872 |
| Startup losses 38% of 1.4 m ÷ 5 years | | | | | .39 | 106,400 |
| TOTAL INDIRECT | | | | | 3.17 | 868,205 |
| TOTAL MANUFACTURING COSTS | | | | | 69.96 | 19,234,767 |

COST PER TON $P_2O_5$ IN PRODUCT -- $152.09

*Includes allowance for drying a portion of the rock fed to rock grinding.

The estimated investment required for this plant erected at Gresik is $2,600,000, including a 275,000 mt/year granulation plant and all auxiliaries and off-sites.

The phosphoric acid plant represents the largest investment required for any of the facilities proposed. Therefore, a detailed investment cost estimate is included in this report and shown in table 11.

The total investment cost is approximately $14,800,000. The estimated cost of producing the acid at Gresik is $155.93/ton of $P_2O_5$ in acid, or $84.20/ton of 54% $P_2O_5$ acid. The production cost estimate is shown in table 12.

It is estimated that about 21 months will be required to build the phosphate production facilities, including unloading facilities for phosphate rock and sulfur and a bulk blend plant (discussed later).

In preparing the estimates (investment and production costs), it was assumed that a standard dihydrate plant design would be selected. The dihydrate process for production of wet process acid was selected for a number of reasons. Other processes such as hemihydrate and anhydrite are more difficult to operate. Experience has shown that the payout time for the dihydrate process is shorter. There are five major processes for production of wet process phosphoric acid. A comparison of these processes is shown in table 13. This comparison shows the favorable position of the standard dihydrate process in relation to the other four processes.

Recovery and processing of byproduct gypsum for wall-board production was considered for the Gresik installation and rejected for the immediate plans. The gypsum recovery step requires substantial

Table 11

Total Investment - 300 mt/day Wet Process Phosphoric Acid Plant - 94,500 mt/year of $P_2O_5$

| Item | | Cost, $ |
|---|---|---|
| Battery limits plant - including ground rock and acid storage, dryer for outside storage of unground rock | | ,014,520 |
| Land - including preparation of cooling ponds, gypsum disposal area & land | | 461,820 |
| Dikes - for cooling and gypsum ponds | | 457,950 |
| Scales | | 50,000 |
| Site improvement, lighting | | 61,920 |
| Contaminated $H_2O$ System | | 419,250 |
| Pipe racks including steam & $H_2O$ piping | | 321,984 |
| Field office, service building and phone service | | 75,600 |
| Power distribution facilities | | 185,760 |
| Mobile equipment | | 144,000 |
| | subtotal 1 | 11,192,804 |
| Engineering | (20% of subtotal 1) | 2,238,560 |
| | subtotal 2 | 13,431,364 |
| Contractors fee | (10% of subtotal 2) | 1,343,136 |
| TOTAL ACID PLANT[a] | | 14,774,500 |

[a]Does not include power production capital costs and water system costs.

Table 12

Estimated Production Cost of Wet Process Acid

ASSUMPTIONS:

1. Plant capacity of 300 mt/day of $P_2O_5$ which is equivalent to 556 tons/day of 75% $H_3PO_4$ (54% $P_2O_5$). This capacity is equivalent to 94,500 annual mt of $P_2O_5$. Acid plant will operate 315 days/year.

2. Plant location will be at Gresik, Indonesia. Plant will be constructed as an addition to present nitrogen production facilities of Petrokimia.

3. Plant investment (see attached investment estimate) was estimated as Battery limits cost including rock grinding and sulfuric acid, plus all auxiliaries required except power production and addition to existing water supply facilities, which are shown separately.

| | Units | Units/mt of $P_2O_5$ | Units/year | Cost/ Unit, $ | Cost/mt $P_2O_5$, $ | Total Cost, $ |
|---|---|---|---|---|---|---|
| Direct Costs | | | | | | |
| Phosphate rock (70 BPL) | mt | 3.32 | 313,740 | 27.5 | 91.30 | 8,627,850 |
| Sulphur | mt | 0.90 | 85,050 | 25.0 | 22.50 | 2,126,250 |
| Water | M gal | 16.0 | 1,512,000 | 0.045 | 0.73 | 68,985 |
| Steam | M lb | 5.0 | 478,170 | self suppl. | - | - |
| Power | kWh | 275. | 25,987,500 | .012 | 3.30 | 311,850 |
| TOTAL RAW MATERIALS | | | | | 117.83 | 11,134,935 |
| Rock Grinding & Handling | | | | | 2.42 | 228,690 |
| Operating labor (29) | | | | | .24 | 22,900 |
| Maintenance labor (25) | | | | | .21 | 19,500 |
| Maintenance materials | | | | | 4.00 | 378,000 |
| Supplies | | | | | 1.42 | 134,190 |
| Chemical analysis | | | | | .02 | 1,890 |
| Supervision | | | | | .16 | 15,120 |
| TOTAL DIRECT COSTS | | | | | 126.30 | 11,935,225 |
| Indirect Costs | | | | | | |
| Depreciation (Capital Investment ÷ 15 years) | | | | | 10.42 | 984,966 |
| Interest on Capital Investment 14,774,500 ÷ 2 x 12% | | | | | 9.38 | 886,470 |
| Interest on Operating Capital Direct costs ÷ 3 x 12% | | | | | 5.05 | 477,409 |
| Taxes (Property) | None | | | | - | - |
| Insurance (.006 x Cap. Invest.) | | | | | .94 | 88,647 |
| Plant Overhead | | | | | 2.00 | 189,000 |
| Startup losses - 62% of total startup losses of 1.4 M over 5 years) | | | | | 1.84 | 173,600 |
| TOTAL INDIRECT COSTS | | | | | 29.63 | 2,800,092 |
| TOTAL MANUFACTURING COSTS | | | | | 155.93 | 14,735,317 |
| TOTAL MANUFACTURING COSTS PER TON ACID -- | | | | | | |

Table 13

Comparison of Wet-Process Phosphoric Acid Processes

| | $P_2O_5$ Recovery % | Production Cost diff. $/mt $P_2O_5$[a] | Relative Maint. Cost | Relative Payout |
|---|---|---|---|---|
| Dihydrate | 95 | | 1.00 | 1.00 |
| Hemihydrate | 93 | + $2.40 | 1.11 | 1.15 |
| Hemihydrate-Dihydrate | 96 | + $ .90 | 1.16 | 1.07 |
| Dihydrate-Hemihydrate | 97 | + $ .70 | 1.31 | 1.15 |
| Anhydrite | 91 | + $4.20 | 1.22 | 1.25 |

[a]Based on U.S. costs in 1967.

additional investment and development of a market for the treated material. A major disadvantage to including gypsum processing in the immediate phase is the requirement for close attention of operating and engineering personnel at a time when full attention will be needed to successfully get the acid plant and superphosphate plants on-stream and up to capacity.

Of considerable importance is the land requirement for gypsum disposal. Since about five tons of gypsum is produced for each ton of $P_2O_5$ produced in acid, the annual production of gypsum at Gresik is estimated at 472,500 mt/year. Since the material will be discarded, a minimum land area needed for gypsum disposal is 300 acres. A total of approximately 500 acres is most desirable. Preliminary investigation indicates that at least this much land is available adjacent to the Gresik plant. This land appears to be exceptionally well suited for this use, being situated between the present plant area and Selat Surabaya. It is proposed that this land be acquired to accommodate the facility.

Bulk Blending Plant

In order to readily produce the variety of grades of fertilizer (discussed later) proposed for the Gresik operation at low cost, a bulk blending plant is proposed. The projected capacity of the bulk blending plant is 40 mt/hour which is equivalent to 110,000 mt/year with one shift/day operation or up to 220,000 mt/year if operated two shifts/day. The estimated investment cost for the bulk blending plant is $330,000 including potash storage, a building to house the plant, all erection costs, material handling equipment to and from the plant, and services of the equipment suppliers

engineer for the construction period. Operating costs for the blend plant are estimated at $2.00/mt at Gresik.

The proposed formulations and costs to be made in this bulk blending plant are shown in detail in table 14 below.

Table 14. Projected Formulations for Bulk Blending Plant 1976

| Formulation | Material used, % | % N | % $P_2O_5$ | % $K_2O$ | Cost/mt[a] Raw Materials, $ |
|---|---|---|---|---|---|
| 1. 15-15-15 | | | | | |
| 4-44-0 | 0.35 | 1.40 | 15.40 | | 24.41 |
| 46-0-0 | .30 | 13.80 | | | 21.00 |
| 0-0-60 | .25 | | | 15.00 | 10.75 |
| Filler | .10 | | | | 1.00 |
| | 1.00 | 15.20 | 15.40 | 15.00 | 57.16 |
| 2. 23-23-0 | | | | | |
| 4-44-0 | 0.53 | 2.12 | 23.32 | - | 36.97 |
| 46-0-0 | .47 | 21.62 | | | 32.90 |
| | 1.00 | 23.74 | 23.32 | 0 | 69.87 |
| 3. 12-12-24 | | | | | |
| 4-44-0 | 0.28 | 1.12 | 12.32 | | 19.53 |
| 46-0-0 | .24 | 11.04 | | | 16.80 |
| 0-0-60 | .40 | | | 24.00 | 17.20 |
| Filler | .08 | | | | .80 |
| | 1.00 | 12.16 | 12.32 | 24.00 | 54.23 |
| 4. 22-11-11 | | | | | |
| 4-44-0 | 0.25 | 1.00 | 11.00 | | 17.44 |
| 46-0-0 | .46 | 21.16 | | | 32.20 |
| 0-0-60 | .19 | | | 11.40 | 8.17 |
| Filler | .10 | | | | 1.00 |
| | 1.00 | 22.16 | 11.00 | 11.40 | 58.81 |
| 5. 30-15-0 | | | | | |
| 4-44-0 | .35 | 1.40 | 15.40 | | 24.41 |
| 46-0-0 | .65 | 29.90 | | | 45.50 |
| | 1.00 | 31.30 | 15.40 | 0 | 69.91 |

[a] To each of the cost/mt of blends should be added a $2.00/mt blending cost plus a $5.00/mt bagging cost. Therefore, F.O.B. plant costs for the blends will be $7.00/mt higher than indicated in this column.

Tables 15 and 16 indicate possible sales in 1976 and 1980 if the proposed facility is operated at 90%-100% of capacity, 315 days/year.

Table 15

1976 Potential Sales if Plant at Full $P_2O_5$ Production

| Domestic | | Material Wt, mt | $P_2O_5$, mt |
|---|---|---|---|
| Granular TSP | 0-46-0 | 100,000 | 46,000 |
| Ammoniated TSP | 4-44-0 | 8,000 | 3,520 |
| Blends | | | |
| 15-15-15) | | 36,000 | 5,400 |
| 23-23-0 ) | | 36,000 | 8,280 |
| 12-12-24) | 36,272 mt of 4-44-0 | 6,000 | 720 |
| 22-11-11) | | 6,000 | 660 |
| 30-15-0 ) | | 6,000 | 900 |
| | Subtotal | | 65,480 |
| | Projected 1976 Indonesian $P_2O_5$ Consumption | 73,000 | |
| For Export | | | |
| Granular TSP | | 100,000 | 46,000 |
| Blends | | | |
| 23-23-0 ) | | 40,000 | 9,200 |
| 22-11-11) | 30,909 (4-44-0) | 40,000 | 4,400 |
| | Subtotal | | 59,600 |
| TOTAL $P_2O_5$ SALES | | | 125,080 |

Table 16

1980 Potential Sales - Plant at Full Production - Plant $P_2O_5$ Capacity 126,500 mt

| Domestic | Mt Material | Mt $P_2O_5$ |
|---|---|---|
| Granular TSP | 175,000 | 80,500 |
| Blends | | |
| 15-15-15 | 90,000 | 13,500 |
| 23-23-0 | 90,000 | 20,700 |
| 12-12-24 | 28,000 | 3,360 |
| 22-11-11 | 28,000 | 3,080 |
| 30-15-0 | 28,000 | 4,200 |
| TOTAL $P_2O_5$ SALES | | 125,340 |
| Projected Indonesian $P_2O_5$ consumption - 1980 | | 138,000 |

Tables 17, 18, and 19 are summaries of the costs of production of the proposals submitted as well as the raw materials required. Tables 17 and 19 illustrate that while use of imported acid requires considerably less initial capital investment the final costs of production are significantly higher than indigenous production of phosphoric acid under current world market phosphate rock and acid prices.

Table 17. Summary - Annual Costs of Production, $/mt

| | Original Proposal | | TVA |
|---|---|---|---|
| | Alternative I | Alternative II | Proposal |
| Cost/mt $P_2O_5$ in acid | 159.75 | 182.70 | 155.93 |
| Cost/mt acid (0-54-0) | 86.27 | 98.66 | 84.20 |
| Cost/mt TSP | 71.82 | 79.85 | 69.96 |
| Cost/mt $P_2O_5$ in TSP | 156.13 | 173.59 | 152.09 |

Table 18. Summary Projected Costs of Production of All $P_2O_5$ Products

| | | $/mt | |
|---|---|---|---|
| 1. Granular TSP | 0-46-0 | 69.96 | |
| 2. Run-of-pile TSP | 0-46-0 | 68.50 | |
| 3. Ammoniated TSP (Gran.) | 4-44-0 | 70.00 | |
| 4. Phosphoric acid | 0-54-0 | 84.20 | |
| 5. Blends - bagged | | | |
| a. 15-15-15 | | 57.16 | + $7/mt blending and bagging cost |
| b. 23-23-0 | | 69.87 | |
| c. 12-12-24 | | 54.23 | |
| d. 22-11-11 | | 58.81 | |
| e. 30-15-0 | | 69.91 | |

Table 19. Summary of Annual Raw Material Requirements

| | Original Proposal | | TVA |
|---|---|---|---|
| | Alternative I | Alternative II | Proposal |
| Phosphoric Acid (mt) | | 128,000 | |
| Phosphate Rock (mt) | 313,740 | 78,600 | 421,815 |
| Sulphur (mt) | 63,787 | - | 85,050 |
| Water (gal) | 1,134,000 | - | 1,512,000 |
| Power (kWh) | 20,490,583 | 1,500,000 | 27,362,500 |

It would be advantageous both in terms of reliability of supply and perhaps price to have a source of phosphate rock closer to Indonesia than either North America or North Africa. Figure 5 illustrates the effect of a price reduction of phosphate rock on the cost of production of TSP.

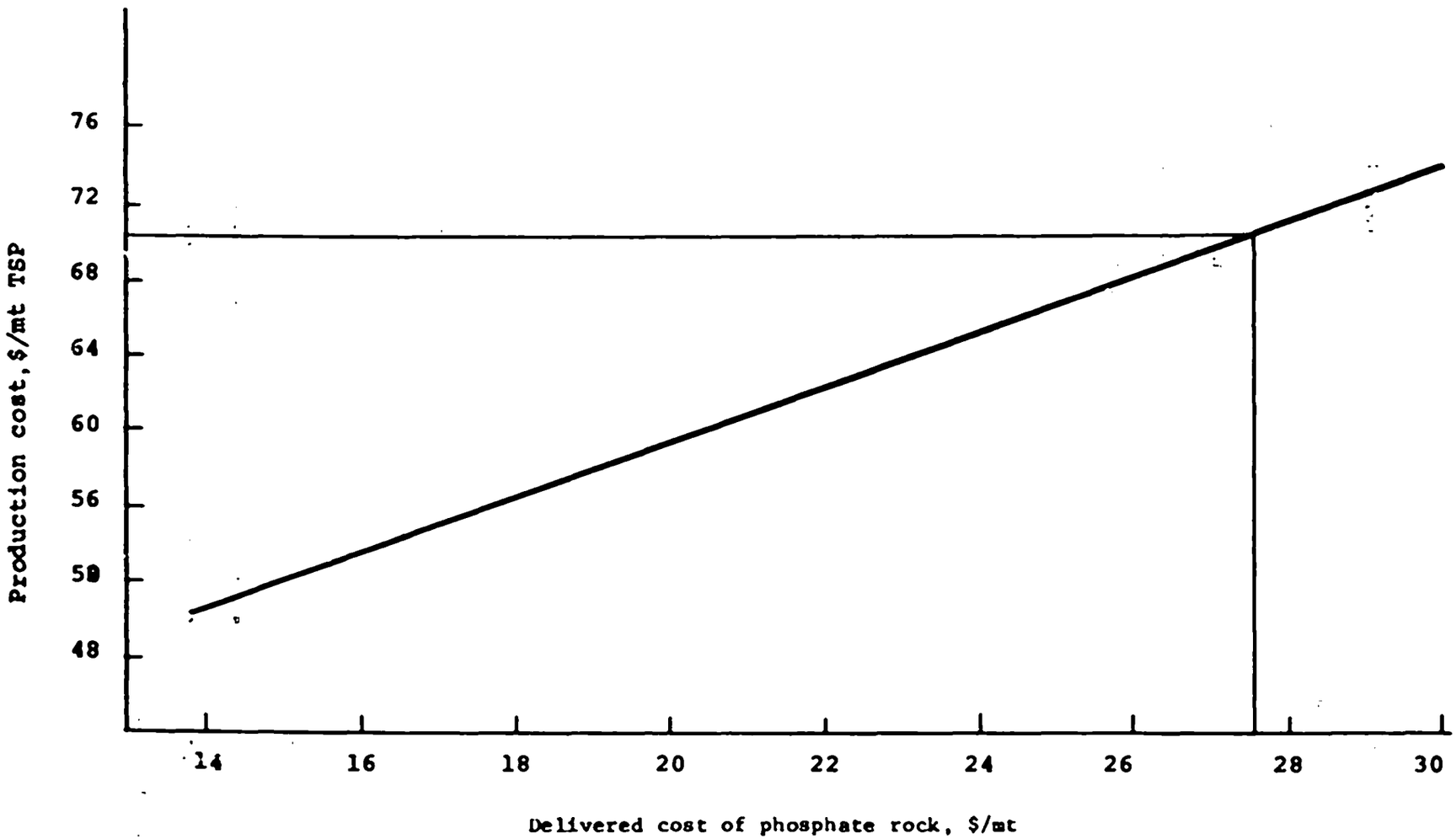



Figure 5. Effect of Phosphate Rock Cost on Production Cost of TSP (275,000 mt/y) (for Indonesia only)

## V. SUPPORT FACILITIES AND INVESTMENT SUMMARY

The support facilities required for the phosphate fertilizer production facilities at Gresik are described below:

1. Additional power production facilities estimated by personnel at Petrokimia Gresik have been checked and appear adequate. The estimated cost of three 2500 kVA diesel generators is $1,584,250. Details of the cost estimate follow.

| | |
|---|---|
| Diesel Generators (3-2500 kVA @ $150/kVA) | $1,125,000 |
| Packing | 21,000 |
| Shipping and handling | 9,750 |
| Installation labor | 112,500 |
| Building ($30/$M^2$) | 45,000 |
| Foundations ($60/$M^3$) | 18,000 |
| Lighting (Auxiliary- $10/$M^2$) | 15,000 |
| Piping | 22,000 |
| Switch gear | 170,000 |
| Painting & Miscellaneous | 12,000 |
| Distribution ($30/M) | 34,000 |
| TOTAL | $1,584,250 |
| | ($210/kVA) |

2. <u>Demineralized Water Plant</u>

(Assuming 40% condensate recovery)

The cost of the demineralized water plant (by Petrokimia Gresik) is estimated at $188,500 to provide 30 $M^3$/hour of demineralized water. This quantity of water plus recovered condensate will provide 50 $M^3$/hour total to meet requirements.

3. Additional cooling tower facilities to handle a circulation of 5000 GPM (20 $M^3$) are required. The estimated cost of this facility is $96,000.

4. Outside Auxiliary Storage for Phosphate Rock

The Gresik Phosphate operation at full capacity will require about 1300 tons of phosphate rock/day (421,815 mt of rock/year). The acid plant requirement is 313,740 mt/year; superphosphate production requires 108,075 mt. Since phosphate rock will be imported from a source (or sources) located a considerable distance from Indonesia, it is recommended that outside storage for about 50,000 tons of rock be provided. Approximately 5 acres of leveled land should be adequate. The investment estimate for the acid plant includes covered rock storage adequate for 10 days' supply and a rock dryer to dry outside-stored (uncovered) rock fed to the rock grinding unit.

5. Incoming Raw Materials Handling Facilities

Unloading facilities for water transported phosphate and sulphur will be required. Two schemes were considered for this installation; the originally conceived scheme of constructing a mooring pier for ships plus a conveyor 2300 meters (M) long to move materials from the pier to the plant, and a second scheme involving excavation of a barge canal.

Van Houten and Associates, a New York marine engineering firm, informally estimated that a concrete pier constructed to take advantage of the maximum water depth (27 ft) would cost $6,000,000. Such a pier would be capable of handling ship mooring loads of a 12,000 mt ship, would accommodate two unloaders with design

capacity of 2000 mt/hour, and a conveyor to handle 1000 mt/hour. The two unloaders would cost $1,500,000 each and the belt (with hoppers) will cost $1,500,000 installed. Additional facilities such as a discharge hopper for the belt and conveyors to plant storage and to an auxiliary storage area would add about $150,000. The total cost of the original pier scheme then would be $10,650,000. This high cost led to consideration of a second scheme, which is to replace the pier and 2300 M long conveyor with an excavated barge channel and shorter conveyor.

It appears that such a barge channel could be excavated approximately parallel to the present drainage ditch at reasonable cost. If this can be done, a separate investigation should be made to determine the feasibility of transporting phosphate rock in vessels considerably larger than 12,000 mt, unloading these larger vessels outside the bar at the mouth of the harbor into barges, and moving the barges into the proposed canal for unloading. Use of vessels larger than 12,000 tons should reduce the freight cost on phosphate rock to Indonesia below that required for the smaller vessels.

Whichever facility is built, its design should include the possibility that a substantial portion of the finished goods produced at Gresik could be moved by water to other parts of Indonesia through this same facility.

It is recommended that consideration be given to establishing a separate authority for the barge or dock facility in order to relieve the Petrokimia plant of the full burden of amortizing these facilities. These facilities could be available part time for in and out shipment

of fertilizer and other materials from other sources not necessarily associated with Petrokimia. In this way, maximum use of this facility would be possible.

A preliminary estimate of the cost of facilities required for the barge scheme is shown as follows:

Table 20. Estimated Cost of Construction of Barge Channel

| | |
|---|---|
| Channel Excavation[a] | $ 716,000 |
| (rock walk & concrete dryland dock at plant end of channel) | 130,000 |
| Barge Unloader (2) | 3,000,000 |
| Conveyor (1000 mt/hour) - 400 M long | 300,000 |
| Barges (five 5,000 mt) | 2,500,000 |
| Auxiliary Facilities (discharge hopper, conveyor, etc.) | 150,000 |
| Towboat (1500 hp) | 357,000 |
| TOTAL | $7,000,000 |

[a]Channel excavation includes: (1) a section from shoreline 1000 M offshore, and (2) a section from shoreline 1400 M inland toward the plant. Cost of offshore section is estimated at $216,000. Cost of inland section is estimated at $500,000.

## Layout of Proposed Facilities

The Petrokimia plant layout was reviewed with Petrokimia personnel to identify possible locations of the phosphoric acid, sulphuric acid, superphosphate, and bulk blend plants. Also, possible location of a future ammonium phosphate (MAP or DAP) and compound granulation unit was studied.

Two areas within the existing nitrogen fertilizer complex appear to provide adequate space for the proposed facilities.

One irregular area east and south of the present sulphuric acid plant contains 9 acres and would provide room for erection of the sulphuric, phosphoric acid, TSP, and bulk blend plants. In addition, 9 acres north of the bagged storage facility will serve as storage, drying and grinding area for phosphate rock.

A second area of 11 acres can be made available by relocating the equipment storage yard and shed. This area is west of the main office building. Since phosphate rock and sulphur would be brought into the plant from the north side, this area would extend raw materials conveying requirements, as well as finished product. However, it constitutes the largest block of land available.

As has been mentioned elsewhere in this report, land for gypsum disposal, which is available north of the plant, will have to be purchased.

Training Requirements

Whichever proposal is finally decided upon by Petrokimia, some training of plant operating personnel will be necessary.

Initially, four key operating personnel should be sent for 3 months to operating phosphoric acid, triple superphosphate and bulk blending plants. These personnel should return to conduct seminars for the remaining plant personnel prior to plant startup with assistance from one expatriate experienced in these operations.

In the original construction contract, provision should be made for the contractor's expatriate personnel to conduct on-the-job training during plant startup.

It is recommended that a $200,000 budget item be allocated for this training. This $200,000 should be incorporated in the construction contract.

Table 21. Summary of Investment Cost - All Proposals (Not including operating capital or interest costs), in Millions of Dollars

| | Original Proposal | | TVA |
|---|---|---|---|
| | Alternative I | Alternative II | Proposal |
| | 200,000 mt TPY-TSP Local acid | 200,000 mt TPY-TSP Imported acid | 275,000 mt TPY-TSP Local acid |
| Phosphoric acid plant (incl. $H_2SO_4$ plant & storage) | 13.33 | - | 14.8 |
| Phosphoric acid storage (imported acid) | | 1.47 | |
| Triple superphosphate plant | 2.40 | 2.40 | 2.6 |
| Bulk blend plant | - | - | .33 |
| Utilities: | | | |
| Power | 1.58 | .50 | 1.58 |
| Water (demineralized) | .188 | | .188 |
| Water (make-up) | .086 | | .086 |
| Cooling tower | .096 | | .096 |
| TOTAL PLANT INVESTMENT | 17.68 | 4.37 | 19.68 |
| Materials handling facilities | | | |
| A. Cement pier (800 mt) | 6.0 | 6.0 | |
| Reversible conveyor belt (2300 mt) | 1.5 | 1.5 | |
| Dock mounted ship unloading cranes | 3.0 | 3.0 | |
| Discharge hoppers & connect. belts, misc. maint. equip. | .15 | .15 | |
| TOTAL | 10.65 | 10.65 | |
| B. Barge channel to plant gate | | | |
| 5 - 500 mt barges | | | 2.50 |
| 1 - 1500 hp towboat | | | .36 |
| 2 - barge unloaders | | | 3.00 |
| Belt conveyor 400 mt | | | .30 |
| Excavation | | | .71 |
| Concrete dock (dryland) | | | .13 |
| TOTAL ALL FACILITIES | 28.33 | 15.02 | 26.68 |

## VI. ANALYSIS OF COSTS OF TSP PRODUCTION WHEN THE INVESTMENT COSTS OF THE RAW MATERIALS HANDLING SYSTEM ARE ADDED (DOCK AND BELT VERSUS BARGES)

Table 22. Alternative I - Production Costs for 200,000 mt TSP with Locally Produced Acid

| | Cost $/mt TSP | Total cost, $ |
|---|---|---|
| TOTAL DIRECT[a] | 68.18 | 13,636,000 |
| Indirect Costs | | |
| Depreciation - TSP Plant (2.4 million ÷ 15 years) | .80 | 160,000 |
| Depreciation Dock & Belt (10.65 million ÷ 25 years) | 2.13 | 426,000 |
| Insurance TSP Plant, Dock & Belt (.006 x 13.05 million) | .39 | 78,300 |
| Taxes None | - | - |
| Plant Overhead | 1.00 | 200,000 |
| Interest on Investment (C.I. ÷ 2 x 12% (13.05 million)) | 3.92 | 783,000 |
| Interest on Operating Capital (TDC - Acid cost ÷ 3 x 12%) | .52 | 103,760 |
| Startup Losses | .53 | 106,400 |
| TOTAL INDIRECT | 9.29 | 1,857,460 |
| TOTAL COST OF MANUFACTURING | 77.47 | 15,493,460 |

COST PER TON $P_2O_5$ IN PRODUCT --$168.41

[a]The $27.50/mt delivered cost of phosphate rock includes operating costs of Dock & Belt to get the material into the plant.

Table 23. Alternative II - Production Cost for 200,000 mt TSP with Imported Acid

| | Cost $/mt TSP | Total cost, $ |
|---|---|---|
| TOTAL DIRECT COST | 76.11 | 15,222,000 |
| TOTAL INDIRECT COSTS | 9.29 | 1,857,460 |
| TOTAL MANUFACTURING COST | 85.40 | 17,079,460 |

COST PER TON $P_2O_5$ IN PRODUCT --$185.65

Table 24. Alternative III - TVA Proposal for Production of 275,000 mt TSP/year

| | Cost $/mt TSP | Total cost, $ |
|---|---|---|
| TOTAL DIRECT | 66.79 | 18,366,562 |
| Indirect Costs | | |
| Depreciation - TSP Plant | .63 | 173,333 |
| Depreciation - channel, barges, & towboat (7 million ÷ 25 years) | 1.02 | 280,000 |
| Insurance - TSP Plant & barge facility (9.6 million x .006) | .21 | 57,600 |
| Taxes - Personnel & Property - None | - | - |
| Interest on Investment (C.I. ÷ 2 x 12% (9.6 million)) | 2.09 | 576,000 |
| Interest on Operating Capital | .52 | 141,872 |
| Startup Losses | .39 | 106,400 |
| TOTAL INDIRECT | 4.84 | 1,332,205 |
| TOTAL MANUFACTURING COST | 71.63 | 19,698,767 |

COST PER TON $P_2O_5$ IN PRODUCT --$155.72

Table 25. Annual Costs of Production/mt (including Materials Handling Facility), $

| | Original Proposal | | TVA |
|---|---|---|---|
| | Alternative I (Dock & Belt) | Alternative II (Dock, Belt & Acid pipeline) | Proposal (Barging to plant gate) |
| Cost/mt $P_2O_5$ in acid[a] | 159.75 | 182.70 | 155.93 |
| Cost/mt acid (0-54-0)[a] | 86.27 | 98.66 | 84.20 |
| Cost/mt TSP | 77.47 | 85.40 | 71.63 |
| Cost/mt $P_2O_5$ in TSP | 168.41 | 185.65 | 155.72 |

[a]The capital costs of the materials handling systems were charged to the end product TSP. However, if acid production were to be considered separately, its costs are understated above. All costs above are overstated if some of the benefits of the materials handling system accrue to the nitrogen production portion of Petrokimia or if it is used to load-out finished goods for water transportation.

# VII. THE PHOSPHATE MARKET IN INDONESIA

## (Preliminary Analysis)[1]

Consumption--1959-72

Phosphate consumption has increased significantly in Indonesia since 1959. Starting from a low of 8,000 mt of $P_2O_5$, consumption rose to an estimated 49,000 mt of $P_2O_5$ in 1972 (table 25). Although this represents a substantial growth in phosphate use over a 13 year period, the actual rise per annum has been less clear cut. For example, Indonesian agriculture apparently consumed as much as 45,600 mt of $P_2O_5$ as early as 1965. Use, however, actually declined in the years immediately following and did not reach or surpass the 1965 level until 1972.

Although the decline during the 1966-67 period was no doubt influenced to a large extent by the unstable economic and political situation that prevailed in Indonesia during that time, most of these losses had been regained in 1969. Therefore, it seems worth noting that phosphate use has increased only slightly since 1969 and actually very little since 1965, assuming the consumption figure for that year is correct.

There are several reasons for this disappointing performance in recent years. First, the phosphate procurement program has been inconsistent in relating imports to actual sales. This is shown clearly in figure 6 and table 26. (Such procedures not only led to high inventories but to a large extent constributed to the fertilizer shortages that followed. It is a fact

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[1] A major market survey is now being made jointly by Petrokimia, USAID and TVA. Although results reported in this section are still preliminary, they are adequate for the purposes of this study. The main market survey data will be published in a separate report possibly by June 1, 1973.

Table 25. Actual Consumption of Phosphate 1959-72 and Forecast of Its Use 1973-80 All Sectors of Indonesia

| Year | Actual Consumption | National[a,b] Fertilizer Study Forecast | TVA/USAID Forecast[c] Highly Optimal Conditions[d] | TVA/USAID Forecast[c] Normal Conditions[e] |
|---|---|---|---|---|
| | | mt (000) $P_2O_5$ | | |
| 1959 | 8.0 | | | |
| 1960 | 19.0 | | | |
| 1961 | 13.0 | | | |
| 1962 | 20.4 | | | |
| 1963 | 12.3 | | | |
| 1964 | 26.1 | | | |
| 1965 | 45.6 | | | |
| 1966 | 25.1 | | | |
| 1967 | 8.4 | | | |
| 1968 | 32.5 | | | |
| 1969 | 42.8 | 52.0 | | |
| 1970 | 45.4 | 62.2 (20)[f] | | |
| 1971 | 40.7 | 74.5 (20) | | |
| 1972 | 49.0 est. | 89.2 (20) | | |
| 1973 | | 106.7 (20) | 60.4 (23.3)[f] | 55.1 (10.4)[f] |
| 1974 | | 127.7 (20) | 79.9 (32.3) | 62.7 (13.8) |
| 1975 | | 146.9 (15) | 105.4 (31.9) | 73.5 (17.2) |
| 1976 | | 168.9 (15) | 122.2 (15.9) | 84.3 (14.7) |
| 1977 | | 194.3 (15) | 138.0 (12.9) | 96.3 (14.2) |
| 1978 | | 223.4 (15) | 155.7 (12.5) | 110.1 (14.3) |
| 1979 | | 256.9 (15) | 185.6 (19.1) | 130.6 (18.5) |
| 1980 | | 295.6 (15) | 213.2 (14.8) | 149.5 (14.5) |

[a]National Fertilizer Study completed October 1971 and published October 1972.
[b]1969-70 figures were derived from trend line estimates and do not represent real consumption figures for that period.
[c]TVA/USAID Team estimate March 17, 1973.
[d]For explanation see table 17.
[e]For explanation see table 18.
[f]Values in parentheses represent annual rate of growth.

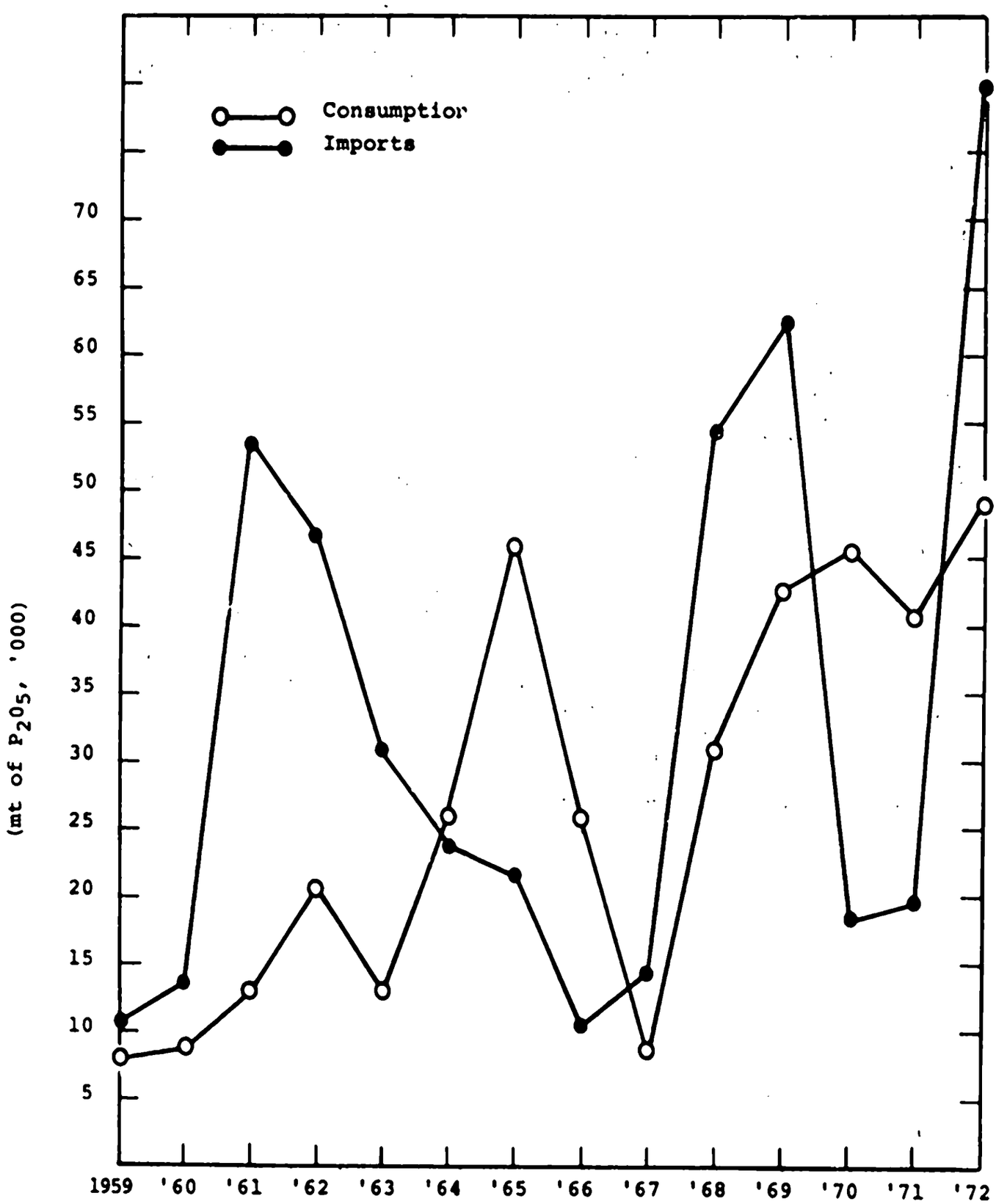


Figure 6. Relationship Between Imports and Consumption of Phosphate (mt $P_2O_5$)

Table 26. Comparison of Changing Importance of Major Types of Nitrogen and Phosphate Fertilizer Between 1959 - 1970 (Food and Estate Sector)

| Year | Total[a] N Supply mt 000 | Total[a] $P_2O_5$ Supply mt 000 | Ammonium Sulfate % of N supply | TSP | Compounds | Other |
|---|---|---|---|---|---|---|
| | | | | % of total $P_2O_5$ supply | | |
| 1959 | 25.4 | 10.4 | 91 | 0 | 0 | 100 |
| 1960 | 7.2 | 13.3 | 17 | 8 | 0 | 92 |
| 1961 | 79.3 | 55.3 | 45 | 10 | 4 | 86 |
| 1962 | 78.9 | 46.9 | 4 | 12 | 8 | 81 |
| 1963 | 63.6 | 30.8 | 32 | 12 | 10 | 78 |
| 1964 | 83.3 | 24.0 | 19 | 3 | 38 | 59 |
| 1965 | 92.8 | 22.9 | 28 | 14 | 23 | 63 |
| 1966 | 98.5 | 10.6 | 14 | 0 | 32 | 68 |
| 1967 | 104.9 | 14.2 | 8 | 78 | 17 | 5 |
| 1968 | 186.4 | 54.6 | 0 | 82 | 14 | 4 |
| 1969 | 146.3 | 62.5 | 11 | 69 | 28 | 3 |
| 1970 | 148.9 | 18.1 | 11 | 28 | 48 | 24 |

[a]Supply is expressed as tonnage imported and may or may not have been consumed in the same year (figure 6).

Source National Fertilizer Study

that a phosphate shortage did exist in many parts of Indonesia during the last quarter of 1971 and the first half of 1972. This was caused in part by the excessive importing of phosphates during 1968 and 1969 and the resultant embargo placed during 1970-71 by the GOI on all TSP imports to the food sector until the surplus was removed (table 27, column 3).

Second, BIMAS, always a heavy promoter of phosphate on rice, was not as active in 1970 and 1971 as in previous years. It may be that the Indonesian farmers are prepared to use phosphate at the level prescribed by the GOI only if the phosphate fertilizer is tied to a government subsidized program such as offered by BIMAS.

Third, rice production rose sharply between 1968-71 and rice prices to the farmer generally dropped or remained constant to other essential items. The net effect of this was farmers had less cash and little incentive to spend more money for fertilizer.

Finally, a severe drought hit much of Indonesia during the last half of 1972. This latter point probably affected consumption of nitrogen more than phosphate but was nevertheless one of the many factors that accounted for the disappointing rate of growth in $P_2O_5$ consumption during these past 3 years.

Early reports of phosphate sales for the 1972-73 wet season indicate that phosphate use is again on the increase in the food sector. Some of this increase is already reflected in a slight rise in the consumption figures for 1972. Much of this is no doubt due to the increased activity of the BIMAS and the improved pricing structure for rice. As a result, prospects are good for a substantial increase in phosphate use in the food sector during the next 12 to 24 months.

Table 27. Actual Supply (Imports) of Ammonium Sulfate, Triple Superphosphate and Compound Fertilizers 1959-72

| Year | Ammonium Sulfate | TSP/DAP[a] | Compound |
|---|---|---|---|
| | | Mt of product | |
| 1959 | 11,000 | 0 | 0 |
| 1960 | 5,900 | 2,100 | 0 |
| 1961 | 170,000 | 12,000 | 11,000 |
| 1962 | 14,964 | 11,920 | 17,293 |
| 1963 | 97,900 | 8,100 | 16,000 |
| 1964 | 75,913 | 1,458 | 38,166 |
| 1965 | 122,580 | 7,035 | 30,315 |
| 1966 | 67,985 | 0 | 22,285 |
| 1967 | 43,170 | 24,000 | 18,230 |
| 1968 | 3,600 | 97,900 | 50,807 |
| 1969 | 74,828 | 93,531 | 92,427 |
| 1970 | 75,918 | 10,766 | 54,404 |
| 1971 | 78,000 | 0 | 60,000 (est.) |
| 1972 | 80,000 | 120,000 (est.) | 65,000 (est.) |

[a]Used mainly by the food sector. TSP/DAP refers to triple superphosphate and diammonium phosphate.

Source: National Fertilizer Study and USAID records.

Future Demand for Phosphates in Indonesia

There is considerable disagreement about the future growth potential for phosphates in Indonesia. Several projections of use have been made, some by Indonesian experts, others by foreign consultants, most however vary widely in their estimates on the amount of $P_2O_5$ that will be consumed in Indonesia by 1980. The most recent and perhaps the most comprehensive of these studies has been the one known as the National Fertilizer Study (NFS).

National Fertilizer Study Projections

The Government of Indonesia contracted with Agar-Und Hydrotechnik Gmbh Inhausen International Co. (AHT) in 1970 to conduct a complete National Fertilizer Study (NFS) of Indonesia. Their report was completed in 1971 and published in October 1972. One of the conclusions of this study was for phosphate use to increase nearly seven times during the 1970 and 1980 period. These estimates appear in the third column of table 25.

There were three basic assumptions that greatly influenced the projections of the NFS team. These were: (a) the use of trend line estimates rather than the actual consumption figures for 1969 and 1970; (b) a rather optimistic assumption that the annual rate of growth for phosphate consumption would be 20% per annum from 1971 through 1974 and 15% per annum from 1975 through 1980; and (c) that an extremely large area of soil was deficient in phosphates. (Surprisingly, the National Fertilizer Study Team rejected, as inconclusive, some work then in progress at Bogor that indicated that the sawah area thought to be responsive to phosphate was not as widespread as once believed. This resulted in the inclusion in their calculations, of a considerable area of sawah (rice land) now believed to be nonresponsive to phosphate applications). These three factors (high base period, high annual growth rate and possible overestimation of rice area responsive

to phosphate) let to an estimate of 295,000 mt of $P_2O_5$ to be consumed in Indonesia by 1980. If this goal is reached, Indonesia will have matched the Brazilian performance for 1962-71 and the effort made by India between 1962 and 1969. However, neither these, nor any other nations have been able to sustain such a growth rate over 10 years as forecast by the NFS team.

TVA/USAID Projections of Phosphate Consumption

The TVA/USAID Team has also made projections for phosphate use in Indonesia through 1980. These estimates appear in columns 4 and 5 of table 25.

In contrast to the NFS Team, the TVA/USAID Team had the benefit of working with more accurate figures of phosphate consumption for 1970 and good estimates of phosphate use for 1971 and 1972 as well. As a result, the 1970-72 base line used in establishing the estimates of phosphate use for 1973 onward were nearly 18,000 mt of $P_2O_5$ below the one used by the NFS Team to establish their 1970 level. This in itself was sufficient to cause a highly significant difference in estimates between the two teams. However, there were other contributing factors as well. There are explained below.

The TVA/USAID Team estimates for phosphate consumption were based upon two different sets of assumptions for the food sector. These were classed as: (1) highly optimal set of conditions, and (2) normal conditions.

Estimates based Upon Highly Optimal Conditions (Situation 1)

For the estimate (Situation 1) to apply, a highly optimistic set of conditions were assumed to prevail in the food sector over the entire

8 year period (1973-80). These were:

1. The GOI would set and defend a new price for stalk paddy at or above Rp 20/kg before 1974 and this would be adjusted periodically as the cost of living changes.
2. Easy credit terms would be offered to the rice and maize farmers particularly over the 1973-75 period.
3. The pricing structure for fertilizer will be adjusted to improve margins allowed for its distribution or the government will openly declare its willingness to absorb losses incurred in transporting fertilizers to the more remote areas of Indonesia.

As a result of these preconditions, it was assumed phosphate use in the food sector would increase 40%/year from 1973 through 1975 (table 28, column 3). This would result in a use level in 1975 similar to the 171,000 mt of TSP (78,700 mt $P_2O_5$) currently established by BIMAS as necessary to reach the current rice production targets.

4. It was further assumed the GOI will continue to place major emphasis on rice production through 1977-78 at which time an equally major effort would also be directed toward intensifying the multiple cropping systems.

Should all of these preconditons be fulfilled, phosphate use could reach 212,200 mt as $P_2O_5$ by 1980 (table 28, column 11).

Estimates Based Upon Normal Market Growth (Situation 2)

The fertilizer survey team also made an estimate for phosphate consumption under a more normal set of market conditions. Situation 2, a situation that represents more closely what probably will happen, was based upon the following assumptions:

Table 28. Forecast (Situation 1, Highly Optimal Conditions)[a] Estimated Phosphate Consumption (mt $P_2O_5$) All Sectors - Indonesia 1972-80

| | Food Sector[a] 000 mt $P_2O_5$ | | | | | Estate Sector[b] 000 mt $P_2O_5$ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Subsidized Phosphate[c] | Growth % | Other Phosphate[d] | Growth % | Subtotal | Phosphate Rock[e] | Other Phosphate[d] | Growth % | Subtotal | Total All Indonesia |
| 1972 | 27.6 | f | 7.0 | f | 34.6 | 5.8 | 8.6 | f | 14.4 | 49.0 |
| 1973 | 38.6 | 40 | 7.7 | 10 | 45.3 | 4.2 | 10.9 | 15 | 15.1 | 60.4 |
| 1974 | 54.0 | 40 | 8.5 | 10 | 62.5 | 5.0 | 12.4 | 15 | 17.4 | 79.9 |
| 1975 | 75.6 | 40 | 9.8 | 15 | 85.4 | 6.0 | 14.0 | 15 | 20.0 | 105.4 |
| 1976 | 86.9 | 15 | 11.3 | 15 | 98.2 | 7.2 | 16.8 | 20 | 24.0 | 122.2 |
| 1977 | 95.6 | 10 | 13.6 | 20 | 109.2 | 7.9 | 20.9 | 20 | 28.8 | 138.0 |
| 1978 | 105.2 | 10 | 17.7 | 30 | 122.9 | 8.7 | 24.4 | 15 | 33.1 | 155.7 |
| 1979 | 126.2 | 20 | 23.0 | 30 | 149.2 | 9.6 | 26.8 | 10 | 36.4 | 185.6 |
| 1980 | 145.1 | 15 | 27.6 | 20 | 172.7 | 10.6 | 29.4 | 10 | 40.0 | 212.2 |

[a]Assumes that fertilizer will be treated as a strategic noncommercial item from 1973-75 and the government will try to get farmers to use phosphate regardless of cost. Assumes further that floor price for rice will remain above Rps 20.00/kg and that the government will take strong measures to ensure this to be the case. Also assumes very heavy emphasis on production of secondary crops starting in 1975. Food sector considered all sectors other than PNP Estates.

[b]Assumes continued emphasis on rehabilitation of the estates with major efforts directed toward expanding oil palm and sugarcane production.

[c]Consists mainly of TSP and DAP.

[d]Consists mainly of compounds but could be replaced by TSP/DAP should the price spread bet[illegible] nonsubsidized sector become too great.

[e]Assumes phosphate rock will continue to be recommended on rubber and oil palm in North Sumatra and that the supply from Christmas Island will be adequate and competitive.

[f]Figures for 1972 are preliminary and may actually be slightly less than shown above. Calculations for future growth in estate sector based upon 13.1 mt/year - 3 year average.

1. Current phosphate recommendations and requirements will be reevaluated and based more closely on information now available from the Soils Research Institute at Bogor and the Directorate of Techniques in Pasar Minggu.
2. The GOI will adequately defend the existing floor price of Rp 17.5/kg for stalk paddi.
3. The GOI will take major steps before 1975 to encourage a substantial increase in rice production in the outer islands.
4. Major emphasis on Java will be to develop the production of vegetables and other secondary crops by 1975 and eventually give major emphasis by 1977 to multiple cropping systems similar to those used in Taiwan where other crops are profitably grown with rice.

Conditions Applying to Both Situations

In both instances, the growth of fertilizer use by the estate sector was assumed to become more intensive and due mainly to the expanded efforts to increase the production of sugarcane, oil palm and cotton. More modest, but still significant, increases were also assumed for the rubber and tea estates provided the current plans for their rehabilitation were realized before 1976. (This fits into the current plans of the World Bank.) Should this rehabilitation program be delayed, the current projections will be too optimistic for the estate sector.

General Discussion

The results of these estimates appear in tables 28, 29, 30 and figure 7. It is clear that in either Situation 1 or Situation 2 the estimates developed by the TVA/USAID Team are considerably below those made by the NFS

Table 29. Forecast (Situation 2, Normal Conditions) Estimated Phosphate Consumption (mt $P_2O_5$) All Sectors - Indonesia 1972-80

| | Food Sector[a] 000 mt $P_2O_5$ | | | | | Estate Sector[b] 000 mt $P_2O_5$ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Subsidized Phosphate[c] | Growth % | Other Phosphate[d] | Growth % | Subtotal | Phosphate Rock[e] | Other Phosphate[d] | Growth % | Subtotal | Total All Indonesia |
| 1972 | 27.6 | f | 7.0 | f | 34.6 | 5.8 | 8.6 | f | 14.4 | 49.0 |
| 1973 | 32.3 | 17 | 7.7 | 10 | 40.0 | 4.2 | 10.9 | 15 | 15.1 | 55.1 |
| 1974 | 36.8 | 13.3 | 8.5 | 10 | 45.3 | 5.0 | 12.4 | 15 | 17.4 | 62.7 |
| 1975 | 43.7 | 17.5 | 9.8 | 15 | 53.5 | 6.0 | 14.0 | 15 | 20.0 | 73.5 |
| 1976 | 49.0 | 13.6 | 11.3 | 15 | 60.3 | 7.2 | 16.8 | 20 | 24.0 | 84.3 |
| 1977 | 53.9 | 10.0 | 13.6 | 20 | 67.5 | 7.9 | 20.9 | 20 | 28.8 | 96.3 |
| 1978 | 59.3 | 10.0 | 17.7 | 30 | 77.0 | 8.7 | 24.4 | 15 | 33.1 | 110.1 |
| 1979 | 71.2 | 20.0 | 23.0 | 30 | 94.2 | 9.6 | 26.8 | 10 | 36.4 | 130.6 |
| 1980 | 81.9 | 15.0 | 27.6 | 20 | 109.5 | 10.6 | 29.4 | 10 | 40.0 | 149.5 |

[a]Assumes government will adequately defend current floor price for rice (17.5 Rps/kg) and will place major emphasis on production of secondary crops by 1975 and beyond. Includes all sectors using fertilizer outside of PNP estates.

[b]Consists mainly of PNP estates. Assumes continued emphasis on rehabilitation of the estates with major efforts toward expanding oil palm and sugarcane production.

[c]Consists mainly of TSP and DAP.

[d]Consists mainly of compound fertilizers but partially substitutable by TSP/DAP should the price spread between subsidized and nonsubsidized phosphates become too great.

[e]Assumes phosphate rock will continue to be recommended on rubber and oil palm in North Sumatra and that the supply from Christmas Island will be adequate and competitive in price.

[f]Figures for 1972 are preliminary and may actually be slightly less than shown above. Calculations for future growth in estate sector based upon 3 year average of 13.1 mt/year

Table 30. Forecast[a] Triple Superphosphate (TSP) Diammonium Phosphate (DAP) Sales, Mt

| | Food[b] Sector Indonesia 1973-76 | | | | | | |
|---|---|---|---|---|---|---|---|
| Region | 1973[c] | Growth % | 1974 | Growth % | 1975 | Growth % | 1976 |
| East Java | 15,700 | 10 | 17,200 | 10 | 19,000 | 20 | 22,800 |
| Central Java | 19,400 | 12 | 21,700 | 15 | 25,000 | 15 | 28,500 |
| West Java | 27,600 | 15 | 31,700 | 20 | 38,000 | 10 | 41,100 |
| Subtotal | 62,700 | | 70,600 | | 82,000 | | 92,400 |
| Outer Islands | 7,500 | 20 | 9,000 | 30 | 11,700 | 20 | 14,100 |
| Grand total | 70,200 | | 79,600 | | 93,700 | | 106,500 |

| | Percent Total Consumed Per Quarter[d] | | | |
|---|---|---|---|---|
| Region | I | II | III | IV |
| East Java | 26 | 9 | 14 | 51 |
| Central Java | 25 | 10 | 13 | 52 |
| West Java | 23 | 10 | 12 | 55 |
| Outer Islands | 19 | 9 | 12 | 60 |

[a]Assumes government will provide realistic price support to farmers for rice and that GOI will accelerate its program to expand the multiple cropping system.

[b]Assumes consumption by all components of the market other than the PNP and industrial crops estates.

[c]Assumes nearly 90% increase in TSP/DAP sales over 1972. This is entirely possible since 1972 had an extended drought (7 months) and a shortage of TSP supply in the market during the first quarter.

[d]Quarter established as follows: I - Jan. 1-March 31; II - April 1-June 30; III - July 1-Sept. 30; IV - Oct. 1-Dec. 31.

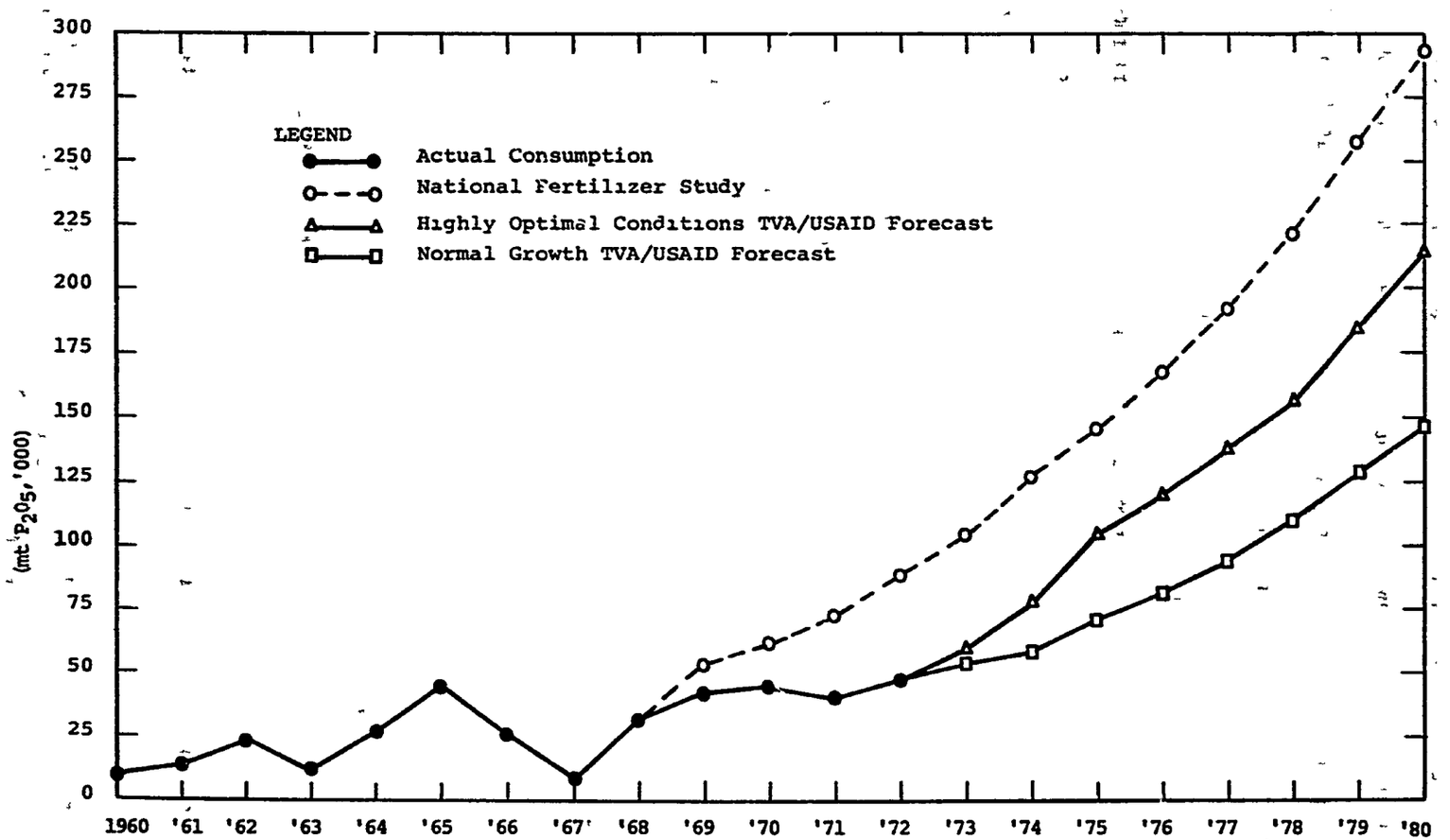


Figure 7. Actual Phosphate Use and Forecasts of Use by NFS and TVA/USAID Fertilizer Teams

Team. For example, the estimate for Situation 2 (normal market conditions) is nearly 50% less (149,000 mt $P_2O_5$) than the 295,600 mt forecast by the NFS Team to be consumed by 1980. Even under the most ideal conditions (Situation 1) estimates of phosphate consumption still fall 33% (213,000 mt $P_2O_5$) below the NFS estimates for 1980.

Product Mix (Current Situation)

Nearly 71% of all the phosphate used in Indonesia was consumed by the food sector[1] (table 28) in 1972. The remaining 29% was consumed by the government-owned (PNP) and foreign estates. The actual product mix (type of phosphate fertilizer used) varied greatly between the two sectors. For example, TSP/DAP accounted for nearly 80% of all phosphate sold in the food sector and nearly 57% of the total phosphate used in all Indonesia. Compound fertilizers (mainly as 16-20-0, 15-15-15 and 20-20-0) accounted for the remaining 20% in the food sector, 60% for the estate sector and 28% of the phosphate used overall. Surprisingly, rock phosphate accounted for 38% of the estate phosphate market and 12% of the total phosphate market in 1972. Other types of phosphate fertilizers (mainly as double superphosphate and fused magnesium phosphate) made up the remaining 3% of the market and were used primarily in the estate sector.

The main market for rock phosphate appears to be on rubber and oil palm of North Sumatra; whereas, the main market for compounds is located in East and Central Java as well as West Sumatra. Most of the TSP is consumed on Java with Central and West Java accounting for 57% of that market.

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[1]Consumption for the food sector is considered as all tonnage not ~~officially~~ reported as consumed by the government (PNP) or foreign estates.

Product Mix (Future Changes)

The current product mix of phosphates and future changes in its composition are highly dependent upon government policy. This is particularly true for the food sector and partially true for the type of phosphates used in the estate sector as well.

Food Sector--Concentrated phosphates (mainly TSP and DAP) will remain as the dominant (80% or more) sources of phosphate used in food sector as long as the government continues to subsidize the sale of only those phosphate products. Under such a policy (differential subsidy on phosphates) the nonsubsidized compounds will probably retain the current 20% share of the market in the food sector but may actually decline slightly should the spread between subsidized and nonsubsidized phosphates continue to increase.

Regardless of the current trend, there is a large market potential for compounds in the food sector, particularly in the vegetable, maize and to some degree the rice markets of East Java, South and West Sumatra. However, this will not be realized as long as the heavy subsidy remains only for TSP and DAP.

Estates Sector--The product mix appears to be changing in the estate sector. In North Sumatra there is a definite trend away from compounds and toward the use of striaght phosphatic materials (TSP and rock pnosphate). On the other hand, the estates of East and Central Java are testing compound fertilizers for the first time and appear to be ready to increase its use, particularly for sugarcane, cotton, and coffee. As a general rule, single nutrient fertilizers (including straight phosphates) are increasing in popularity as the estate sector develops the more sophisticated ''prescription system'' of applying fertilizers according to soil and leaf analysis. As a

result, the compound phosphate markets for the estates appear to be in East and Central Java, South Sulawesi and Lombok. The straight fertilizer phosphate market should increase in West Java and North Sumatra. Furthermore, the rock phosphate market may become even stronger in West Java (assuming the estates are rehabilitated) and North Sumatra as the estates rehabilitate their rubber holdings and expand the oil palm hectarage.

Forecast - Petrokimia's Share of the Phosphate Market

It is difficult to predict, with any degree of accuracy, the product mix of a market, and particularly that portion of the total market that can be captured by any single production unit, the personnel of which have no previous experience in either the production or marketing of these products. The following forecast has been developed on the assumptions that: (a) Petrokimia will develop a fully staffed and highly trained marketing arm, one that has equal status with production and finance, (b) the size plant eventually built will produce phosphates that would be low enough in cost and sufficient quality to effectively compete with imports currently coming into Indonesia, (c) Petrokimia will be allowed to import those phosphates it cannot produce but could market, (d) the production unit will come on-stream in 1975, will be operated at between 60% and 80% of rated capacity in 1976 and between 80% and 100% of capacity by 1980, and (e) Petrokimia will be able to capture 100% of the market for subsidized phosphates (by government decree) but only 40% of the compound market in 1976 and 70% in 1980. The results of this forecast based upon the above assumptions are shown in table 31.

Market Share in 1976--The total phosphate market (excluding phosphate rock) in 1976 was estimated at 87,100 mt of $P_2O_5$ if normal marketing conditions prevail (Situation 2) and 115,000 mt of $P_2O_5$ if highly optimal conditions (Situation 1) are established by the GOI. It is assumed Petrokimia could

Table 31. Forecast--Petrokimia's Share of Phosphate Market 1976 and 1980

| Parameter | Market Conditions[a] | | | | | | | | Totals mt $P_2O_5$ (000) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Situation 1 Normal Conditions | | | | Situation 1 Highly Optimal Conditions | | | | Situation 2 Normal | | Situation 1 High Optimal | |
| | TSP/DAP | | Compounds | | TSP/DAP | | Compounds | | | | | |
| | 1976 | 1980 | 1976 | 1980 | 1976 | 1980 | 1976 | 1980 | 1976 | 1980 | 1976 | 1980 |
| Total Market[b] (000) mt $P_2O_5$ | 49.0 | 81.9 | 28.1 | 57.0 | 86.9 | 145.1 | 28.1 | 57.0 | 87.1 | 139.9 | 115.0 | 202.1 |
| Petrokimia's share of market expressed as % | 100[c] | 100[c] | 40[d] | 70[d] | 100[c] | 100[c] | 40[d] | 70[d] | 69 | 87 | 85 | 92 |
| Tonnage (000 mt $P_2O_5$) | 49.0 | 81.9 | 11.2 | 39.9 | 86.9 | 145.1 | 11.2 | 39.9 | 60.2 | 121.8 | 98.1 | 185.0 |
| Petrokimia Production Proposed Plant Rated Capacity 126,000 mt $P_2O_5$ | | | | | | | | | | | | |
| 1976 | | | | | | | | | | | | |
| Operated at 60% rated capacity Surplus/Deficit | | | | | | | | | +15.4 | | -22.5 | |
| Operated at 80% rated capacity Surplus/Deficit | | | | | | | | | +40.6 | | + 2.7 | |
| 1980 | | | | | | | | | | | | |
| Operated at 80% rated capacity Surplus/Deficit | | | | | | | | | | -21.0 | | -84.2 |
| Operated at 100% rated capacity Surplus/Deficit | | | | | | | | | | + 4.2 | | -59.0 |

[a] See tables 17 and 18.
[b] Does not include phosphate rock for direct application.
[c] Assumes government will insure this.
[d] Assumes very competitive market for compounds.

capture 69% of the market (60,200 mt of $P_2O_5$) if Situation 2 prevailed and 85% of the market (98,100 mt of $P_2O_5$) if Situation 1 prevailed.

Surplus/Deficit 1976--Two sets of production conditions were assumed, both based on past performance of similar production units located in other developing countries. Production units of this type seldom operate at above 80% of capacity during their first few years of operation and often operate no higher than 60% of their design capacity. Calculations were based upon operation at 60% and 80% of rated capacity.

A surplus of phosphate will exist in 1976 if an 80% operational level can be achieved. This surplus was estimated at 40,600 mt $P_2O_5$ for Situation 2 and only 2,700 mt of $P_2O_5$ for Situation 1.

Where the production units operated at only 60% of capacity, a small surplus (15,400 mt $P_2O_5$) prevailed under Situation 2 but a deficit of 22,500 mt $P_2O_5$ occurred should the unit operate at that level and Situation 1 prevail in the marketplace.

Market Share in 1980--The total market (excluding phosphate rock) in 1980 was estimated at 139,900 mt of $P_2O_5$ assuming Situation 2 and 202,100 mt $P_2O_5$ assuming Situation 1 prevails. It is assumed Petrokimia could capture 87% of the market (121,800 mt) under Situation 2 and 92% of the market (185,000 mt) under Situation 1.

Surplus/Deficit 1980--Production rates for 1980 were assumed to be between 80% and 100% of rated capacity. Production would approximately meet market demand (surplus of 4,200 mt $P_2O_5$) only when the facility was operated at 100% of rated capacity and Situation 2 market conditions prevailed. In all other instances, a deficit was predicted by 1980. This varied from 21,000 mt $P_2O_5$ if the unit operated at only 80% of capacity for Situation 2 to 84,200 mt if Situation 1 prevailed and the unit was operated at a similar (80%) efficiency level.

Conclusion--The proposed phosphate unit of 126,000 mt capacity has sufficient flexibility in product mix and is adequate in size if the market develops along the lines prescribed for Situation 2. The proposed plant is too small to serve the entire phosphate market if Situation 1 prevails from 1973-80.

## VIII. POTENTIAL EXPORT MARKETS[1] FOR PHOSPHATE FERTILIZERS

There is a strong possibility the domestic market will not be able to absorb the entire annual output of the proposed new plant (if operated at maximum capacity) before 1979. Therefore, three choices must be considered by Petrokimia during the interim. They are:

a. delay the plant construction until 1977,

b. build now but operate at a scaled-back rate of production (which may happen anyway) or

c. build the plant now and export the surplus product.

All too frequently planners choose the latter (point c.) as the most attractive of the three alternatives and do so without sufficient analysis of the export markets. One needs indeed to establish whether the product is needed; if so, where and at what price it can be sold. The following is an attempt to highlight potential export markets for phosphate in Asia. However, greater in-depth study of these markets as to the real demand and competitiveness of Petrokimia Product is required <u>before</u> arriving at a final decision to enter the export market.

### Phosphate Markets in Asia

The Asian countries, as a group, do not produce phosphates in sufficient amounts to meet the total needs of the region. The surplus/deficit position for each of eighteen Asian countries is summarized in table 32 for the period 1971-75.

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[1] This is a preliminary examination of the phosphate markets in Asia. A more detailed report will be available in July 1973.

Only three countries in Asia presently produce surplus quantities of phosphate. These are Japan, Taiwan and South Korea. There are 11 phosphate-deficient countries of which North Vietnam, South Vietnam, Thailand, India, The Philippines, Malaysia, Sri Lanka, Bangladesh and Burma represent significant markets.

Japan's Production Inadequate to Meet Demands of Asian Market

Although Japan is now modernizing its phosphate industry and now may become a major supplier of $P_2O_5$ to the Asian market, its production (current through 1975) is insufficient to meet the total demands of the region. The size of the net deficit for the region to some extent is highly dependent upon the overall operating efficiency of the Japanese phosphate industry. This may hold as long as the current world shortage of phosphate continues. Assuming the Japanese industry operates at only 80% of rated capacity, by 1975 the deficit for the region as a whole will be about 229,741 mt of $P_2O_5$ (table 32). On the other hand, this deficit would drop to only 138,609 mt of $P_2O_5$ in 1975 should the industry function at 90% of its overall capacity. Based upon its recent performance, this is not likely to happen. Regardless of the level at which the Japanese industry operates, additional $P_2O_5$ capacity must be built within the region or the member countries will continue to be dependent upon outside sources to meet the deficit.

New Phosphate Capacity Now Being Built Within the Region

India and Japan have been most active in adding to their capability to produce phosphate. India has done so to meet the insatiable demand of its domestic market whereas Japan has done so as part of its ever increasing drive to serve as a main source of phosphate to the deficit countries within

Table 32. Summary Estimated Supply of Phosphate (mt $P_2O_5$) in Selected Countries of Asia 1971-75

| Country | 1971 | | 1972 | | 1973 | | 1974 | | 1975 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surplus | Deficit | Surplus | Deficit | Surplus | Deficit | Surplus | Deficit | Surplus | Deficit |
| Japan | | | | | | | | | | |
| 90% capacity | 12,100 | | 433,234 | | 409,753 | | 376,273 | | 335,792 | |
| 80% capacity | - | | 323,234 | | 303,753 | | 267,273 | | 226,792 | |
| Taiwan | 500 | | 13,808 | | 12,161 | | 19,519 | | 17,868 | |
| South Korea | 15,646 | | 1,040 | | | 3,040 | | 7,120 | | 11,300 |
| North Korea | - | - | - | - | - | - | - | - | - | - |
| Peoples Rep. of China | | 2,000 | - | - | - | - | - | - | - | - |
| New Zealand | 201 | | - | - | - | - | - | - | - | - |
| Australia | | 48,476 | (May build new capacity by 1977) | | | | | | | |
| North Vietnam | | 63,000 | | 43,200 | | 48,491 | | 53,782 | | 59,073 |
| Laos | | 73 | | 445 | | 489 | | 534 | | 578 |
| Cambodia | | 400 | | 800 | | 1,000 | | 1,000 | | 1,500 |
| South Vietnam | | 34,100 | | 42,631 | | 46,283 | | 49,936 | | 53,588 |
| Philippines | | 34,000 | | 24,316 | | 29,407 | | 44,687 | | 49,967 |
| Thailand | | 36,000 | | 48,234 | | 52,953 | | 57,671 | | 62,390 |
| Malaysia | | 17,800 | | 16,628 | | 17,972 | | 19,317 | | 20,661 |
| Burma | | 5,000 | | 6,208 | | 6,819 | | 7,429 | | 8,039 |
| Sri Lanka | | 5,000 | | 9,278 | | 10,198 | | 11,119 | | 12,039 |
| India | | 232,978 | | 251,997 | | 265,787 | | 216,576 | | 171,366 |
| Bangladesh | India/Pak War | | | 15,000 | | 20,000 | | 24,000 | | 24,000 |
| Totals | 28,447 | 474,827 | 448,072[a] | 458,737 | 421,914[a] | 502,439 | 395,792[a] | 493,171 | 335,792[a] | 474,401 |
| Net Balance: | | | | | | | | | | |
| Japan 90% capacity | | 446,380 | | 10,665 | | 81,525 | | 97,379 | | 138,609 |
| Japan 80% capacity | | (not calculated) | | 120,665 | | 186,525 | | 206,379 | | 229,741 |

[a]Surplus totals are for Japan industry operating at 90% of capacity.

the region. Other countries are following a different policy. North Korea and the Peoples Republic of China appear to be following a building program that essentially matches added capacity with domestic growth. New Zealand and Australia have followed a similar program, building new capacity and utilizing raw materials available to them through the British Phosphate Commission (materials from Christmas Island, Narau, etc.).

There are signs that this policy may be changing. Recent attempts have been made by Australia to develop its own phosphate deposits (Broken Hill). If successful, this could place that country in a strong export position in rock phosphate as well as finished phosphates. Current information leads us to believe that Australia will not become a significant exporter of phosphoric acid or other concentrated phosphates before 1978 but will be a factor in phosphate rock export market by 1976. Until another Asian country makes a serious effort to develop a basic capability in phosphate, Japan will continue to be a major phosphate supplier (finished product) to the Asian market even though it must import all the necessary phosphate rock to produce finished phosphate fertilizers.

ASEAN Market

Collectively, the current member countries of the Association of Southeast Asia Nations (ASEAN) will represent a total deficit of over 132,000 mt of $P_2O_5$ by 1975 (table 32). These are The Philippines (49,967), Thailand (62,390) and Malaysia (20,661). It is doubtful that any of these countries will build additional $P_2O_5$ facilities before 1977.

Product Mix--The product requirements (phosphate) for this market varies. The Thailand market is served mainly with 16-20-0 imported from Japan. The West European countries supply most of the remaining market with a varying assortment of NPK compounds. The Philippines market is served mainly through Japan (16-20-0) but to a slight extent by U.S. suppliers as well.

Malaysia is mainly an NPK market with materials supplied either as blends from Singapore suppliers (USA) or compounds from Japan. No dominant supplier appears to have emerged in this market at the present time.

Additional Markets

There are other fertilizer phosphate markets potentially available to Indonesian exports. North Vietnam (59,073), South Vietnam (53,588), India (171,366), Sri Lanka (12,039), Burma (12,039) and Bangladesh (24,000) all represent significant potential for export. At the moment, South Vietnam is served by U.S. suppliers through the USAID program. The main phosphate product is a 16-8-8 compound. However, sizable quantities of TSP and DAP are also imported. Little is known about the North Vietnam market at this time. Burma uses primarily triple superphosphate and is served mainly by U.S. suppliers. Sri Lanka is a growing user of TSP but is served mainly by the communist bloc countries. Bangladesh represents a growing market, uses both TSP and DAP and is served by a wide range of donor countries including the United States.

India, by far the biggest market for phosphate exports, also is the most competitive. Although a major importer of phosphate as DAP, India is now broadening its base to various compounds, blends and TSP. Its suppliers originate mainly from Japan, Western and Eastern Europe and North America.

Major Competitors for the Phosphate Markets

The major phosphate exporting countries and their product mix are summarized in table 33. Although many suppliers are located a great distance from the Asian market, they are close to a source of raw materials. This coupled with today's innovations in water transport makes it possible

for them to market almost anywhere in the world including Asia. With this in mind, it would seem worth noting that the prime exporters of TSP are the United States, Netherlands, Morocco, and Tunisia. The United States and Canada are prime suppliers of DAP and Belgium, Germany, and the Netherlands major suppliers of compound (complex) fertilizers (table 33). All of these have long experience in the Asian phosphate market and will not be easily dislodged from their present positions.

Some Additional Thoughts

A sizable market for phosphates does exist in Southeast Asia. At the moment, production within the region is insufficient to meet its overall needs. This market is now being served by some very formidable competition. Among these are the facilities located in Japan, Western Europe, North Africa and North America. Even under today's scarce supply sellers' market condition, this market will not be easily penetrated by any new supplier. If a plant is to be built in Indonesia that will require the export of phosphate, even for only 3 years, considerable additional market analysis will be needed. This may require extensive outside assistance from an organization knowledgeable of this market.

Table 33.3 1970-71 World Export Product Mix (1000 mt $P_2O_5$)

| | Single Super | Conc. Super | Basic Slag | Ammonium Phos. | Other Phos. | Other Complex | Total |
|---|---|---|---|---|---|---|---|
| Austria | - | - | - | - | 15.0 | .1 | 15.1 |
| Belgium | 17.0 | 20.6 | 173.5 | - | - | 236.4 | 447.6 |
| France | 2.7 | .2 | 56.6 | - | .7 | 37.2 | 97.3 |
| Germany F.R. | 1.9 | - | 35.5 | - | 9.4 | 95.4 | 142.2 |
| Italy | 1.4 | - | - | - | .2 | 68.4 | 70.0 |
| Luxemburg | - | - | 122.4 | - | - | - | 122.4 |
| Netherlands | 11.8 | 63.9 | - | 35.0 | - | 98.8 | 209.6 |
| Norway | - | - | - | - | - | 60.3 | 60.3 |
| Portugal | 7.7 | 33.9 | .2 | - | - | 5.5 | 47.2 |
| Spain | 15.0 | - | - | - | - | - | 15.0 |
| Sweden | - | .1 | 3.5 | - | .1 | 1.9 | 5.6 |
| United Kingdom | - | - | - | - | - | 15.2 | 15.2 |
| Yugoslavia | 5.5 | - | - | - | 4.1 | - | 9.6 |
| USSR | 121.6 | - | - | - | 10.3 | - | 131.9 |
| Canada | - | - | - | 260.0(est) | - | - | 260.0 |
| USA | 3.0 | 262.0 | - | 460.0 | 50.3 | - | 775.0 |
| Mexico | - | - | - | 9.6 | - | .4 | 10.0 |
| Japan | 1.1 | 1.7 | - | - | 6.1 | 19.0 | 27.9 |
| Korea | - | - | - | - | - | 4.9 | 4.9 |
| Morocco | - | 54.6 | - | - | - | - | 54.6 |
| Senegal | .6 | 6.2 | - | - | 4.5 | - | 11.3 |
| Tunisia | - | 175.3 | - | - | - | - | 175.3 |
| Uganda | 3.7 | - | - | - | - | - | 3.7 |
| Total | 189.0 | 618.5 | 391.6 | 764.6 | 100.4 | 613.5 | 2,711.7 |

Source: Phosphate-Sulphur Symposium, Lakeland, Florida, October 12-13, 1972.

## IX. SOME PROBLEMS OF DISTRIBUTING FERTILIZER IN THE FOOD SECTOR OF INDONESIA

For Petrokimia to successfully market its production in Indonesia, it will have to develop a marketing apparatus that will essentially solve the current problems of distribution. The following is presented merely as background information and should prove helpful if and when Petrokimia begins to expand its marketing effort.

A major shift has occurred in agencies involved in fertilizer distribution. Prior to 1969 nearly 80% of all fertilizer and agricultural chemicals consumed in the food sector were distributed by the government owned and controlled P.N. Pertani. This has all changed. Today P.T. PUSRI and P.N. Pertamina[1] have replaced P.N. Pertani as the main importers and distributors of fertilizers. Collectively, the two government organizations import or produce over 85% of the urea and import 70% of the TSP sold in the food sector. This shift has been accomplished primarily because of government action through limiting Pertani's supplies rather than the result of a real competition in the marketplace among these three agencies.

It may be too early to try to describe the type of marketing and distribution system that is replacing P.N. Pertani. However, a trend has been established which seems worthy of description at this time. It seems to follow one of two basic patterns. The systems being developed by P.T. PUSRI and P.N. Pertamina are examples of each.

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[1] A recent decree by the President has reinstated P.N. Pertani as a major distributor of fertilizer for the 1972-73 wet season. It remains to be seen as to what the respective roles of Pertamina and Pertani will be in the future. Pertamina has apparently retained its role as an importer.

PUSRI Marketing System

The system employed by P.T. PUSRI and several other importers appears to be one of the most efficient that could develop under the present conditions in Indonesia.

Basically, PUSRI imports fertilizers for sale through a small number of relatively large and efficient private distributors. PUSRI owns or rents a limited amount of warehouses. (These are located primarily at the port areas, although PUSRI now is beginning to develop some inland storage capabilities.) The distributors take ownership of the fertilizer at the port area (second line godown) and sell through their own independently owned network of subdistributors (wholesalers) located at major trading areas inland. The latter has its own network of independently owned subwholesaler-retailer outlets which sell to other retailers or farmers. In most cases, the subwholesaler-retail operations are of a ''general store'' type found in most local markets. Fertilizers are only one of several hundred items they offer for sale. In this type of system, most of the fertilizer is stored in warehouses at the port areas and dispatched from these warehouses directly (usually by truck) to the small warehouses of the subdistributor and/or directly to the retail shops. Most units (inland) maintain stocks to last no more than 1 week during peak sales periods and about 3 weeks during the off season. The entire system is built around the assumption that large quantities of product are available at the port areas and can be quickly dispatched (within 2 days) to meet increased market demand at the local level.[1]

The present system allows for major profits to occur at the importer-distributor levels. Relatively low margins and low volume are

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[1]Recent shifts in government policy discourage the private importers from holding fertilizer in the port areas.

realized at the retail end of the distribution chain (table 34). This type of system assures reasonably rapid turnover of capital and does not require a large number of personnel with high technical expertise to operate (particularly at the retail level) since the system's function is primarily one of logistics not of market development.

Disadvantages of PUSRI System

There are some very serious disadvantages of this system. First, it can function smoothly only if procurement by the importers is timely and accurately reflects the true demand of the system. Overprocurement will result in serious fluctuations in price and heavy financial loss by the importer, or retailer, or both. A second disadvantage is the lack of vertical control (top down) that can be brought to bear at the retail level. For example, PUSRI can suggest but not necessarily enforce policy with regard to pricing, packaging or product promotion. Furthermore, PUSRI cannot accurately determine the actual sales or product inventory, future demand, or crops being fertilized with the product they sell to the distributor. Finally, and probably the most serious disadvantage of this system is that PUSRI has placed in the hands of a few distributors a very major portion of the total fertilizer it imports. Should another importer, for example, convince as few as three distributors to drop PUSRI products and handle their own, PUSRI could lose over 50% of its market overnight.

Pertamina Distribution System

P.N. Pertamina has employed a slightly different method of distributing fertilizer.[1] It has attempted to retain control of the

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[1]As mentioned previously Pertamina has recently been ordered out of the fertilizer business. However, it has been one of the systems that replaced Pertani and seems worthy of inclusion in the discussion.

Table 34. Example of Sales Volume, Purchase Price and Gross Margins for Urea Sold in Private Sector Distribution System[a]

Java November 1972 (INMAS Sales)

| Level of Distribution | Sales Volume | Purchase Price[b] Range | Purchase Price[b] Average | Average Gross Margins |
|---|---|---|---|---|
| | mt | Rps./kg | | |
| Importer | 10,000 - 200,000 | 18.10 | 18.10 | 4.5 |
| Distributor | 5,000 - 70,000 | 22.0-23.4 | 22.60 | 2.8 |
| Subdistributor (wholesaler) | 1,000 - 10,000 | 22.0-27.3 | 25.40 | 1.2 |
| Retailer | 75 - 3,000 | 23.6-29.0 | 26.60 | 1.5 |
| Farmer | - | 26.0-34.0 | 28.10 | |

[a]Preliminary results of market survey now in progress.
[b]FOB price. Transport charges not included.

fertilizer through the chain by establishing a rather simple vertically integrated system of Pertamina owned or controlled warehouses located at strategic points in the port areas and provinces. These are operated by their own personnel who dispense fertilizer solely for the BIMAS program through a mobile method of delivery similar to that employed by the foreign contractors during the BIMAS Gotong Rojong period of 1967-70.

Disadvantages of Pertamina System

This system although capable of distributing fertilizer at relatively low cost lacks the capability of supplying fertilizer when the farmer needs it or when he has the SPPB credits to pay for it. Frequently, deliveries to the village will occur after the farmer is ready to plant or before the SPPB's have been made available from the BRI. It has a further disadvantage in that the farmer does not relate Pertamina with any specific retail outlet where he could purchase Pertamina fertilizer products should the BIMAS program no longer function in his area. (Pertamina does not sell in the traditional INMAS cash market.) Finally, it has limited its activities to BIMAS. This automatically reduces its potential volume and increases per unit costs above what are necessary.

Pertani Distribution System

The distribution system followed by Pertani is the only one that, under present government policy, has the potential to effectively meet the fertilizer and agricultural chemical needs of the food sector and sustain the least amount of losses. Pertani has nationwide distribution capability, owns a vast network of warehouses many of which are well located, has a staff that is familiar with the requirements of an effective fertilizer distribution system and, in theory, is able to effectively implement national

policy. The major fault with the Pertani system of distribution was its high cost of operation. This was due primarily to the failure by the GOI to recognize the role (and cost) P.N. Pertani was playing in market development, and its large unwieldy organizational structure which had developed because of political or social forces and not necessarily because Pertani management sincerely felt that was the type needed to distribute fertilizer.

General Comments on Inadequacy of the System

Under the present mode of operation, not one organization involved in the distribution of fertilizers (PUSRI, Pertani, Pertamina, INTRADA, etc.) makes a serious effort to conduct a market development campaign built on sound educational and promotional principles. This responsibility is left to the GOI (presumably BIMAS or Extension). PUSRI has made an effort in this area; however, under its current method of distribution it would seem valid to question its ultimate effectiveness. The reason being that unless PUSRI achieves a monopolistic position such as once enjoyed by Pertani, it has no assurance that profits made by the distributors as a result of PUSRI's efforts in educational programs will reappear as increased sales of PUSRI products. To be effective and to generate profit, PUSRI must develop better control than it now has over its distribution system.

Pertani must undertake a major program in the upgrading of its personnel if it is to play a major role in consumer education on fertilizers.

Some Good Reasons Why the Current Method of Distribution Has Developed

The current distribution system[1] now emerging is the result of recent shifts in government policy. The areas of major concern deal with

[1]Again remember the current distribution is now being changed. The BUUD concept is being pushed--Pertani is again being given a major role in distribution and Pertamina has been temporarily taken out of fertilizer distribution.

requirements, procurement, methods of appointing importers and distributors, credit policy at the importer level, pricing policy for fertilizer, and the general implementation of the BIMAS program.

The Pertani system is the residual of a previous era but nevertheless exists because of the need to support government programs. Pertamina is essentially a modification of the Pertani system and was formed primarily to serve BIMAS (because of the GOI desire to remove Pertani from its dominant position), but hopefully in a manner that would be of less direct cost to the government. (Another reason most probably is to develop a fertilizer market for the urea plant planned to be built near Cirebon.)

PUSRI's distribution system is built around the need to develop a market for PUSRI II product but its operational aspect is a clear reflection of the lack of confidence the private sector has in government policy in the area of fertilizer marketing. Under its present organizational structure, no real repercussions would occur from the distributor level downward if large surpluses or acute shortages of fertilizer should develop.

The system below the importer (PUSRI) is an independently owned operation and, because of this and its multiplicity of nonfertilizer product lines, would simply reject additional purchases of fertilizer should the market become flooded with product. The net result would be a shift toward handling a greater volume of other products. The same would happen should a shortage of fertilizers develop.

This is mainly due to the versatility of the entire system, and particularly the components to the network which are built around the ''general store'' concept of merchandising where the success of the operation is not dependent upon the sale of any one item. Because of this very point there is

little desire on the part of this type of retailer or wholesaler to promote fertilizers and agricultural chemicals unless the potential for profit is high.

The system developed by P.N. Pertani is very sensitive to changes in government policy. For example, the entire distribution apparatus comes to a halt when supplies of fertilizers are choked off. The sole function of that system and its financial status is built around the premise that it is a highly specialized unit aimed at effectively distributing a minimum level of fertilizers and agricultural chemicals.

Because of the huge investment in personnel and facilities, it is extremely vulnerable to heavy financial loss in a very short time frame when supplies become unavailable and the system stands idle. However, as contrasted to the system developed by PUSRI, the Pertani system in theory has sufficient control from the top down to work itself out of a surplus situation. Although costly, this could lead to further market development if handled correctly. This is because Pertani management has control at the retail level and PUSRI does not. For example, assuming it had the authority to do so, Pertani could order a cut in price of urea at specific marketing areas and hold fast in others thus minimizing unnecessary losses. PUSRI's system lacks this selective control at the moment.

Only the PUSRI system can minimize losses or possibly even make a profit under the present system. However, the Pertani system, if allowed to function as suggested under its current reorganizational patterns, offers the greatest potential for developing the fertilizer market in Indonesia over the shortest time frame and at the least costs to the government.

Adequacy of Present Systems to Develop New Fertilizer Markets

Under the present environment, new fertilizer markets will not develop as rapidly as they should unless the government is willing to supply massive doses of easy credit and cheap fertilizer to the farmer. Under the present restrictions, Pertani cannot, PUSRI distributors lack the motivation, and Pertamina does not have the organizational structure to focus effectively on ways to develop the fertilizer market.

The BIMAS is attempting to accomplish this goal but must develop its plans more closely in harmony with all facilities interested in marketing fertilizer. The fertilizer industry does have certain talents that are essential for the success of BIMAS. It remains to be seen if one organization can harness these talents.

In general, one can conclude that most components of the distribution systems replacing P.N. Pertani lack the organizational structure, depth in trained personnel knowledgeable in marketing, and control or continuity necessary for the orderly development of an effective marketing capability. Until this is corrected, PUSRI, Pertamina or even Petrokimia will not be completely successful in serving the Indonesian farmer or the nation.

Current PUSRI and Pertamina Plans

At present, PUSRI is following an import schedule to meet the requirements set for the PUSRI IT seeding program. It hopes to have by 1975 total sales of 400,000 mt of urea. If the target is achieved, this would represent nearly 75% of the urea market in Indonesia forecast for 1975. Pertamina on the other hand appears to be following a similar but less publicized course of action. It too seems to be following some type of market development plan for urea and TSP. Unofficially, it is believed Pertamina hopes to have a urea (or urea phosphate) plant in operation in

the Cirebon area by late 1977. Supposedly, it will be of a size equal to or even larger than the one currently being built by PUSRI in South Sumatra. It appears that both government-owned organizations are aiming at a major share of the area market in Indonesia. Indonesia could have 1,000,000 mt of urea capacity by 1978 if both plants are built according to the size and schedule outlined above. Since the urea market, at its present growth rate, may only be around 850,000 mt in 1978, there could be a fairly significant amount of urea available for export from Indonesia by late 1978.

At present, PUSRI has a policy that no importer can distribute PUSRI fertilizer. Pertamina does not allocate its fertilizer to other distributors but rather sells it all (officially) in the BIMAS program through its own distribution.

Other Importers

More than 30 companies have been authorized over the past 3 years by the DOT to import fertilizer. This number has dwindled greatly in recent months, partly because of indirect pressure placed upon them from both PUSRI and Pertamina, but also because of the official policy of DOT to license only those importers who are sincerely interested in developing a fully mature marketing system. The most prominent in import distribution (besides PUSRI and Pertamina) have been Lemtoro Agung, Intrada and Jaya Niaga. In recent weeks there have been signs that Pertani will also receive an allocation from the DOT and again import major quantities of fertilizer.

In summary, one can conclude that because of the struggle between Pertamina and PUSRI to capture the market vacated by Pertani, the DOT is only partially effective in appointing importers and allocating them tonnage. It may become even less effective once Pertamina officially announces its plans to build a fertilizer plant.