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PROCESSING AND UTILIZATION OF MEDIUM AND LOW GRADE PHOSPHATES THE SITUATION IN PAKISTAN

BY

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TERMS OF REFERENCE

This paper has been prepared on the basis of following Terms of Reference:

- to analyze technology otpions for the utilization and processing of medium-grade phosphates;
- to describe the experience of the fertilizer industry in Pakistan in the beneficiation of domestic low-grade phosphates and with respect to the imported African rocks;
- based on the above suggest innovative strategies for the development of the sub-sector with special emphasis on Afro-Asian co-operation.

CONTENTS

INTRODUCTION

INTRODUCTION

Due to concerted efforts of the 'Geological Survey of Pakistan', deposit of phosphate rock were found in lazara District and adjoining areas of NWFP. Sarhad Developme t uthority (SDA) instituted studies for exploration of these deposits, with the capital and technical assistance granted by the British Government. The first phase of their work was executed from 1975 to 1977 through Powell Duffryn, National Coal Board Consultants (Now BMC Limited), in which an area of about 120 Sq. Kilometers extending from Kotak ibar (Abbottabad) to Ghari Habibullah (Mansehra) was explored. The three reports resulting from the study were (i) A mining feasibility report for target locality, (Kakul deposit), where about 1.1 million tonnes of reserves were established out of which 0.57 million tonnes were placed in the 'proven' category, (ii) A report in the 2nd target locality, Lagarban phosphate deposits, recorded 13.6 million tonnes of ore reserves placed in the inferred category and recommendation for further work as well as a conceptual mining feasibility study and (iii) An overall evaluation report of rock phosphate deposits in Hazara with details of Lambidogi and Dolala area.

Recoverable phosphate reserves are of 0.7 million tonnes of Kakul and 7.704 million tonnes of Lagarban area comprising four principal ore bodies of Southern, Lagarban, North-South, Eastern and Batkanala phosphate.

TECHNOLOGY OPTIONS

TECHNOLOG OPTIONS FOR UTILIZATION OF LOCAL PHOSPHATE ROCK

The rock phosphate found in Pakistan is generally cherty, dolomitic, pelletal, medium grey to dark grey, hard and compact. Kakul area more cherty in nature and Lagarban areas are most dolomitic and Dalola are pyritic in nature. According to Petrographic studies carried out at Albany USA on Lagarban rock revealed the intimate association between apatite, quartz occuring as quartz grain. Haematite (F_2O_3) and hydrated forms of iron are present throughout the sample. Significant variation in ore quality exists within the ore bodies.

The reserves are small, MgO undesirably high, R_2O_3 exceeds the prescribed limits and similarly the carbonates. The utilization of it is therefore a challenge for us all.

Various international agencies carried out beneficiation studies on the siliceous and dolomitic type of local phosphate reserves.

Experiments for the flotation of: (i) carbonates and silica (ii) iron (iii) Phosphate, were carried out at U.S. Bureau of Mines Alabany, USA.

As a result of the various experiments it has been confirmed that the process of phosphate flotation was more successful than carbonate, silica and iron flotation.

Beneficiation was however, not found economical due to high costs of the complicated beneficiation techniques required to reduce the nuisance impurities to desired level. Therefore, the other technical possibilities for the utilization of local impure and medium grade phosphate deposits are the processes which can utilize the impure phosphate rock and are independent of rock quality.

For the utilization and processing of medium grade phosphate rock, following are the options:

- PHOSPHORIC ACID PRODUCTION
- DIRECT COVERSION TO PHOSPHATE FERTILIZER I.E.
  - NP PRODUCTION
  - SSP PRODUCTION
- OTHER OPTIONS
  - BLENDING
  - DIRECT APPLICATION OF PHOSPHATE ROCK.

PHOSPHORIC ACID PRODUCTION:

SIAPE Process

M/S.SIAPE of Tunisia have developed their own process (SIAPE Dihydrate Process) for the production of dilute phosphoric acid (26-30% P_2O_5) using low and medium grade rock phosphate. Trials were undertaken on Pakistani rock phosphate by SIAPE in Tunisia. The acid produced was having 26-30% P_2O_5 and 1.2% to 4.26% MgO, The acid could not be concentrated above 50% P_2O_5.

Trials were also conducted on local phosphorite at pilot plant installed at Haripur. The plant employs SIAPE Dihydrate Process. Using silliceous phosphorite, phosphoric acid of 26 28% P_2O_5 concentration could be produced while from dolomitic phosphorite, quality of acid produced was still very poor. It was observed that filteration rate was very poor. Pipe lines in filternation section chocked frequently due to excessive sludge formation.

IMI Process

IMI, HCl route for the manufacture of pure grade phosphoric acid have the drawback of relatively high capital cost of the plant. In IMI process very dilute acid 13-16% phosphoric acid can be produced and require high energy for its concentration. Research studies are under progress at FR&DI for manufacture of phosphoric acid by IMI process, but still the studies are at preliminary level.

Furnace Process

Furnace process can only be possible at very low cost of electricity through the use of nuclear energy. Over all local deposites (composite rock) can also be utilzed for SSP by blending it with Jordan rock in 1:1 ratio, as concluded by lab.scale trials.

In breif both the above processes being expensive cannot be adopted of the utilization of local deposits.

Conclusion

It may be concluded that dolomitic nature of phosphate deposits 2.62 million ton (Batkanala and Southern) as such without beneficiation cannot be utilized for phosphoric acid as well as phosphatic fertilizers manufacture like TSP, MAP & DAP owing to the excessive impurities particularly 5-6% MgO.

3.19 million ton siliceous deposits (Eastern) as such without beneficiation though can be processed but still remain problematic in respect of excessive sludge formation and reduced filteration rate of phosphoric acid due to the presence of excessive amount of (SiO_2) silica upto 24%.

Even the overall deposits (composite rock) still remain problematic and cannot be utilized for Phosphoric Acid manufacture because the quality of Acid produced is poor, which cannot be utilized for TSP manufacture.

DIRECT CONVERSION TO PHOSPHOTIC FERTILIZERS

NP Production:

NP being very complicated process cannot utilize the impure local rock at all. Therefore, there is no possibility of local rock utilization for NP manufacture.

SSP Production:

As a result of various plant scale trials, it is concluded that local siliceous ore body (Eastern) can safely be utilized for SSP manufacture like that of Kakul rock. (Recoverable siliceous Eastern reserves are 3.19 million ton).

2.62 million dolomitic reserves (Southern and Batkanala) can only be utilized for SSP manufacture, having 16% water soluble P_2O_5 by blending it with Jordan rock in 1:3 ratio.

Overall local deposits (compsite rock) can also be utilized for SSP manufacture by blending it with Jordan rock in 1:1 ratio, as concluded by lab. scale trials.

OTHER OPTIONS.

Blending

Blending is one of the options, by which overall local phosphate deposits can be utilized as such for Phosphoric Acid and Phosphatic fertilizers manufacture like TSP, MAP nd DAP. Encouraging results were achieved with 1:1 blend of overall local deposits and Jordan Rock. On the other hand local recoverable Phosphate deposits 7.4 million tons alone are not sufficient for an economically viable commercial plant.

Direct Application

Experiments have been conducted in Pakistan on rice, cotton, wheat, sugarcane and maize to check direct application of Phospal (Senegalese calcined phosphate). Agronomic efficiency of the directly applied Phospal is identical to SSP, it is 15% less for wheat and 27% less for maize. Further trials are being planned.

However local rock phosphate has not been evaluated for direct application.

EXPERIENCE OF PAKISTAN

BACK GROUND

Existence of phosphate mineral in Abbottabad District was first of all reported in 1969. Exploration was then entrusted to Sarhad Development Authority, who hired PD-NCB Consultants of U.K. through British Government.

Then phosphate rock reserves estimation, Geology and nature of phosphate reserves and exploration feasibilities etc. were undertaken by PD-NCB British Mining Consultants of U.K. from 1975-1977 as phase-I of the study.

For the Phase-II studies Creamer and Warner Ltd. of U.K. were appointed as sub-consultant to British Mining Consultants. Alongwith the Beneficiation studies, limited trials were made for the evaluation of phospahte reserves for Single Superphospahte manufacture at Warren Spring Laboratory U.K. from 1980-1982.

Evaluation of phosphate reserves for Phosphoric acid MAP, DAP and TSP manufacture was not included in the scope of work to be carried out by British Consultants.

Salient features of both the studies carried out by PD-NCB are summarized below:

- Mineralogical studies of PD-NCB on siliceous and dolomitic reserves showed that phosphate is present at collaphane and dahllite, silica occurs as chert and quartz. Carbonates mainly as dolomite with possibly minor amount of calcite. Iron oxide occurs as limonite (Iron hydroxide).

- In the report various beneficiation techniques were discussed, out of which Froth flotation was most promising method of increasing P_2O_5 contents and reducing R_2O_3, but with this technique MgO content could not be reduced and remained high. Furthermore, the beneficiation techniques recommended was not commerercially proven.

- Wet classification by screening and dry pneumatic classification both did not show encouraging results due to little differential separation of minerals.

  Calcination followed by hydration, only marginally reduced the MgO contents from rock.

- Heavy density liquid separation technique was tried but according to their report, this technique can not be utilized at the plant level because of fine grind size.

- According to creamer and warner Ltd. U.K., high intensity magnetic separation and acid leaching were found suitable. Although level of Fe_2O_3 was reduced upto 1.15% while MgO could not be reduced below 2%. However such a level of performance was only possible at higher P_2O_5 losses.

  In brief PD-NCB report did not committedly suggest the process, which should be adopted for beneficiation.

- Regarding the Warn Spring Lab. U.K. studies carried out in October, 1983 for the asssesment of the possibilities for making Single Superphosphate from Hazara Ore. A limited series of tests were made with the Eastern rock (Siliceous) finely ground rock gave a product(SSP) with acceptable handling characteristics without the necessity for mixing with any Jordanian rock.

Present status of the Medium and Low Grade Phosphate Reserves

Ore Body	Recoverable Reserves Million Ton	Classification	Grade & Nature of impurities
Kakul	0.75	Medium grade Siliceous deposits	P_2O_5 28-31% SiO_2 20-25% MgO upto 1%
Eastern	3.199	Medium grade Siliceous deposits	P_2O_5 28-31% SiO_2 20% MgO upto 1%
Batkanala	0.78	Medium grade dolomitic deposits	P_2O_5 18-24% MgO 4-5.5% SiO_2 6-8%
Southern	1.84	Medium grade dolomitic deposits	P_2O_5 18-24% MgO 4-5.5% SiO_2 6-8%
Lagarban North-South	1.5	Medium grade Silicous dolomitic	P_2O_5 18-24%
Malakand Carbanotite	Exact size of deposit not known but understood to be millions of Ton.	Low Grade calcite, Carbanotite	P_2O_5 3.5% MgO 1.5% Carbonate 20 30 Fe_2O_3 7%

7.4 Million tonnes rock phosphate of all Ore bodies generally consists of Francolite, dolomite chert, quartz and geothite, medium grey to dark grey in colour, hard & compact in nature.

All these indigenous phosphate reserves according to their composition are classified in two types of medium grade phosphorites, one with higher dolomitic contents such as Batkanala and Southern and other with low dolomitic contents but usually higher SiO_2 (Siliceous) corresponding to Kakul and Eastern Phosphorites.

Composition of these two types of the phosphorite is given below:

Average Composition of indigenous phosphate deposits

	Medium Grade					Low Grade
	Siliceous Phosphorite		Dolomitic	Phosphorite		Malakand Carbanotite
	Kakul	Eastern	Batkanala	Southern	Composite & Lagar-t n Rock	
P_2O_5	30.9	30.6	27.99	26.27	30.43	3.5
CaO	40.78	40.75	42.74	41.90	49	43
SiO_2	18.42	19.6	6.48	6.81	8.7	9
MgO	1.37	1.27	5.91	5.32	1.6	1.5
Fe_2O_3	2.1	1.3	1.3	2.23	0.3	7
Al_2O_5	1.1	0.8	0.6	0.50	0.88	1
LOI	1.2	2.08	12.80	11.99		20-30%
Organic Matter	-	0.19	0.40	0.10	-	-
F	2.2	2.5	2.61	2.62		0.23

Various International Agencies carried out Beneficiation sutdies on both these types of phosphate reserves and concluded that whereas it was comparatively easier to up grade Siliceous rock, removal of magnesium and other impurities from the dolomitic rock posed problem. Studies carrid out at FR&DI confirmed the above findings.

Processing and Utilization of
ROM Indigenous Phosphate Reserves

The world richer grade phosphate reserves are being rapidly exhausted. Continuous efforts are being made everywhere for utilizing the locally available impure and low grade rock according to the strategy planned for beneficiation, equipment design and ultimately product specification.

All the indigenous phosphate deposits classified as medium grade Siliceous and dolomitic are unfortunately problematic due to their slow reactivity and presence of excessive amount of nuisance impurities. Although the indigenous reserves are small yet keeping in view the increasing demand of phosphatic fertilizer in the country, research & development studies for the identification of processing problems and possibility of their utilization for manufacture of phosphatic fertilizer were initiated on modest and preliminary level.

Strategy of research work planned was to find out various possibilities for the utilization of ROM ore bodies including blending of these ore bodies with imported rock. Therefore, during the last few years extensive Laboratory research work as well as plant scale production tests were carried out jointly by Technical Staff of NFC Head Office, FR&DI and Lyallpur Chemicals & Fertilizers Ltd. at Faisalabad SSP plant to find out the exact conditions and proportion of various blends of local and imported rock for the partial utilization of indigenous ore bodies.

While this work was under progress studies for the up gradation of rock and removal of nuisance impurities by flotation were continued.

Laboratory & Plant Scale
SSP manufacturing Tests

Extensive Laboratory scale acidulation tests were performed for the evaluation of all the local reserves for SSP manufacture during 1978-80.

Based on the abvoe laboratory scale findings plant scale SSP manufacturing tests were conducted at Lallpur Chemicals & Fertilizers Ltd., Faisalabad during 1982 and 1983, in order to confirm the Laboratory findings and also to identify the plant operation problem, if any.

In April 1984 four more plant scale trials were carried out utilizing 100 ton of Siliceous, Kakul rock phosphate with a view to verify the previous tests and to find out the nature of modification required before switching over the production of Single Superphosphate using local rock at SSP plant, Jaranwala.

Again in January, 1987 four more plant trials were conducted utilizing 76 ton (Siliceous) Eastern phosphorite for SSP manufacturing at Lyallpur Chemicals & Fertilizers Ltd., Faisalabad.

Summary of the plant scale trials for SSP manufacture conducted on individual ore bodies & their blend ith Jordan rock (1982-84).

	Ore Body	Processing of rock at Plant	Grade of SSP achieved	Remarks
1.	Kakul 28.9% P_2O_5 (Siliceous)	Satisfactory processing at Plant	SSP of Grade-II (16% water soluble P_2O_5 produced.	ORE body can be utilized for SSP manufacture
2.	Eastern Lagarban 30.6 P_2O_5 (Siliceous)	Satisfactory processing at Plant	SSP of Grade-II (16% W.S. P_2O_5) produced	Ore body can be utilized for SSP manufacture.
3.	Batkanala 27.4 % P_2O_5 (dolomitic)	Cannot be processed slurry flows out of Den.	Paste like SSP produced	Ore body cannot be utilized for SSP manufacture
4.	Southern Lagarban (dolomitic)	Cannot be processed slurry flow out of Den	Paste like SSP produced	Ore body cannot be utilized for SSP manufacture.
5.	Composite rock over-all blend of Local ore bodies	Cannot be processed slurry flows out of Den	Paste like SSP produced	Overall blend cannot be utilized for SSP manufacture.

Plant Scale SSP manufacturing Trials for partial utilization of Ore Bodies by blending with Jordan Rock

Batkanala+Jordan rock 1:1 blend	Can be processed	SSP having 12- 13% P2O5 was produced grade poor than Grade-II SSP	Ore body with 1:1 blend can not be utilized for SSP manufacture.
Southern+Jordan rock 1:1 blend	Can be processed	Poor P2O5 contents even lower than SSP of Grade-II (16% W.S. P2O5) produced.	Ore body with 1:1 blend can not be utilized for SSP manufacture.
Laboratory scale Trial only			
Batkanala+Jordan rock 1:3 blend	Satisfactory processing Ex-den cutable	SSP of Grade-II was produced	Ore body <u>can be utilized</u> by blending with Jordan rock.
Southern+Jordan rock 1:3 blend	Satisfactory processing Ex-den cutable	SSP of Grade II was produced	Ore body <u>can be utilized</u> by blending with Jordan rock.
Lagarban Composite rock + Jordan rock 1:1 blend	Satisfactory processing Ex-den cutable	SSP of Grade-II was produced	Composite rock <u>can be utilized</u> by blending with Jordan rock.

CONCLUSION

- Siliceous deposits Kakul & Eastern ore bodies can safely be used for SSP manufacture (Based on above findings SSP plant was proposed which is exclusively utilizing Kakul rock for SSP manufacture at Haripur.

- Lot of problems were faced in laboratory and during plant scale trials for the manufacture of SSP utilizing dolomitic reserves. So the utilization of these dolomitic ore bodies remained problematic.

- 1:1 blend of dolomitic reserves with Jordan rock could not be processed due to very poor grade of SSP produced.

- Dolomitic can be utilized for SSP manufacture having 16% water soluble P2O5 by blending it with Jordan rock in 1:3 ratio.

- Overall composite lagarban rock can also be utilized for SSP manufacture by blending it with Jordan rock in 1:1 ratio.

- The above studies provided useful data regarding the behaviour and performance of dolomitic rock blend which could be extended for dolomitic reserves at Hazara Phosphate Fertilizers Ltd. Haripur when Kakul reserves would be exhausted.

Processing & Utilization of indigenous phosphate reserves for Phosphoric acid manufacture

In order to assess the suitability of indigenous phosphate ore bodies Laboratory scale and Pilot Plant scale trials were extensively taken up from July, 1986 at FR&DI. Number of continuously running bench scale and Pilot plant trial have been completed so far.

In 1983-1986 prior to the establishment of FR&DI, few pilot plant trials were also carried out by SIAPE at Tunisia, using our different indigenous reserves.

All the trials for the evaluation of local ore bodies were carried out at 100 Kg P2O5/day capacity pilot plant (SIAPE Dihydrate process) installed at Haripur. For each test run Pilot plant was operated continuously round the clock for two to three months duration.

Results of the Pilot plant trials using represented ore bodies supplied by Sarhad Development Authority are summarized below.

Summary of Pilot Plant trials carried out for assessing the suitability of local ore bodies for Phosphoric acid manufacture.

No. of Pilot Plant trials completed	Ore Body	Processing Condition	Remarks
I	Kakul (Siliceous) July-Sept. 1986	Processing & P2O5 recovery satisfactory	Can be utilized for Phosphoric acid manufacture
II	Eastern (Siliceous) Dec., 1986-March, 1986	Processing & P2O5 recovery satisfactory	Can be utilized for Phosphoric acid manufacture
III	Batkanala (Dolomitic) July-Sept. 1987	Problematic processing poor P2O5 recovery	Cannot be utilized for Phosphoric acid manufacture.
IV	Southern (Dolomitic) Nov., 1987-Jan., 1988	Problematic processing poor P2O5 recovery	Cannot be utilized for Phosphoric acid manufacture
V	Composite (Mixed) Lagarban April-June, 1988	Less problematic poor P2O5 recovery	Cannot be utilized for Phosphoric acid manufacture.
VI	Blend of Composite with Jordan rock 1:1 ratio Dec.-March 1989	Processing & recovery satisfactory encouraging results	Can be utilized for Phosphoric acid manufacture

Result & Discussions

a) Although problem of reduced filteration rate (50% less than standard) and chocking of pipe lines in filteration section due to excessive sludge formation was faced at the pilot plant, yet phoshporic acid of 26 28 P2O5 concentration could be manufactured by utilizing indigenous silice us reserved (Kakul and Eastern phosphorite)

b) Quality of acid is also comparatively better, having low impurities and can be concentrated upto 50% P2O5 for further processing to TSP, MAP & DAP.

c) Very dilute phosphoric acid could be manufactured using dolomitic reserves. Higher concentration of product acid could not be achieved due to very high viscosity of slurry in the reactor upto 500 CP as compared to 150-200 CP for Siliceous reserves.

d) Due to high viscosity of the slurry found by using dolomitic reserves, filteration rates were very low (50% less than that of Siliceous reserves) and moreover P2O5 losses in Phosphogypsum were increasee to abvoe 1%, which ultimately resulted in low P2O5 recovery.

e) Moreover at higher viscosity (500 CP) slurry pump stopped working and transfer of slurry from reactor to over head became difficult in case of dolomitic reserves.

f) Quality of the product acid of dolomitic reserves was very poor due to excessive impurities and the acid become paste like at 36-38% P2O5 concentration, hence its further processing for TSP, MAP & DAP was not possible.

g) After the completion of above pilot plant trials no erosion on any part (such as impellar, agitators) was noticed. Any how this problem of erosion is expected during the regular operation of plant.

CONCLUSION

1. Siliceous Phosphorites Lakut & Batkanala can be utilized for phosphoric acid manufacture. Product acid being better quality can be used for TSP, MAP, & DAP manufacture.

2. Dolomitic phosphorite Batkanala & Southern cannot be utilized for Phosphoric acid manufacture, product acid being very impure which upon concentration becomes paste like at 36% P2O5. Therefore, cannot be further processed for TSP, MAP & DAP.

3. Composite(mixed Lagarban rock), though the quality of rock is better, it could be processed for phosphoric acid manufacture but still the quality of acid is impure as compared to Siliceous rock acid.

4. Encouraging results were achieved with 1:1 blend of Composite & Jordan rock, quality of product acid achieved was better, which can be easily processed for TSP, MAP & DAP.

5. As the total recoverable reserves 7.4 million tonnes are not sufficient for a reasonable fertilizer plant, this test run encourage the use of Jordan and Composite Lagarban 1:1 blend for the production of Phosphoric acid.

Bench scale studies for the manufacture of TSP, MAP & DAP

To assess the suitability of product acid of various local ore bodies for the manufacture of phosphatic fertilizers like TSP, MAP & DAP series of bench scale studies were also carried out at FR&DI, Faisalabad since 1986.

Results achieved are summarized below:

	Product acid	Processing for TSP, MAP & DAP	Remarks
I.	Siliceous ore body (Eastern)	- Can be concentrated upto 50% P2O5 - Required grade achieved.	Siliceous ore bodies can be utilized.
II.	Dolomitic ore bodies a) Batkanala b) Southern	Acid upon concentration become paste like at 36% P2O5. Further processing to TSP, MAP & DAP not possible.	Dolomitic ore bodies cannot be utilized.
III.	Composite Lagarban	Sticky TSP achieved	Composite Rock can not be utilized.
IV.	Composite Lagarban + Jordan 1:1 blend	- Can be concentrated upto 50% P2O5. - Satisfactorily processed. Required grade achieved.	1:1 blend can be utilized for manufacture of Phosphatic Fertilizers.

Results & Discussion

a) It was concluded that TSP of 46% Total P2O5 37-39% W.S P2O5 having 96-98% P2O5 availability with good physical state could be manufactured using Eastern rock (Siliceous reserves).

b) MAP (11-55-0) and DAP 14-46-0) could be produced, but the problem of more increased viscosity and reduced fluidity of ammoniated slurry (MAP & DAP) was observed as compared to the ammoniation of Jordan rock acid.

c) As the product acid of dolomitic reserves becomes paste like at 36% P2O5, hence its further processing for TSP, MAP and DAP became impossible.

Utilizing dolomitic rock and dolomitic dilute phosphoric acid (20-28% P2O5) for TSP manufacture by slurry process resulted in very sticky and hygroscopic TSP product.

CONCLUSION

- As result of the various studies performed, it is concluded that inspite of few problems siliceous indigenous phosphorite reserved can be utilized for phosphatic fertilizer manufacture.

- Dolomitic reserves being very problematic for ROM utilization as well as for Beneficiation. Therefore, blending is one of the option for the partial utilization of the dolomitic reserves for SSP, Phosphoric acid, TSP, MAP & DAP manufacture.

DISCUSSIONS OF TECHNOLOGICAL CAPABILTIES OF AFRICAN & ASIAN COUNTRIES

- Techno-Economic Feasibility and Investment Studies.
- Process design, basic and detailed engineering.
- Project Management, Procurement, Construction and Inspection Services.
- Plant start-up, commissioning and operation.
- Market Development, Marketing and Distribution.
- Maintenance, technical back-up and spare parts.
- Capabilities with respect to the Establishment of facilities for research and development, testing, inspectin, quality control etc.
- Manpower training facilities.
- Joint Ventures.
- Barter and counter trade agreements.
- Market Sharing.
- Balancing, Modernization and Rehabilitation of Fertilizer Plants.
- Conclusions and Reco me .lations.

Techno-Economic Feasibility and Investment Studies:

Asian regions possess good capabilities with respect to Techno-Economic Feasibility and Investment Studies. Japan, Korea & India are good example where such facilities are available. Pakistan is also making headway in this direction. These countries therefore are in a good position to render services for feasibility and investment studies.

In order to develop local expertise it is necessary that the feasibility and techno-economic studies be carried out in close association of local counter-parts. Pakistan has recently introduced a law making it mandatory for foreign consultants to associate local consultants. Similar laws could be framed by other developing countries.

Process design, basic and
detailed engineering

Transfer of technical know how cannot be completed without the knowledge of process design, basic and detailed engineering. Proper analysis of limitation of the plant capabilities can be made by thorough analysis only if expertise is available in these areas. India, China and Korea have developed expertise in this area to a large extent. These facilities have been developed with the assistance of industrialized countries such as Japan, Europe and United States and therefore the quality of process design, basic and detailed engineering available in these countries is comparable with those in the developed countries. China and India have made a big head way in developing its own know how because of their planning to create a technological base for the development of industry. Pakistan also has capabilities in this area but its development has been slow. There is a need to develop such facilities in African countries so that they can also achieve self-reliance as far as possible.

In order to achieve self reliance in this area, the developing countries should make it a point to depute their experts in the office of the engineering licensors and engineering contractors where any projects has to be executed.

Project Management, Procurement, Construction and Inspection Servicves

During the past twenty years, large scale fertilizer projects have been established in China, India and Pakistan which has developed these countries in developing capabilities in Fertilizer Project Management such as procurement (under guidelines of various financing agencies) constr :tion and erection, project cost control, p..oduction cost control, scheduled and preventive maintenance, manpower training, optimization etc. It is now within the capability of these countries to utilize their experience in promoting and establishing similar facilities in African countries. The capabilities in the inspection area however, cannot be categorised as of very good standard as those of international companies. This is because of the high cost of the testing equipment and their availability.

Plant start up, commissioning, and operation.

Because of much higher literacy rate in the Asian regions compared to African, the capabilities in this area are of course enormous. Korea, India and Pakistan have taken up various assignments in Gulf, Middle East and Saudi Arabia and it can be said without hesitation that the requirement of African region in this area can be easily met. It will be worth while to state that many African countries are already enjoying the benefits of trained man power from India, Pakistan and Korea.

Indian, Pakistani and Korean expatriates are working in African countries on individual basis as well as through government to government and through assignment from various consultants and contractors.

Market Development, Marketing and Distribution

In this area, Asian region has versatile experience. Most of the Asian countries are capable to provide assistance to the African region to their entire satisfaction.

It should however be borne in mind that market development, marketing and distribution system largely depends upon adequacy of the infrastructural facilities in each country.

Pakistan and India have developed this expertise and are now self dependent. They have attained this expertise from ab-inito; through research and development in marketing, training and field work.

This experience can be exchanged with African region where practically similar conditions exist.

Maintenance, technical
back-up and spare parts

Asian countries have developed good expertise in the maintenance of the plant and equipment, although there is a lack of sense of preventive maintenance. Various parts are used many times after repair simply because of the high cost of the new spare parts.

It is important to develop resources to produce spare parts of general equipment and machinery, locally, in order to avoid high costs and assured availability. Because of the rapid advancement in technology, spare parts of many machines are either not available after some length of time or if available are at very high price.

It is proposed that the developing countri should obtain all the manufacturi g d awings of spare parts at the time of purchase a well as agree with the supplier regarding local fabri ation of spare parts.

There is also a need to undertake standardization as far as practicable within the country level if not at the regional level.

Capabilities with respect to the Establishment of facilities for research and development, testing, inspectin, quality control etc.

Although some Asian countries possess capabilities in this area but they cannot match international standards due to lack of sophisticated equipment and techniques in this area. However, the basic training and orientation for establishment of such facilities can easily be undertaken by the Asian countries.

India and China have highly developed research facilities and are actively engaged in research for the upgrading of low grade phosphatic ores. India can therefore, contribute effectively towards the development of phosphate rock based Fertilizer Projects. More recently, Pakistan has also established a Fertilizer Research & Development Centre for this purpose.

In Africa, Tunisia has developed its own process to utilize low grade phosphate rock for manufacture of phosphoric acid (SIAPE process). They are capable to supply basic engineering through their own design company.

Manpower training facilities

Most of the Asian countries have established many Technical Training Centres or Training Institutes. China, Korea, India and Pakistan could be the countries from where African region countries can get benefit in different fields specially in the phosphatic fertilizer industries. The operating plants could also be a good training ground. Asian countries can provide this service at very low rates compared to the developed countries.

Developing countries can also make use of UNIDO's publication: Guide to Training Opportunities for Industrial Development, 1988 (PI/101 October, 1987).

Joint Ventures

The joint ventures are one of the best ways to use each others capabilities. Many African region countries possess phosphate rock raw material which would be the potential source for setting up of phosphatic fertilizer plants in the Asian region. Middle income developing countries of the African and Asian regions can also make investments into low income countries. Countries deficient in the raw materials can set up plants where relevant raw material is available and arrange agreements to market their production in the consuming countries.

India has taken up steps to set up joint venture plants in Gulf and Middle East in order to cater for their own market demands.

Technical co-operation between Afro Asian countries is also beneficial for the solution of each other's problems which can be achieved by exchange of personnel, holding of joint technical seminars and meetings.

Needless to say that without the assistance of developed countries and international financial institutions, many joint ventures cannot be materialized.

Barter and contner trade agreements

Many developed countries have made barter and counter trade agreements with the developing countries. There is need to undertake proper research so that each country can identify how they can utilize each others raw materials, resources and capabilities to the maximum. Following materials are suggested to promote counter trade among Afro-Asian region:

- Setting up of joint commission by each country within Afro Asian region.

- Setting up of Afro Asian Chamber of Commerce and Industry.

- Utilization of international bodies like UNDP (United Nations Development Programme), TCDC (Technical Cooperation among Developing Countries), OIC (Organization of Islamic Countries etc.).

- Setting up of an organization to promote the cooperation for the development of phosphatic fertilizer in Afro Asian region.

- Liberal aid and cheap credit facilities by developed countries with transfer of know-how.

Market Sharing

India is reportedly setting up plants in the gas rich countries (where cheap gas is available as raw material) and making necessary arrangements to share the market for India's consumption at international competitive prices. Similarly many industrially developed countries are making investments and making necessary agreements to lift the production for their own consumption or consumption of other markets in order to remain competitive in the international market. Since fertilizer consumption in the African countries is limited, world scale plants in these regions could be set up for their marketing in Asian countries where its demand is rising.

Balancing, Modernization and
Rehabilitation of Fertilizer Plant.

Many developing Asian countries have acquired vast experience of rehabilitation of fertilizer plants as they had to undertake rehabilitation of their own fertilizer plants in order to reduce the cost of production. They are therefore best suited to assist African countries in execution of rehabilitation projects.

It would be kept in view that from 1982 onwards, when no new fertilizer plants were set up, emphasis shifted to balancing, modernization and rehabilitation of the existing fertilizer plants. This was done to reduce the cost of production, through energy conservation, optimization, inventory control and capacity expansion of the fertilizer projects.

Conclusions and Recommendations:

A Committee may be formulated comprising of representatives from African and Asian countries & UNIDO to promote the cause of Afro-Asian Co-operation:

- The Committee should identify joint venture programme between Asian and African countries.

- Raw materials, their use, process development and assistance and co-operation available among various countries should also be identified.

- The Committee may also define the cost of services from Asia and Africa.

UNIDO may undertake the following assignments, if approved:

- A list of reliable consultants/contractors of Asia and Africa needs to be prepared.

- A list of companies which could provide man-power training and management may be developed.

- Measures to promote barter trade among the Afro-Asian countries should be identified.

- A roster of experts for both Asian and African regions need to be developed.

- A detailed study should be conducted under the auspices of UNIDO to identify all areas of co-operation among Afro-Asian countries in the fields of Phosphatic Fertilizers and its raw materials.