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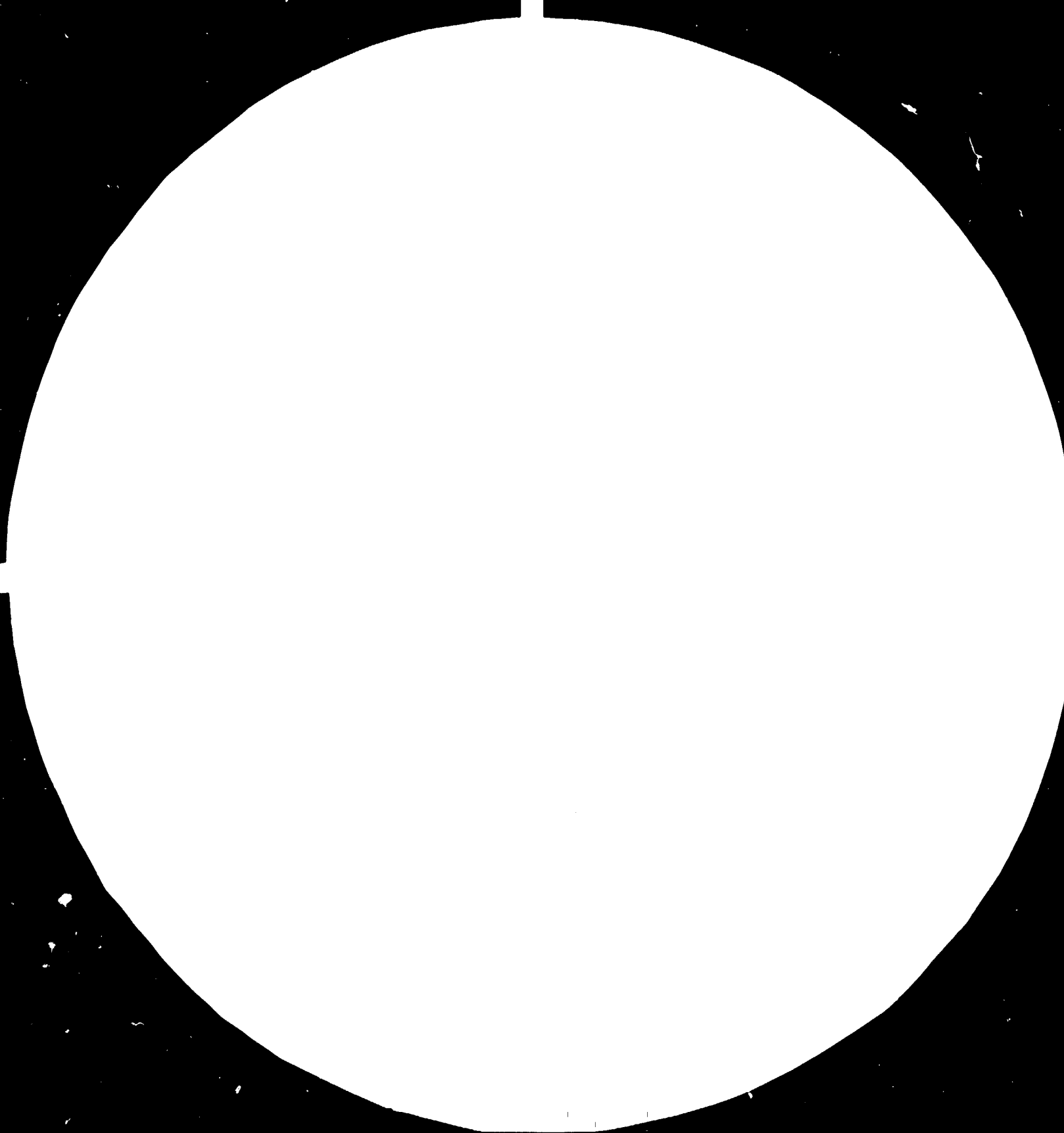

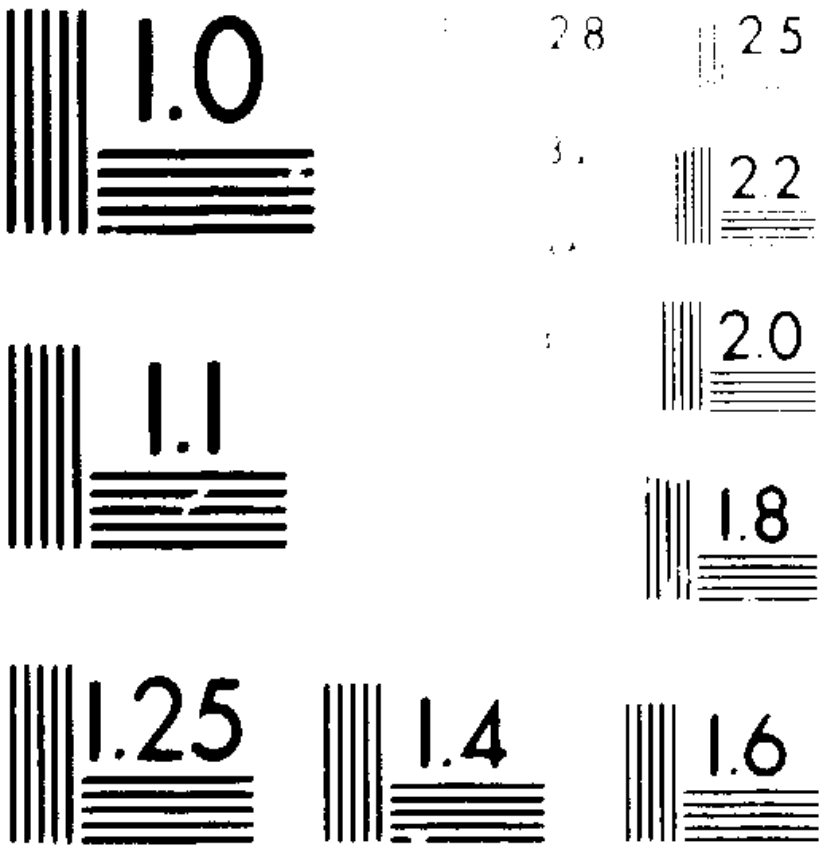

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Bangladesh.

OPERATION AND MANAGEMENT OF FERTILIZER PLANTS

DP/BGD/78/002

BANGLADESH

Terminal report*

Prepared for the Government of the People's Republic of Bangladesh by the United Nations Industrial Development Organization, acting as executing agency for the United Nations Development Programme

Based on the work of Wybe G. Wals, training adviser for phosphate plants

United Nations Industrial Development Organization
Vienna

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EXCHANGE RATE

The monetary unit of The People's Republic of Bangladesh is the Taka, abbreviated as Tk. and pegged to the US Dollar.

1 Taka = 100 Paisa

The exchange rate, as fixed by UNDP Dhaka, is as follows :

October, November	1980	1 US$ = Tk. 15.60
Per 1 December	1980	1 US$ = Tk. 16.00
Per 1 January	1981	1 US$ = Tk. 16.45
Per 1 May	1981	1 US$ = Tk. 17.30
Per 1 June	1981	1 US$ = Tk. 17.55
Per 1 July	1981	1 US$ = Tk. 17.75
Per 1 August	1981	1 US$ = Tk. 18.50
Per 1 November	1981	1 US$ = Tk. 19.20
Per 1 January	1982	1 US$ = Tk. 20.40
Per 1 April	1982	1 US$ = Tk. 21.15
Per 1 July	1982	1 US$ = Tk. 21.86
Per 1 October	1982	1 US$ = Tk. 22.56
Per 1 December	1982	1 US$ = Tk. 23.80
Per 1 April	1983	1 US$ = Tk. 24.20
Per 1 October	1983	1 US$ = Tk. 24.27

ACKNOWLEDGEMENT

The Training Adviser wishes to acknowledge the whole hearted cooperation extended by the management and the staff of TSP Complex Ltd. Chittagong and their valuable assistance in the implementation of the task of the Training Adviser.

Particular mention is made of the help and the contribution of the following officers of TSP Complex Ltd.

Mr. S.A.K.M. Delwar Hussain, General Manager

Mr. Md. Sufian Akhand, Dept. General Manager and former Training Manager

Mr. Mohammad Sadeque, Additional Chief Operation Manager

Mr. Anil Baran Choudhuri, Dy. Chief Chemist.

Thanks are due to the UNIDO representatives at UNDP Headquarters Dhaka, headed by Mr. V.C. Lavides, Senior Industrial Development Field Adviser, and his Programme Officer Mr. A. Muhtala for their support in difficult matters and circumstances.

Thanks are also due to Mr. Walter Holzhausen, Resident Representative of UNDP Dhaka for his personal support of the project and his Senior Administrative Assistant in the Chittagong sub-office Mr. Neville C. Harney, who was very helpful and provided all facilities.

The Training Adviser expresses also his grateful thanks to his back-stopping officer Mr. R. Jumen at UNIDO Headquarters in Vienna, Austria for his contribution in this project.

Last but not least, the Training Adviser expresses also his deep gratitude to those and in particularly Mr. Ronald D. Young of the Tennessee Valley Authority USA and Mr. F. Chaouni of Office Cherifien des Phosphates Morocco, for their valuable information for the benefit of TSP Complex Ltd.

ABSTRACT.

A. Purpose of the project.

The purpose of the project is to up-grade the skills of operating and maintenance personnel, see Annex I, of TSP Complex Ltd., Chittagong to achieve the following objectives :

1. To enable the TSP Complex Ltd. to operate at 85 % of its rated capacity

2. To enable the TSP Complex Ltd. to operate at 100 % of its rated capacity

The main plants at TSP Complex Ltd., see Annex : Site Plan, and their rated capacities are :

SA-I, Sulphuric Acid Plant I, : 100 MTPD of H2SO4 as 100 % H2SO4

SA-II, Sulphuric Acid Plant II, : 400 MTPD of H2SO4 as 100 % H2SO4

PA-I, Phosphoric Acid Plant I, : 32 MTPD of P2O5 as 100 % P2O5

PA-II, Phosphoric Acid Plant II, : 135 MTPD of P2O5 as 100 % P2O5

TSP-I, TSP Plant I, : 100 MTPD of TSP containing 46 % tot. P2O5

TSP-II, TSP Plant II, : 430 MTPD of TSP containing 46 % tot. P2O5

Granulation Plant : 500 MTPD of TSP containing 46 % tot. P2O5

All plants are designed for 20 operating hours per day to meet their rated daily capacity.

The yearly capacities are :

TSP-I : 32,000 MTPY of TSP fertiliser in powder form

TSP-II: 120,000 MTPY of TSP fertiliser in powder form.

Note :

MTPD = Metric Ton Per Day

MTPY = Metric Ton Per Year

TSP = Triple Super Phosphate (fertiliser)

B Impediments and remedial actions

The impediments, which hamper the implementation of the project to achieve the objectives, are mainly the down-times and because of their importance, they have been registered since 1974-1975, see Annex II.

Plans have been made, described as remedial actions, for the purpose to reduce the impediments as much as possible, as follows :

1. Down-time due to mechanical-, and process-troubles.

   Remedial actions : training, advices and on-the-job coaching of personnel of TSP Complex Ltd. and supervising practical assignments, see Annex III, during the training courses.

2. Down-time due to instrument troubles.

   Remedial actions : training, advices and on-the-job coaching of operators of the plants and preparation of an instrumentation training course at Foxboro Singapore for four(4) instrument engineers.

3. Down-time due to power failure and electrical troubles.

   Remedial actions : a main sub-station of 10 MVA (Mega Volt Amperes) has been implemented to transform 33 k Volts into 11 k Volts. Since 10 November 1983 the 33 k Volts have been used.

   The existing supply lines of 11 k Volts have many branch lines, which means that any trouble caused by other consumers has its influence on TSP Complex Ltd.

   When electricity of 33 k Volts will be used, less fluctuation in power supply will be expected, so that electrical troubles may be reduced.

4. Down-time due to corrosion troubles

   Remedial actions : training in corrosion protection and implementation of FIRP, Fertilizer Industries Rehabilitation Project, in which corroded items such as absorbtion and drying towers of SA-II will be completely renewed.

5. Shortage of raw materials.

   Remedial action : implementation of a terminal for imported phosphoric acid, a project which has already been approved by the Dutch Government and will be given as a grant.

   and to use other sources like spent acid of the DDT factory.

6. Non-lifting of TSP products

   Remedial actions : increasing of the bagging section, which project has also been approved by the Dutch Government as a grant.

7. Failure of granulation plant.

Remedial actions : as the granulation plant has not been taken over by TSP Complex Ltd. all repair work has to be done by the Dutch contractor HCG, Hollandse Constructie Groep.

On-the-job coaching is still required as the operation procedures change frequently.

8. Decrease in rated capacities due to high salinity of river water

Remedial actions : implementation of WPA terminal for the import of phosphoric acid.

9. Transfer of expertise of personnel to other factories of BCIC, Bangladesh Chemical Industries Corporation.

Remedial actions : thanks to the General Manager, Mr. S.A.K.M. Dalwar Hussain, of TSP Complex Ltd. the transfer of expertise of personnel has been stopped.

10. Exodus of skilled personnel to the Middle-East

Anybody may go to the Middle-East without any reservation and the remedial actions are as follows :

a. Training for all personnel of TSP Complex Ltd. especially operators.

b. To extend the class room area of the training centre by 31'-4" x 17'-0" = 532.7 sq. ft = 49.5 sq. meters, see Annex IV-A.

c. 3 Officers have been nominated being the permanent staff members of the training centre.

d. Increase of number of teachers by six, see Annex V, who got their training at BMDC, Bangladesh Management Development Centre in Chittagong and were certified on Thursday 6 October 1983 in four modules : Job relations, job instructions, job methods and job safety.

11. Shortage of shovel loaders.

Remedial actions : further investigation required as the results of the two practical assignments on this subject were not sufficient.

12. Production cost of TSP fertilizer

If the production cost remains higher than the sales price, it may be an impediment.

Remedial actions : investigation required as suggested in section "Economical running plants".

13. Not awarding of the fellowships

Remedial actions : to be discussed in meeting with high-top officials.

C. Activities carried out

The activities, abstracted from the chapter concerned, are directed to the impediments, mentioned before, with the aim to achieve the objectives and summarized as follows :

1. Granulation plant

The contractor of the granulation plant started the erection on Wednesday 17 November 1983 and during the period before and after the erection the following activities were conducted by the Training Adviser :

a. preparation of training course in Holland, see Annex VI, for :

3 senior officers and 1 senior branch officer

b.1 theoretical lectures in granulation technology for the personnel of the granulation plant, consisting of :

4 senior branch officers, 4 branch officers.

5 junior officers and 10 operators, based on the prepared manuals, see Annex VII-A, on that subject.

b.2 in-plant training for the personnel of the granulation plant, see Annex VII and the distribution of operating instructions, see Annex VII-A.

b.3 on-the-job coaching during start-up of the granulation plant

c. discussion and advising the management of TSP Complex Ltd. about the expecting bottle necks of the granulation plant and how to solve them.

d. preparation of the instructions for the mechanical performance guarantees and for the process performance guarantees.

2. WPA, Wet-process Phosphoric Acid, terminal

The study of a WPA terminal for the import of phosphoric acid at the premises of TSP Complex Ltd. and consequently the preparation of specifications for invitation to tender in the international press.

3. Practical assignments

The establishment and the supervision by the Training Adviser of the practical assignments, see Annex III, as a part of the production and maintenance productivity course conducted by the ILO, International Labour Organization.

Advising and supporting the desire of more certified teachers for conducting the TWI, Training Within Industries, modular course sponsored by ILO, see Annex V.

4. Fellowship

The preparation of nomination forms and contacting the training centers abroad for:

a. 2 Senior Officers to attend a seminar in phosphate fertilizers in Bangkok, Thailand, sponsored by IFDC, International Fertilizer Development Center, Muscle Shoals, Alabama 35660, USA.

b. 3 Senior Officers to attend a training programme in maintenance and production management at IFDC, USA.

c. 4 Junior Officers to attend a training course in instrumentation at Foxboro Far East Pte. Ltd., Singapore.

D. Outputs produced

The outputs produced in relation to the activities mentioned in item C above, are summarized below as follows :

1. Granulation plant

   a. self-reliance in granulation techniques

   b. trained persons of :

      8 managerial staff

      4 supervisory staff

      4 first-line supervisory staff

      16 operational staff

   c. skilled persons of :

      4 first-line supervisory staff

      16 operational staff

2. WPA -terminal

   Self-reliance in know-how, to enable to build a WPA-terminal by themselves.

3. Practical assignments

   a. self-reliance in tackling problems

   b. 80 trained first line supervisors

   c. 12 certified teachers

   d. reducing of wastages

   e. increasing of productivity.

E. Achievement

The achievement of immediate objective in regard to the higher level objective : to run the plants at 100 % of their rated capacities on year basis, is that the plants, except the granulation plant, have been operated at 100.2 %, see Annex II-B, of their rated capacities during the first half year of the financial year 1982 - 1983 on stream day basis.

F. Utilization of project results

1. Results already utilized

   a. Granulation plant.

      Operating the granulation plant in the night shift, from 22.00 to 06.00 hrs without any supervision of the contractor.

   b. Practical assignments

      Boiler drum level control loop of SA-II plant is now working on automatic system. The team members, who realized this assignment have been rewarded.

   c. extension of class room area of the training centre from 510.7 sq. ft to 1042.7 sq. ft.(completed in June 1983) see Annex IV-A.

   d. the involvement of twelve newly certified teachers in the training courses for first line supervisors, see Annex V.

2. Results likely to be utilized.

   a. granulation plant

      Operating the granulation plant at 100 % of its rated capacity to be able to run the up-stream plants also on 100 % of their rated capacities.

   b. WPA terminal.

      If the WPA terminal has been implemented the results likely to be utilized are :

      - reducing impediments
      - increasing the reaction sections of TSP-I and TSP-II to approx. 150 % of their rated capacities of powder TSP to cover lost of production due to down-time days.

   c. practical assignments.

      Implementation of the practical assignments to reduce mechanical and operation troubles.

G. Findings

The findings gained from the project of the Training Adviser are as follows:

1. Maintenance and operation of the plants are progressing, but the instrument section in its operation and maintenance is still weak.

2. The implementation of a NPA terminal should be executed as soon as possible, so that the impediments could be reduced considerably

   Moreover, during operation of the NPA terminal, the FIRP, Fertilizer Industries Rehabilitation Project, can be executed so that the production of TSP fertilizer can be continued without interruption.

3. The granulation plant is still a pain in the neck with regard to the project objectives, and as the granulation plant still belongs to the contractor we still depending on their planning schedule of repairing, replacement, etc. Their planning is time consuming because decisions have to be approved by the headquarters of the contractor in Holland.

4. The selected fellows to undergo a training in foreign countries have not been awarded, although sufficient funds were available. This rejection has impeded the activities of the UNIDO Training Adviser very much.

5. To achieve the objective to run the plants at 100 % of their rated capacities, actions should be executed as described in chapter IV

6. As long as the production cost is higher than the sales price, actions should be undertaken to run the plants economically for the survival of the TSP Complex Ltd.

H. Conclusions

It may be concluded, that based on the project experience and based on the progress of the individual intended outputs/results, the objective to enable the TSP Complex Ltd. to operate at 100% of its rated capacity on year basis is certainly to be achieved, when all the remedial actions will be executed under the guidance of the UNIDO Training Adviser.

I. Recommendations

To achieve the objective of producing TSP fertilizer at 100 % of the rated capacity on a year basis at the TSP Complex Ltd. Chittagong, it is recommended that :

The assignment of the UNIDO Training Adviser should be extended till the end of December 1985

The activities during the extended period will be based on the following :

1. The granulation plant, the follow-up of personnel in operation and advising modification where required.
2. The completion of the training of operators of the other plants of TSP Complex Ltd.
3. The implementation of the practical assignments
4. Assistance in matters relating to day-to-day operation and management of TSP Complex Ltd.
5. Evaluation of the tenders, supervising of the erection and training of personnel in operation and maintenance of the WPA-terminal.
6. Budget allocations to carry out the specialized training programmes abroad and the follow-up of the trained personnel in their specialization.
7. Implementation of a section in the training centre for instrumentation courses.
8. Implementation of a section in the training centre for preventive- and regular maintenance courses.
9. Training in quality control
10. Advices and guidance in new projects.
11. Advices and guidance in the execution of economical running plants.
12. The implementation of a Research & Development centre.

I. INTRODUCTION OF FINAL REPORT PART II

The final report part II is a continuation of the final report part I on training to up-grade the skills of operating and maintenance personnel of TSP Complex Ltd. North Patenga , Chittagong.

The final reports cover the periods in which the training adviser has been assigned for, which are :

Part -I : from 15 October 1980 through 14 October 1982

Part-II : from 15 October 1982 through 31 December 1983

As part II is a continuation of part I the purpose of the project, the activities and the results are summarized in chapter II, Abstract.

The activities and the actions required during the second period (Part II) of the assignment of the Training Adviser are described in details in chapter III and IV respectively.

The final report part II may also be called as the Terminal Report.

II ACTIVITIES

The activities during the second period of the Training Adviser from 15 October 1982 through 31 December 1983, are based on the reduction of the constraints, which impede the achievement of the objective to run the plants at 100% of their rated capacities on year basis.

The constraints are :

1. Down-time due to mechanical - and process-troubles
2. Down-time due to instrument troubles
3. Down-time due to power failure and electrical troubles
4. Down-time due to corrosion troubles
5. Shortage of raw materials
6. Non-lifting of TSP products
7. Failure of granulation plant
8. Decrease in rated capacities due to high salinity of river water
9. Transfer of expertise of personnel to other factories of BCIC
10. Exodus of skilled personnel to the Middle-East
11. Shortage of shovel loaders
12. Production cost of TSP fertilizer
13. Not awarding of fellowships.

The activities to reduce the constraints in the second period of the Training Adviser are on priority basis with the aim to achieve the immediate objective, which is, to run the plants at 100 % of their rated capacities on stream day basis.

The details of the activities and on which information they were based, are described in the following sections :

A. Granulation plant

B. WPA, Wet-process Phosphoric Acid, terminal

C. Practical assignments.

D. Instrumentation.

E. Fellowships.

A. Granulation Plant.

1. Description

A contract has been made between BCIC, Bangladesh Chemical Industries Corporation, and HCG, Hollandse Constructie Groep, a Dutch construction firm, to build a granulation plant on turn-key basis at TSP Complex Ltd. Chittagong.

The capacity of the granulation plant is 25 MTPH or 500 MTPD or 150,000 MTPY of gramular TSP fertilizer.

The contract price is Dfl, Dutch florins, 8,996,400.00 equal to US$ 3,598,560.00 (1 US$ = Dfl. 2.50) and given as a grant to the Bangladesh Government from the Dutch Government.

Important dates of the contract are as follows :

- Contract date	: 28 Sep. 1981
- Opening of L.C, Letter of Credit, by BCIC	: 3 Oct. 1981
- Date of effect of the contract (Date of contract coming into force)	: 3 Dec. 1981
- Date of completion of erection works	: 2 Feb. 1983
- Date of hand-over to TSP Complex Ltd (after guaranteed test-run)	: 2 Mar. 1983
- Grace period for HCG ends on	: 28 Apr. 1983

But the contract dates mentioned above could not be kept due to first : the boiler, damaged during transportation, which had to be repaired and the installation of a deaerator, which was forgotten in the supply.

Second : due to wrong erection such as : the chute to the crusher was too horizontally, not good support of polypropylene ducts for which reason they cracked, dust collecting lines erected with pockets, scrubber drain pipe line instead of a launder. All these items had to be adjusted.

Third : due to wrong planning, for instance the reparation of the dryer took place from Sunday 22 May 1983 at 16.00 hrs through Monday 12 September 1983 at 16.00 hrs instead during the period of erection of the granulation plant.

Fourth : due to wrong design such as : the traction of the elevator at a bucket speed of 1.2 meters per second is by friction giving slipping problems, capacity of the primary air fan is too small, outlet of secondary air fan in the furnace not correct designed resulting in hot spots, fire bricks of burner chamber supported by a steel cylinder cracked due to different expansion of steel and fire bricks.

From 7 October 1983 through 12 November 1983 the plant had again to stop for repairing the burner chamber, redesign of lifters of the dryer, lining with teflon sheets the inside of the hopper, installing more counter weights on slipping traction wheel of elevator and replacing of the rubber belts of the conveyors which have been worn out.

Altogether it may be said that the granulation plant has been constructed by putting equipment together without the knowledge of manufacturing TSP, Triple Super Phosphate, from powder into granular form.

Also it should be mentioned that electronic instruments are not the right instruments in a TSP factory.

2. Activities on granulation plant

The activities of the UNIDO Training Adviser regarding the granulation plant may be described as follows :

2.1 Training in Holland

The contracter of the granulation plant obliged in his contract to train 4 engineers in a granulation plant in Holland the techniques of granulation.

However the costs of the air tickets should be borne by the Bangladesh Government but they could not supply them at that time.

Therefore the UNIDO Training Adviser contacted the Dutch ambassador in Dhaka, Mr. W. Sinninghe Damsté, and his second secretary, Mr. O.F.N. Elderenbosch, resulting in an allocation from their special fund of Dfl. (Dutch florins) 30,000. = equal to US$ 10,909.09 (1 US$ = Dfl. 2.75) for the air tickets, winter clothes and pocket money for four engineers of TSP Complex Ltd.

The four engineer, who left TSP Complex Ltd. from Friday 26 November 1982 through Tuesday 28 December 1982, for the training in Holland, were:

Mr. S.A.K.M. Delwar Hussain, General Manager

Mr. Md. Sadeque, Additional Chief Operation Manager

Mr. Habir Ahmed Choudhury, Additional Chief Electrical Engineer

Mr. Mong Tla Thoway, Maintenance Superintendant

Before they left for Holland, they received manuals, see Annex VII-A, and guide lines from the UNIDO Training Adviser.

2.2. Training activities at TSP Complex Ltd

After having appointed the personnel for the shifts and the required educational back-ground for the operation of the granulation plant, see Annex VII, by the UNIDO Training Adviser instead of by the contractor, the training has been conducted by the UNIDO Training Adviser as follows :

a. Theoretical lectures.

During one month, 30 days, the number of persons, see Annex VII, who were theoretically trained in process and operation of the granulation plant, according to the Manuals and Operating instructions, see Annex VII-A, was :

Senior branch officers	= 4
Branch officers	= 4
Junior officers	= 5 (1 reserve)
Operators	=16
Total	29

The lectures were also attended by officers of other departments, such as maintenance, sales and instrument, when they had a spare time.

b. In-plant training.

Two months long after the theoretical lectures the 29 employees were trained in the plant how to operate each equipment, sections of the granulation plant and how to communicate with each others.

c. On-the-job coaching.

When the process engineers from DSM, Dutch State Mines, in Holland, the process owner of the granulation plant, were on site from :

Wed, 30 March 1983 through Sat. 4 June 1983 and

Sat, 27 August 1983 through Son. 9 October 1983

they made changes in operation, such as interlocking system, oil heating system, for which reason the UNIDO Training Adviser had to coached the trained personnel of the granulation plant accordingly.

Also when the plant was running for some couple of days the UNIDO Training Adviser had to modify the operation procedures, such as to close the pressure indicators by start-up, because their ranges are too small or how to open/close the valves of the boiler level indicators, which are differently than the standard procedure.

3. Activities in the near future

The instructions for the Mechanical Performance Guarantees as well as the Process Performance Guarantees have been made by a committee supervised by the UNIDO Training Adviser.

When the gurantee test run by the contractor of the granulation plant has been completed, all the collected data will be evaluated by the committee.

After the granulation plant has been handed over to TSP Complex Ltd., modification will be executed such as the interlocking system, raw material feed system, lowering the platform at the granulator chute etc.

B. WPA, Wet-process Phosphoric Acid, terminal

1. Background

Due to the constraints it was decided to install a WPA terminal as soon as possible for the purpose of importing phosphoric acid.

The decision was made for the following reasons:

a. to reduce the total down-time of TSP Complex Ltd., as the production of TSP will not be hampered if the PA-I, PA-II, SA-I and/or SA-II have to be shut-down due to mechanical-, process-, instrument-, electrical-, and/or corrosion troubles.

b. to minimize the down-time due to shortage of raw materials, which are phosphate rock and elemental sulfur. The presence of imported phosphoric acid may reduce the period of the shortage of elemental sulfur.

c. when the plants have to operate at lower capacities due to high salinity of the river water, additional phosphoric acid may be taken from the imported phosphoric acid.

d. when using imported phosphoric acid, overcapacities in powder TSP can be realized as the reaction sections are able to produce about 150 % of their rated capacities. These overcapacities may increase the total production on year basis.

e. the storages of the WPA-terminal may be used to store TSP Complex Ltd. own produced phosphoric acid.

f. disposal problem of gypsum will be less, as by the production of 1 MT of 100 % P_2O_5 about 5 MT of gypsum will be produced, see Annex VIII as by-product in a wet-process phosphoric acid manufacturing plant.

g. to gain knowledge ; as in the near future a plant will be implemented in Bangladesh, to manufacture TSP from phosphoric acid and phosphate rock, and which can be done by personnel of TSP Complex Ltd.

2. Design of WPA terminal

To design the WPA terminal the following activities have been carried out :

a. contacting suppliers of phosphoric acid

In this respect only OCP, Office Cherifien des Phosphates, of Morocco supplied the necessary information, see Annex IX

The cargos of the vessels are also important to know as the maximum cargo which a vessel can directly unload from the TSP Complex Ltd. jetty is 13,000 MT.

b. soil condition

The soil condition of the premises of TSP Complex Ltd. is :

0.460 MT per square foot or 4.95 MT/square meter.

With this information : data, specifications and drawings of the existing storage tanks have been studied in respect of their foundations.

c. location

The location of the WPA terminal included the piping and valves from the jetty to the terminal and from the terminal to the existing storage tanks together with the transfer pumps has been investigated and a preliminary drawing of the location of the WPA terminal has been made, see Annex X

d. tank design

In accordance with the collected information it was decided to install two storage tanks each having a capacity of 6,000 MT of 52% P_2O_5 phosphoric acid instead of one big storage tank also from the point of view of maintenance, safety and extra storage space for own produced phosphoric acid.

A preliminary sketch of one storage tank of the WPA terminal has been made, see Annex X-A.

e. Specification

After having made the preliminary drawing and sketch, specifications for invitation to tender in the international press have been made on the following subjects :

1. Civil work
2. Steel tank
3. Rubber lining
4. Protection layer
5. Transfer pump
6. Agitation mechanism
7. Piping
8. Valves.

C. Practical assignments

1. Description

At TSP Complex Ltd. training courses are going on since Monday 18 October 1982 which are sponsored by :

Bangladesh Chemical Industries Corporation

Bureau of Manpower Employment & Training, Govt. of Bangladesh

International Labour Organisation

International Development Association

Each training course consists of two parts of courses, each having a duration of one month, of the following subjects :

a. Production and Maintenance Productivity course.

In which 6 basic steps : select, record, examine the facts, develop, install and maintain, are taught in details to make b tter use of existing manpower and machines to increase productivity.

b. TWI, Training Within Industries, Modular course

The lectures given are in 4 modules : Job relations, Job instruction, Job methods and Job safety.

The contents of a module can be explained by its definition :

A module is a self contained body of knowledge, complex in itself, but part of a continuing whole.

The training courses are given to first line supervisors, designated at TSP Complex Ltd. as Junior Officers and those operators who fulfil the following definition of supervisor :

A supervisor is anybody in charge of people or anyone who directs the work of others.

The practical assignments are given to the participants after the 2-week theoretical phase of the Production and Maintenance Productivity course.

A group or also called syndicate of about 4 participants are given a specific problem, which exists at TSP Complex Ltd., and which they have to study and to give recommended improvements based on the knowledge they have gained during the training course.

2. UNIDO inputs

The practical assignments are based on problems related to existing maintenance and production process/methods and to good house keeping . A number of practical assignments is shown in Annex III.

The problems are collected by a committee of departmental and sectional heads and supervised by the UNIDO Training Adviser.

During the period of 10 days of the practical assignments discussion are taken place and after completion the results of the practical assignments are evaluated by the UNIDO Training Adviser.

During the TWI Modular course some lectures are also conducted by the UNIDO Training Adviser in Training Plans and Methods and Technical Training at TSP Complex Ltd.

3 Certified trainers are available at TSP Complex Ltd. to conduct the lectures of the Production and Maintenance Productivity course and six are almost certified trainers, see Annex V.

For the TWI Modular course certified trainers have to be borrowed from other enterprises. Since Thursday 6 October 1983 six members of TSP Complex Ltd. became certified trainers, see Annex V

During the discussions with the General Manager of TSP Complex Ltd. and the UNIDO Training Adviser it was agreed to increase the number of certified trainers as soon as possible.

D. Instrumentation

1. Description

Most of the instruments installed at TSP Complex Ltd. are as old as the plants themselves.

TSP-I was erected in 1969

TSp-II was erected in 1971

Parts of the instruments have been replaced already several times but some not, such as the magnetic flow meters as their spare sparts are out of production.

Good functioning of instruments are essential from the point of view of :

Operation, for example, if the temperature of the sulfuric acid in a pipe is higher than indicated, the pipe corrodes.

Production cost and quality control, for example, any quantity of free sulfuric acid above 2 % in 30 % P2O5 phosphoric acid is a waste of money and moreover the acid with too high excess of free H2SO4 produces a very sticky TSP fertilizer which is difficult to handle.

Not good functioning of the instrumentation does not mean that the operation has to be stopped, as human sense-organs can be used, for example :

if the free H2SO4 in phosphoric acid slurry is 4 to 5 % you can smell it due to the Fluorides escaping from the acid.

if the washing of the filtercake in the phosphoric acid plant is not good, you can taste the gypsum that it is acidic.

if the equipment is overloaded, you can feel the vibration.

2. Activities

a. From 24 October 1983 through 13 November 1983 replacement of existing instruments into new ones, included the erection of a complete new operating control panel, has been executed and was supervised by two instrument engineers of Foxboro Far East Pte. Ltd. Singapore.

During the erection, training in calibration of the installed instruments were conducted by the 2 Singapore instrument engineers in present of UNIDO Training Adviser.

b. Training aids have been ordered by UNIDO Headquarters in Vienna, Austria, to make the training in instrumentation easier.

c. 4 Instrument engineers have been nominated to attend a training course in instrumentation at Foxboro, Singapore, who will be the trainers of the courses to be conducted at the Training Centre of TSP Complex Ltd.

E. Fellowships

In close co-operation with the management of TSP Complex Ltd. the employees are selected for a fellowship in foreign countries.

The most suitable candidates are selected, who have the ability to implement the knowledge, gained from a seminar or training course, in TSP Complex Ltd.

The number of candidates to attend a specific programme, see Annex VI, and which fellowships are financed by UNIDO, are as follows :

a. 2 Candidates for a seminar in phosphate fertilisers in Bangkok, Thailand.

b. 3 Candidates for a training programme in maintenance and production management in the fertiliser industry in Muscle Shoals, USA.

c. 4 Candidates for an instrumentation training course in Singapore.

Seminars, to which the training programme, see item b above, also belongs are essential for TSP Complex Ltd. as exchange of experience between the participants are possible, latest developments in technology are discussed, because TSP Complex Ltd. has no research center and contacts can be made for later correspondences regarding problems, etc.

The instrumentation training course is a special course. With the management of Foxboro Far East Pte. Ltd, Singapore, it has been discussed in details, which type of lectures should be given based on the type of instruments installed at TSP Complex Ltd., with the aim that the participants, after being trained, may become the trainers in instrumentation at the training centre of TSP Complex Ltd.

Also the training aids, ordered from Foxboro Far East Pte. Ltd, Singapore, are meant for the instrumentation training courses at TSP Complex Ltd. However the training aids may be used as standard instruments for calibration purposes.

During 24 October 1983 through 13 November 1983 two instrument engineers of Foxboro Far East Pte. Ltd, Singapore, supervised the erection of instrumentation for SA-I, meanwhile giving training in calibration, test procedures, maintenance, etc.

It is therefore that candidates for the training course in Singapore shall fulfil the following two conditions :

1. All participants shall be from TSP Complex Ltd. Chittagong only

2. All participants shall have already required knowledge and experience in instrumentation.

It is a sad story that all the selected candidates of TSP Complex Ltd. have been rejected to undergo the above mentioned three courses, although there were enough funds available to finance the fellowships.

To get all approvals required for a fellowship abroad, the following points should be taken into consideration :

1. Evidence that funds are available, total amount of the funds etc.

2. Evidence that they have been enrolled in the training course.

3. Participants above 50 years of age are not allowed to undergo a training abroad.

   To seminars it is allowed, but official statement that it is a seminar is a must.

4. Participants, who have once in their life time been abroad, are not allowed to go for a second time.

5. Non-officers are not allowed to undergo a training abroad.

IV ACTIONS.

In chapter III, the activities of the Training Adviser have been described to reduce the constraints to achieve the immediate objective to run the plants at 100 % of their rated capacity on stream-day basis.

To achieve the objective, to run the plants at 100 % of their rated capacity on year basis, investments are required, such as the implementation of a WPA terminal in the near future.

Other constraints which impede the achievement of the objective and which require investments or time are described in this chapter.

Also the not economical running plants the Training Adviser considers them as a constraint.

Therefore these impediments have been put in this separate chapter, in which already some actions have been taken or have to be taken in the near future on the following subjects:

A. Water requirements

B. FIRP, Fertiliser Industries Rehabilitation Project

C. Shovel loaders

D. Quality control

E. Economical running plants

F. R & D, Research & Development, centre.

A. Water requirements

1. Water requirements

The water requirements at TSP Complex Ltd. when the plants are running at 100 percent of their nameplate capacities and without any losses or wastages may be divided in two parts, see Annex XI :

a. 273.5 MT/Hr of low saline water

This water should contain max. 220 ppm chloride ions, as the plants at TSP Complex Ltd. are designed for it.

In the low saline water reservoir, the river water is treated with coagulation aids, such as alum and caustic soda (NaOH) to bring down the turbidity from 100° to 5° before further treatment.

The treated water is filtered and is used for the following purposes :

- Make up water, mainly for the irrigation coolers of the SA-I and SA-II plants and the Ball Mill coolers
- Process water, mainly for filter wash of PA-I and PA-II plants, pump gland sealings and granulation of powder TSP
- The make of dem(neralised) water, mainly for the three boilers and the dilution of sulfuric acid, and phosphoric acid of PA-II plant
- The make of sanitary water, mainly for drinking water and toilets.

b. 1325.0 MT/Hr of river water

The river water is pumped to the hold-up tank, see Annex : Site Plan, and from here the river water is further pumped by two pumps, each having a capacity of 950 MT/Hr, mainly to the scrubbers and barometric condensers of the plants in an one through supply and after being used, drained back to the Karnafuli river.

2. Water supply

The water to TSP Complex Ltd. is supplied from three sources :

a. Karnafuli river

b. Deep tube wells

c. WASA, Water And Sewerage Authority, the municipal water-company.

The WASA water can not be supplied in sufficient quantities to meet the requirements by additional supply.

From the 18 deep tube wells installed in the premises of TSP Complex Ltd., only one tube well, with a capacity of 130 MT/Hr, has been able to deliver water of 220 ppm chlorids ions max. The other deep tube wells are not in service due to high salinity and lack of sufficient underground water.

So the main water supply is from the river Karnafuli, which is pumped by two pumps, each having 1300 MT/Hr capacity, to the 1000 m^3 holding tank and to the 3500 m^3 low saline river water reservoir.

The problem with the river water is its salinity and to receive low saline water can only be done during low tide period, which is 2.5 to 3.0 hours per 24 hours a day.

However, in the dry season starting from December through April, even during the low tide period the salinity of the river water remains high. From these 5 months of dry season there exist a period of average 20 days of which the content of chloride ions is 500 to 600 ppm. Still collection of river water is possible during these 5 months as shown in Annex XI-A, but the quantity is not sufficient to run the plants at 100 % of their nameplate capacity and even sometimes during the 20 days the plants are forced to shut-down, due to the shortage of low saline water.

To increase the quantity for the make of demi-water, low saline is mixed with high saline water to a concentration of max. 220 ppm Chloride ions, which is especially done in the dry season from December through April, but still the increased quantity is not sufficient to meet the requirements, for which reason the capacities of the plants have to be reduced accordingly.

The bottle-necks, to collect low saline water especially during the dry season, can be considered of two kinds :

a. The capacity of 3500 m^3 low saline river water reservoir is too small to supply the plants, when they are operating 20 hours per day, with 20 x 273.5 = 5470 m^3, as the water reservoir can only be filled during the low tide period of 2.5 to 3.0 hours a day.

b. The existing water treatment plant, which produces demi-water from low saline water is too small, especially in the dry season.

The design capacity of the water treatment plant is 34.5 MT per operating hour at a maximum Chloride ions of 220 ppm (parts per million) running per day at 19 operating hours and 5 hours for regeneration. The storage tank has a capacity of 240 M Tons.

The capacity of the water treatment plant depends also on the quantities in ppm, of other elements such as Al, Mg, Ca, Na, etc, but the chloride ions are the most important as the stainless steel used as material of construction corrodes faster at higher concentrations of chloride ions.

Required is 46 MTPH demi-water, equal to, see Annex XI :

20 (hrs/day) x 46 (MT/hr) = 920 MTPD

and at a capacity of the water treatment plant of 34.5 MTPH equal to 19 x 34.5 = 655.5 MTPD at 220 ppm Chloride ions, the capacities of the other plants have to be reduced accordingly.

Production cost during the financial year 1982-1983 of 1 MT of demi-water is :

Variable cost Tk 35.85

Fixed cost Tk 13.57

Production cost Tk 49.42 per 1 MT of demi-water.

3. Solution of low saline water shortage

Before to make any solutions to solve the shortage of low saline water, the following has to be evaluated first :

a. The actual requirements as shown in Annex XI

b. The actual capacity of the water treatment plant as shown in Annex XI-B

c. Using other resin with a higher capacity in the treatment plant, than the existing one, having a volume of 7000 liters of resin with a capacity of :

1.5 milliaequivalent of ion per milliliter of resin.

d. If only the increasing of the storage tanks included pumps, piping and valves, is required of the following :

3500 MT low saline water reservoir

240 MT demi-water tank

The solutions, which have already been made to solve the shortage of low saline water, are as follows :

3.1 Increasing of the capacities of the water requirements system.

The increasing of the capacities is in accordance with the proposal of the FIRP, Fertilizer Industries Rehabilitation Project, as follows :

a. Installation of a third pump of 1300 MT/Hr capacity, to pump the river water to the low saline river water reservoir.

b. Installation of a second low saline river water reservoir with a capacity of 4000 m^3, included a flash mixing agitator set, a chemical dosing system and a salinometer.

c. Installation of a pressure type rapid filter unit

d. Installation of a set of equipment for demineralisation and silica removal for a capacity equal to the existing plant, included a 40 MT/Hr degasifier unit.

3.2 Installation of a WPA, Wet-process Phosphoric Acid, terminal.

By installing a WPA terminal the low saline water requirements can be reduced considerably.

The import of phosphoric acid means, that the plants of TSP-II can be out of operation, except the Ball Mill section, which consumes approx. 3 MT/Hr of low saline water. The Ball Mill section has to run to produce ground phosphate rock required for the manufacturing of TSP.

From TSP-I, the Ball Mill section and the SA-I plant have to operate. The Ball Mill section for the same reason as the Ball Mill section of TSP-II and the SA-I plant for the production of 20% oleum for the DDT factory and H_2SO_4 for other factories than TSP Complex Ltd.

To calculate roughly how much low saline water is required, by importing phosphoric acid is as follows :

The low saline water requirements for TSP-II is 166 MT/Hr, see Annex XI. If only the Ball Mill section of TSP-II is in operation, which requires 3 MT/Hr of low saline water, the total quantity of low saline water may be reduced by 166-3 = 163 MT/Hr, when the other plants of TSP-II are not running, to :

273.5 - 163 = 110.5 MT/Hr of low saline water

Then the water treatment plant has only to produce, see Annex XI :

46.0 - 32.0 = 14 MT/Hr of demi-water.

B. FIRP, Fertiliser Industries Rehabilitation Project.

1. Description

To reduce the impediments at TSP Complex Ltd. due to equipment problems a FIRP programme has been made, which should be implemented in January 1985 during four months. This project will be financed by IDA, International Development Association, affiliated with the World Bank.

The items, which will be prchased, are as follows :

1. Pinion, tyres, girth gear and drive mechanism for the dryer of the granulation plant
2. 12 mm Thick mild steel plates, acid proof bricks and mortar to replace the AT, Absorbtion Tower, and the DT, Drying Tower, of SA-II plant.
3. A 35 cubic meter per hour water treatment plant for the make of demi-water, and accessories.
4. Chlorinator unit
5. Cooling tower
6. River water pump and piping
7. Water reservoir
8. Shovel loader, wash water pump and special tools.
9. Alonised tube bundle for 2nd heat exchanger of SA-II plant.
10. Acid transfer pump.

2. Actions

Before the purchase of the above mentioned items it is recommended to evaluate them if they are required or other equipment should be added, for example :

a. A second water treatment plant is not necessary due to the implementation of a WPA, Wet-process Phosphoric Acid, terminal

b. Graphite tubes for the heat exchangers in the phosphoric acid plant should be added, as about 20 % of the tubes are already out of order.

This evaluation is required, not to increase the production cost unnecessarely due to depreciation.

C. Shovel Loaders

1. Background

At TSP Complex Ltd. there are twenty shovel loaders, which are not in good condition, due to the fact that the average life-time is 10 years and spare parts are difficult to obtain.

The shovel loaders are :

2 Made in Britain, trade-mark Case

1 Made in USA, trade-mark Caterpillar

17 Made in Japan, as follows :

2 nos. Komatsu 20 ; 5 nos. TCM SD 23 ;

2 nos. DB 5 ; 3 nos. SD 22 and 5 nos. SD 10

9 Shovel loaders are continuously required for transport of material from stores and curing houses to places for further processing.

Place of working	Nos. of shovel loaders
1. SA-II Plant	1 (one) no.
2. SA-I & Milling -I Plants	1 (one) no.
3. Bagging -II Plant	2 (two) nos.
4. Bagging -I Plant	1 (one) no.
5. Granulation Plant	1 (one) no.
6. Milling II Plant	2 (two) nos.
7. Transfer of spillages from different places and other works.	1 (one) no.
Total	9 (nine) nos.
8. As standby for interrupted production	2 (two) nos.
Total required	11 (eleven) nos.

2. Actions.

The maintenance programme at the moment is difficult to maintain as the personnel are continuously occupied with repairing of the shovel loaders.

Two syndicates have studied already the problems of the above leaders in their practical assignments, see Annex III, to remedy this problem by reducing the total number to 13 and using the remaining as spare parts, but due to various types, the remedial solution can only partly be achieved.

Other actions how to solve the problems with the shovel loaders should be investigated in the following way :

2.1 By means of interconnections.

How to interpret this solution will be given by examples :

a. Granulation plant.

To connect, by means of a belt conveyor, the green TSP belt conveyor with the hopper of the granulation plant, for which reason one shovel loader can be omitted.

The constraint is that when the granulation plant has a shut-down the green TSP manufacturing plant has also to be stopped.

b. Bagging II Plant

To connect the product belt conveyor of the granulation plant with the hopper of the bagging plant by means of a belt conveyor and a product cooler, for which reason two shovel loaders can be omitted.

As the temperature of the TSP product from the granulation plant is about 80°C same can not be bagged directly into the polythene bags, for which reason a product cooler is required.

2.2. By replacement

By replacement of the shovel loaders, which can not be repaired any longer due to high cost, into new ones, the production of TSP can be continued without interruption and the maintenance programme can be maintained.

Standardisation of all shovel loaders used at all the enterprises of BCIC, would be highly recommended.

D. Quality control

1. Description

The quality control of the TSP fertiliser depends mainly on a good process control which means that the instruments should be working perfectly.

Quality control has also a great influence on production cost, for instance if the concentration of P205 in the TSP fertiliser can be controlled as close as possible to the contractual commitment, any excess would be waste of money.

Not only the chemical analysis, but also the physical properties, such as hardness, shape, screen analysis of the TSP fertiliser and even the packing materials and the exact weight of the quantity of bagged TSP fertiliser are important subjects of quality control.

The TSP fertiliser is sold to BADC, Bangladesh Agricultural Development Corporation, and their contractual agreement on quality of TSP fertiliser is as follows :

Total P205 : 46 %

Available P205 : 43 % - 44%P205

Free acid : 3 % P205 maximum

Moisture content : 2-5 % by weight
Net weight of bagged TSP fertiliser : 50 kg ± 100 grams

Jute or woven polypropylene outer bag

Polythylene inner bag

Inner bag sealed/tied with jute string to prevent moisture entering

Outer bag machine stitched to prevent spillage or leakage.

The quality of TSP fertiliser which are imported to Bangladesh from USAID is shown in Annex XII for powder TSP and Annex XII-A for granular TSP fertiliser.

2. Actions

As soon as the granulation plant is in full production and the parameters are known which quality of product may be obtained, manuals and instructions can be made and training courses may be conducted on quality control.

E. Economical running plants

During the financial year from 1 July 1982 through 30 June 1983 the production cost of 1 Metric Ton of TSP is Tk. [illegible] while the sales price to BADC, Bangladesh Agricultural Development Corporation is Tk. 5735.00 per MT, see Annex XIII and Annex XIII-A.

The farmers are buying the same TSP fertiliser at Tk. 3000.- per MT from BADC, which is made possible because of the subsidy of the Government.

The difference between the production cost and the cost price for the farmers may be too big to reduce, but the reduction of the production may be done step-by-step to achieve the following targets :

a. Below Tk. 5735.00 per MT of TSP fertiliser

Being the sales price to BADC.

b. Below Tk. 4680.00 per MT of TSP fertiliser

Being the sales price of US$ 180.00, which is at an exchange rate of 1 US$ = Tk. 26.00, is Tk. 4680.00 per MT of TSP fertilizer.

This price has been taken as the ex-factory price of US$ 180.00 per MT of TSP fertilizer for a consignment of 5000 MT of powder TSP, sold to Nepal in the month of November 1983.

To avoid misunderstandings, this sale of TSP fertiliser to Nepal was only due to an emergency call from the Nepalese Government for help.

For the survival of TSP Complex Ltd. it is essential that the plants are running economically, which means that the production cost is lower than the sales price.

In Annex XIII-A is shown the build-up of the production cost of TSP fertiliser and in the following sub-sections :

1. Good housekeeping
2. Cheaper raw materials
3. Cheaper utilities and packing materials
4. Selling by-products.

the actions which have been taken place and/or will take place to reduce the production cost, are described in brief.

1. Good housekeeping

At the end of the year 1983 eighty (80) first line supervisors of TSP Complex Ltd. have been trained in good housekeeping in close relation to job safety, not to waste any money due to wastages, leakages, accidents, etc.

In the practical assignments, see Annex III mainly related to good housekeeping, the first line supervisors have to study specific problems and have to give a remedial solution to the problems in cooperation with the UNIDO Training Adviser.

2. Cheaper raw materials

The raw materials, which are used to manufacture TSP, Triple Super Phosphate at TSP Complex Ltd. are elemental sulphur and phosphate rock.

The elemental sulfur is imported from Iran, Iraq, Canada or Poland and phosphate rock from Jordan or Morocco.

To reduce the production cost by using other raw materials, the following sources have been taken into considerations :

a. Spent sulfuric acid

Spent sulfuric acid of a strength of about 70 % H_2SO_4, spec. gravity 1.68 at 30°C from the DDT factory are now being used and mixed with the sulfuric acid for the manufacturing of phosphoric acid with good results.

The constraint is, that only one old tank -car is available, which carries 4 MT of 70 % H_2SO_4 per day from the DDT factory located at Barabkunda, a village about 25 miles from TSP Complex Ltd.

b. Import of WPA, Wet-process Phosphoric Acid.

The Cost & Freight cost of WPA from Morocco at the second half of 1983, to the Chittagong harbour, is :

US$ 380.00 per 1 MT of 100 % P_2O_5, which is :

Tk 9,196.00 per 1 MT of 100 % P_2O_5

using the exchange rate of 1 US$ = Tk. 24.20

The production cost of phosphoric acid at TSP Complex Ltd. during 1982-1983, see Annex XIII is :

Tk. 6,628.37 per 1 MT of 50 % P_2O_5 or about

Tk. 13,256.74 per 1MT of 100 % P_2O_5.

This big difference in cost is the reason, why a WPA terminal in the premises of TSP Complex Ltd. will be implemented in the near future and for which the basis study has been completed.

The WPA terminal will be given as a grant from the Dutch Government to the Government of Bangladesh.

c. Phosphogypsum.

To reduce the import of elemental sulfur a phosphogypsum processing plant has been planned to be installed in the near future.

As raw material is used the gypsum, by product of the phosphoric acid plant, and is processed into SO_2, to be used for the H_2SO_4 plant and CaO, which can be used for the cement manufacturing plant.

An evalnation has been made and approved by the World Bank, which likes to finance this project.

3. Cheaper utilities and packing materials

To reduce the costs of utilies and packing materials, actions will be taken on the following :

a. Fuel

Natural gas from the Bangladesh own gas fields will be used instead of oil, which has to be imported into Bangladesh.

Pipelines from the gasfields to various factories in Chittagong are under construction and the net work of pipelines for natural gas on the premises of TSP Complex Ltd. will be executed soonest.

The work to convert oil into natural gas supply to the granulation plant has been awarded already to a contractor.

b. Polythene inner-bags

The TSP product is bagged in 50-kg polythene inner-bags and in the near future a unit will be purchased so that TSP Complex Ltd. may manufacture the inner-bags itself.

The polythene granulars, the raw material for the unit will be imported.

4. Selling of by-products

The by-products, which are sold during the financial years 1981-1982 and 1982-1983 are shown in Annex XIV and Annex XIV-A respectively, are summarized as follows :

By-product	MT sold in 1981-1982	MT sold in 1982-1983
H2SO4 acid	4,468.417	1,888.859
Oleum	700.297	300.181
P2O5 acid	0.783	0.265
Gypsum	13,084.265	17,967.493
Sulfur sludge	-	99.000

Sulfur sludge is the sediments of melted sulfur, collected from the sulfur melter and has been sold to missionaries in the North of Bangladesh to use the sulfur sludge as a kind of fertilizer in paddy-fields.

The intension is to sell more by-products in the future, to compensate the production cost of TSP fertilizer.

Action is recommended to sell ground phosphate rock, to be used as fertilizer, for example, for the rubber plantations.

F. R & D, Research & Development, centre

A research and development centre is recommended to be implemented at TSP Complex Ltd.
It is also recommended that the R & D centre and the training centre are working closely with each other, due to the fact that the training centre has already gained the expertise in develop ing work, not only by training people but also how to let equipment running more effectively. Therefore the R & D centre should have also an executive task to implement the [illegible].

The research should be restricted to test-work in the laboratory and pilot tests in the existing plants, for example the use of spent sulfuric acid from the DDT factory.

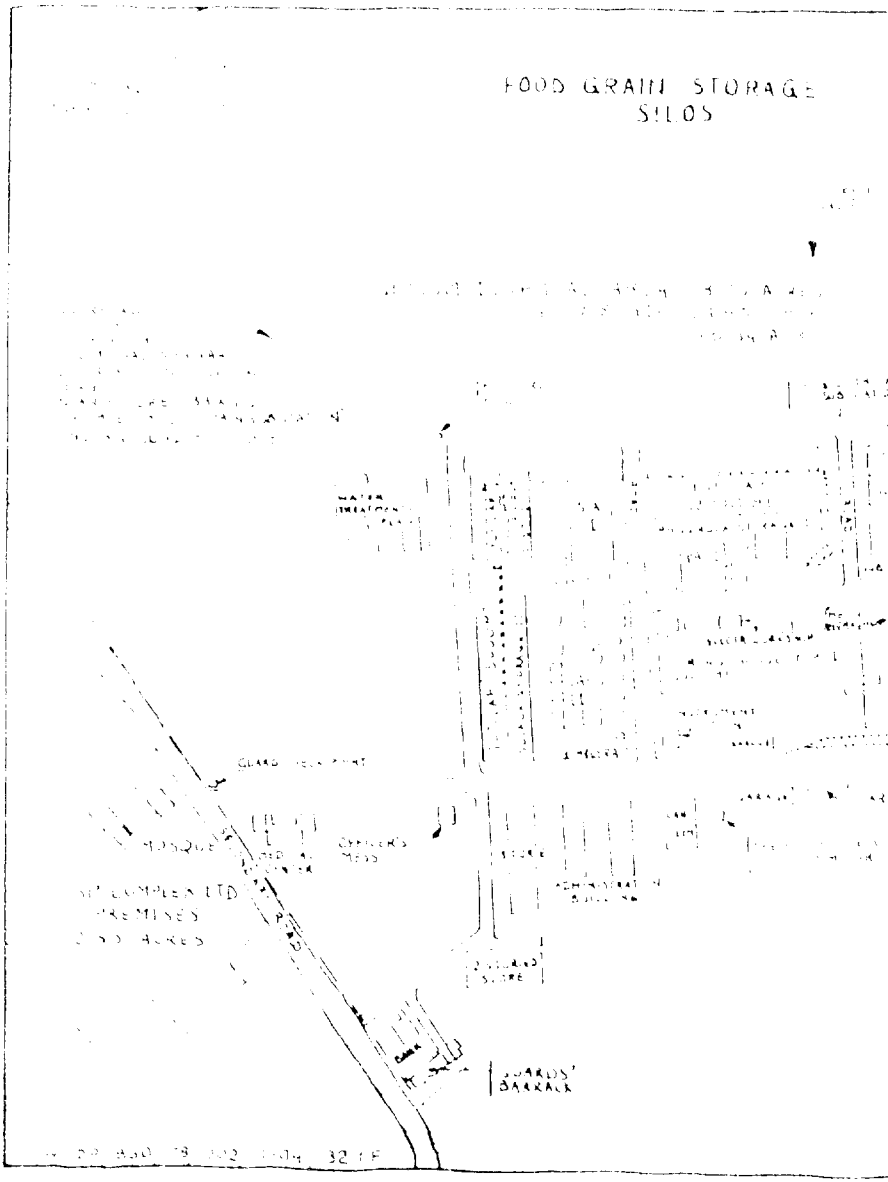
Most important is the development of TSP Complex Ltd, to reduce the constraints, which impede the objective to run the plants at 100 % of their rated capacity on a year basis.

The development of equipment, operation conditions, should be based on :

1. minimizing the import of materials from foreign countries

2. purchasing of locally made equipment, materials, etc.

3. transferring of know-how to the local factories, where the materials are purchased, to get a better product.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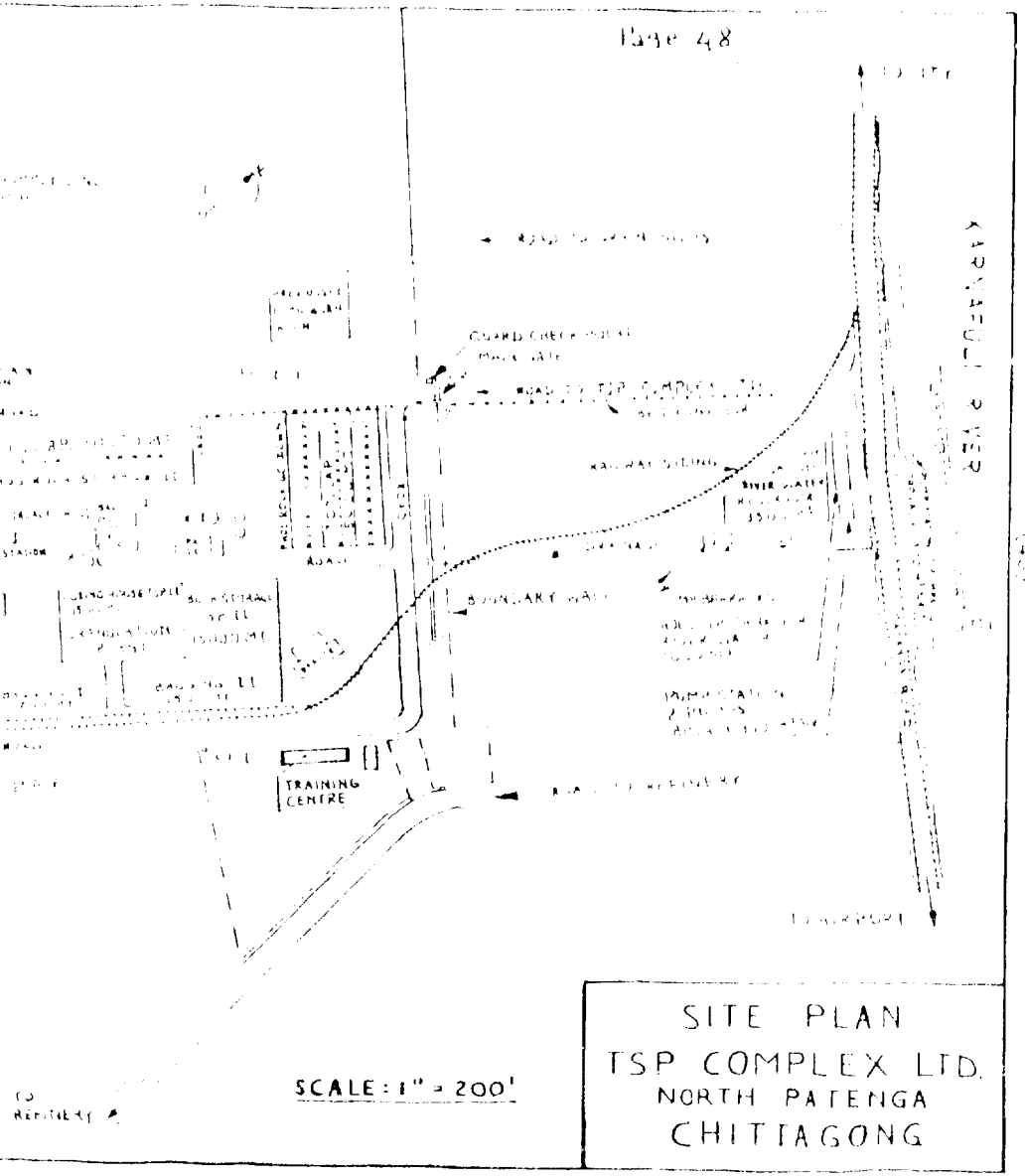


SCALE : 1" = 200'

SITE PLAN
TSP COMPLEX LTD.
NORTH PATENGA
CHITTAGONG

ANNEX I
EMPLOYEES AT TSP COMPLEX LTD. CHITTAGONG
AS PER 1 OCTOBER 1983

Department	Workers	Staff	Officers				Total
			Junior	Mid - Level		Senior	
			First Line Superv. SAC, SACHE	Branch O. AC, ACHE	Sr. Branch O. C, CHE	GM, ACON, DCC,	
Administration	3	149	6	2	-	4	164
Accounts dept.	-	25	5	3	2	2	37
Commercial dept.	-	35	2	5	1	1	44
Production	269	11	39	7	6	3	335
Mech. maintenance	182	9	10	12	1	2	216
Electr. dept.	52	-	4	1	1	1	59
Instr. dept.	25	-	3	1	-	-	29
Fert. Impt. Rehab. Proj.	-	-	-	-	2	1	3
Civil dept.	12	4	-	2	-	-	18
Mat. Planning & Invent. Control	6	32	4	3	3	1	49
Quality Control & Manp. Planning and Training	23	8	9	3	1	2	46
Total	572	273	82	39	17	17	1000

NOTE : Workers for operations are : Helper, SSO (Semi Skilled Operator), SO(Skilled Operator), HSO (High Skilled Operator) and MO (Master Operator)

Workers are working under Factory Act, of which the payscale is fixed by IWWC, Industrial Wages Commission

Officers and Staff are working under the Shops and Establishment Act and are paid according to the guide lines of NPC, National Payscale Commission.

ANNEX II
DOWN - TIME ANALYSIS
OF TSP - I & TSP - II
AT
TSP COMPLEX LTD. CHITTAGONG

YEAR	Mechanical Days	Electrical Days	Instrument Days	Corro-sion Days	Process trouble -s Days	Power Failure Days	Shortage raw-mat. Days	Non-lifting Days	Others Days	Total loss Days
974-75	36	25	-	-	40	21	-	-	-	122
1975-76	52	6	5	-	23	26	61	-	-	173
1976-77	54	4	15	-	15	24	108	-	-	220
1977-78	146	4	6	5	28	20	35	-	-	234
1978-79	102	3	3	-	5	12	79	10	-	214
1979-80	40	8	5	-	5	4	75	15	47	199
1980-81	37	3	3	5	7	11	70	48	(Over hauling)	184
1981-82	32	4	1	65	6	6	74	51	-	239
1982-83	36	3	7	13	12	5	22	-	129 (Gran. plant)	227

ANNEX II-A

TREND OF PRODUCTION OF GREEN TSP AT
TSP COMPLEX LTD. CHITTAGONG

Year	Installed capacity (MT)	Target (MT)	Production (MT)	% of Achievemnets on Installed Capacity	% of Achievemnets on Target
1974-75	96,000 *1	50,000	32,851	34.22	65.70
1975-76	1,20,000	60.000	40,690	33.91	67.82
1976-77	1,29,000 *2	50,000	38,018	29.47	76.04
1977-78	1,52,000	40,000	41,274	27.15	103.99
1978-79	1,52,000	60,000	62,287	40.98	103.81
1979-80	1,52,000	80,000	71,118	46.79	88.90
1980-81	1,52,000	75,000	71,461	47.01	95.28
1981-82	1,52,000	85,000	57,888	38.08	68.10
1982-83	1,52,000	75,000	68,602	45.13	91.47

Note : * 1 = TSP-II having installed capacity of 1,20,000 MT per year was commissioned in Sept. 1974 and as such, installed capacity on the available days stands at 96,000 MT for the year 1974-75.

*2 = TSP-I with an annual capacity of 32,000 MT was commissioned in April, 1977 and as such installed capacity of TSP Complex (TSP-I & II) on the available days stands at 1.29,000 MT for the year 1976-77.

Year is financial year, starting from 1st. of July to 1st. of July of following year.

MT = Metric Ton

ANNEX II - B

TREND OF PRODUCTION OF GREEN TSP AT TSP COMPLEX LTD. CHITTAGONG

Year	Installed Capacity (MT) per day	Total Available Days	Total Stream Days	Total Down-time Days	Production (MT) per Year	Production (MT) per Stream day	% Production Capacity on Stream day
1974-75	400	303	181	122	32851	181	45.25
1975-76	400	366	193	173	40690	211	52.75
1976-77	430	365	145	220	38018	262	60.93
1977-78	500	365	131	234	41274	315	63.00
1978-79	500	365	151	214	62287	412	82.40
1979-80	500	366	167	199	71118	426	85.20
1980-81	500	365	181	184	71461	395	79.00
1981-82	500	365	126	239	57888	459	91.80
1982-83 1st Half	500	184	93	91	46633	501	100.20
1982-83 2nd - Half	500	181	45	136	21969	488	97.60
1982-83	500	365	138	227	68602	497	99.40

Note : See Note Annex II-A

ANNEX III
BATCH WISE PRACTICAL ASSIGNMENTS
OF PRODUCTION & MAINTENANCE PRODUCTIVITY COURSES

IST BATCH.

1. Bucket Elevator in Bagging-I failing frequently. How can this be reduce or eliminated ?

2. Sulphur Melter of SA-II plant consumes much steam, How can the consumption be reduced ?

3. Melting coils of sulphur melter (SA-II) Plant are corroded at excessive rate. How can this be reduced ?

4. Dust loss through Milling-I [illegible] emission is excessive. How can this be reduced ?

5. Shovel loaders become out of order frequently. How can this be reduced ?

6. Dust loss through Milling-II [illegible] emission is excessive. How can this be reduced ?

2ND BATCH

7. To study the causes of idle hours of different types of shovel loaders. What are the measures to be adopted for continuous service ?

8. Life time of acid flowing through three pipe lines from acid pump tank in SA-I plant is very short. Causes of short life is to be found out and suggest remedial measures.

9. To study the abnormal behaviour of merric scales and rectification of the same in rock unloading belt conveyor from jetty.

10. To study the existing sanitary and cooling water consumption rates. What measures are to be adopted to reduce the consumption ?

11. Boiler drum level control loop of SA-II plant does not work in auto system. How can this be put into auto system ?

12. Life time of the 2nd heat exchange tubes of SA-II plant is considerably short. Errossion/Corrossion occurs inside the tubes. What are the causes behind and suggest remedial measures ?

3RD BATCH.

13. Steam produced in SA-II Plant is not sufficient for works in full load. How can the consumption of steam be balanced with the produced quantity of steam

14. Quantitative losses of P_2O_5 from materials handling items to bagging section and suggestion for remedial measure excluding PA-II plant.

15. Excessive dust observed in Bagging-II Plant during bagging operation which should be reduced.

16. To study the P_2O_5 losses in PA-II Plant and to suggest the remedial measures.

17. Dust loss through Milling-II Plant stack is excessive. How can this be reduced.

18. At the junction of flow of materials from one conveyor to another, huge quantity falls on the ground. How can this spillage of materials be eleminated.

4TH BATCH

19. Identify the major causes of frequent failure of SA-I Plant and qualify the reasons in percentage in order of importance and suggest remedial measure.

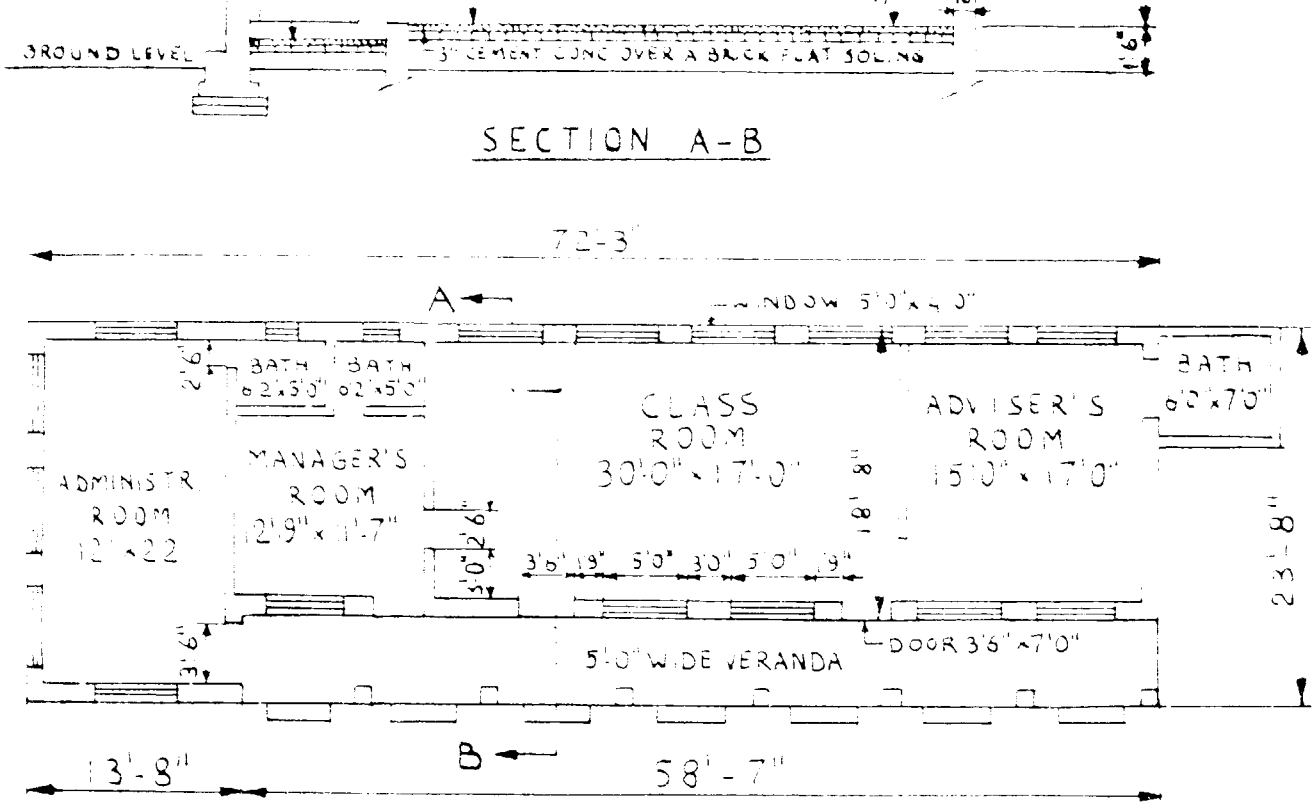
20. To study the problems of measuring feeds & products of PA-I Plant & suggest remedial measures.

21. To study the causes of frequent leakages of rubber lined vessels of PA-II Plant.

22. To analyse downtime of SA-II Plant for the period July'82 to June'83 and suggest effective method of maintenance in the line with preventive maintenance & breakdown maintenance.

23. To study the reasons for bending the agitators shaft of PA-II Plant premixer and suggest remedial measures.

24. To study the causes of frequent failure of acid circulation pump of SA-I Plant and suggest remedial measures.



TRAINING CENTER
AT
TSP FERTILIZER COMPLEX LTD CHITTAGONG
WGW BGD/78/002/11-04/32.11.F

ANNEX XII
QUALITY OF
TRIPLE SUPERPHOSPHATE, RUN-OF-PILE
AS PER USA - AID STANDARDS

SPECIFICATION

Phosphorus content

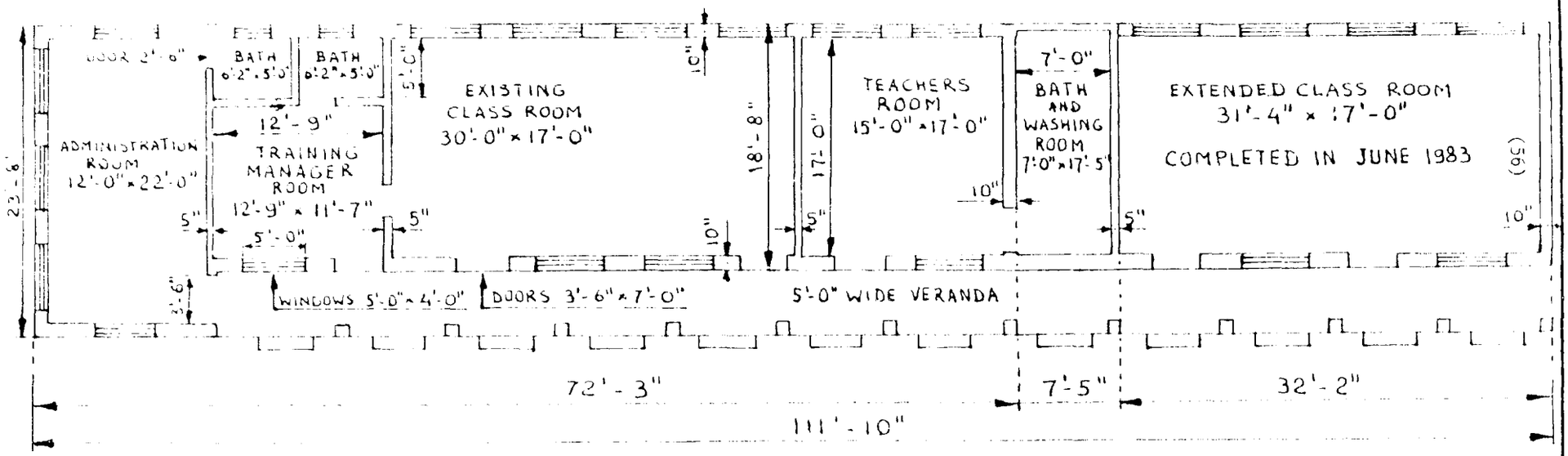
Available	44.0 to 46.0%[a] as P_2O_5, min.
Water soluble	75% of guaranteed P_2O_5, min.
Free acid content	5.5% as H_3PO_4, maximum
Moisture content	6.0% as H_2O, maximum
Screen size (Tyler)	90.0% - 6 mesh, minimum
Physical condition	Free - flowing

ANALYTICAL METHODS FOR QUALITY CONTROL

Chemical	A.O.A.C. Number, or as noted
Total	2.026c, 2.027 and 2.028b
Citrate Insoluble	2.036, 2.037 and 2.038
Available	2.040
Water soluble	2.032 and 2.033
Free acid	No. 11 Section XI (AFPC[b])
Moisture	2.013

Physical	T. F. I. Method Number
Sieve analysis	500

a. Offers should be made on guaranteed minimum and it will be evaluated



0 2 4 6 8 FT.
SCALE

FOR ELEVATION SEE ANNEX IV

ANNEX IV-A

PLAN OF TRAINING CENTRE
AT
TSP COMPLEX LTD.
CHITTAGONG

WGW DP BGD /8/002/11-04/32.1.F

ANNEX V
ILO TRAINING COURSES OF TSP PERSONNEL
TO BECOME ILO TRAINER

A. IN PRODUCTION AND MAINTENANCE PRODUCTIVITY

A.1 4-Week Train The Trainers Course at the Technical Training Institute of Karnaphuli Paper and Rayon Complex, Chandraghona.

From 2-8-1982 through 28-8-1982

1. Mr. Syed Asadullah, DCC (Deputy Chief Chemist)
2. Mr. N.K. Sen, C(Chemist)
3. Mr. A.U.M. Zubair, AME (Asstt. Mech. Engineer)

A.2. 2-Week Training Of Trainers Course at the Bangladesh Management and Development Centre, Chittagong

From 15-12-1982 through 30-12-1982

1. Mrs. Sufia Amirul, AC (Asstt. Chemist)
2. Mr. A. Axis Khan, AC (")
3. Mr. Mukul Kanti Choudhury, AME (Asstt. Mech. Engineer)

A.3. 3-Week Train The Trainers (TTT) Course at the Training Centre of TSP Complex Ltd. Chittagong

divided as follows :

a. 1-Week Test-Course for Participation in the TTT-Course.
From 16-4-1983 through 21-4-1983.

b. 2-Week TTT Course
From 24-9-1983 through 6-10-1983.

1. Mrs. Sufia Amirul , AC (Asstt. Chemist)
stood first in overall coarse
2. Mr. Shamsul Huda, AC
3. Mr. Mizanur Rahman, AME
4. Mr. Zahirul Alam, SAC (Sub-Asstt. Chemist)
5. Mr Faslul Hoque, SAIE (Sub-Asstt. Instr. Engineer)
6. Mr. Ziauddin Ahmed, SAME (Sub-Asstt. Mech Engineer)

B. IN TRAINING WITHIN INDUSTRIES MODULES :
JOB RELATIONS, JOB INSTRUCTION, JOP METHODS
AND JOB SAFETY

B.1 8-Week Enterprice Training Manager Course at Bangladesh Management and Development Centre, Chittagong.
From 14-8-1983 through 6-10-1983

1. Mr. Fashiur Rahman, DCC (Deputy Chief Chemist)
   Stood first in Job Relations

2. Mr. A. Samad Nakib, C (Chemist)
   Stood second in Overall and first in Job Instruction.

3. Mr. A. Jalil, C

4. Mr. A. Aziz Khan, AC (Asstt. Chemist) Stood first in Overall and first in Job Methods.

5. Mr. A. Motaleb, AC

6. Mr. Mahboob H. Choudhury, AC

Participants of various enterprises have attended this training course :

6 from TSP Complex Ltd

1 from Karnaphuli Rayon Complex

2 from General Electric Manufacturing Company

1 from Paksiy Paper Mill

1 from Khulna News Print Mill

1 from Fenchuganj Urea Factory

1 from Ghorasal Urea Factory

1 from Chattak Cement Factory

2 from Sylhet Pulp and Paper Mill

1 from Chemical Complex Chittagong.

ANNEX VI
FELLOWSHIP
FOR TSP COMPLEX LTD. EMPLOYEES

A. Through Dutch aid.

For training of granulation techniques in Holland, from 26 November 1982 through 28 December 1982

Mr. S.A.K.M. Delwar Hussain, General Manager

Mr. Md. Sadeque, Additional Chief Operation Manager

Mr. Kabir Ahmed Choudhury, Additional Chief Electrical Engineer

Mr. Mong Hla Thoway, Maintenance Superintendant

Result : They received a good training

B. Through UNIDO funds

a. For a seminar course on phosphate fertilisers in Bangkok, Thailand, from 10 July 1983 through 16 July 1983, sponsored by IFDC, International Fertiliser Development Center.

Mr. S.A.K.M. Delwar Hussain, General Manager

Mr. Anil Baran Choudhuri, DCC, Deputy Chief Chemist

Result : Not approved by the Government

b. For a maintenance and production management training progras at IFDC, International Fertiliser Development Center, Muscle Shoals, USA, from 3 October 1983 through 21 October 1983.

Mr. Anil Baran Choudhuri, DCC

Mr. Syed Nowsher Alam, DCC

Mr. A.T.M. Khaled, DCC

Result : Not approved by the Government

c. For a 5-week instrumentation training course at Foxboro Far East Pte. Ltd. Singapore, starting date 28 November 1983.

Mr. Bashir Mohammad, SAIE, Sub Assistant Instrument Engineer

Mr. Ali Asgar, HST, High Skilled Technician

Mr. Jaker Ahmed, HST, "

Mr. Serajul Islam, AF, Analytical Foreman

Result : Not approved by the Government.

ANNEX VII
SHIFT PERSONNEL
OF GRANULATION PLANT OF
TSP COMPLEX LTD. CHITTAGONG.

There are 4 shifts for the granulation plant and they are controlled, included the shifts of the other plants of TSP Complex Ltd. by :

a. One Overall Shift-in-Charge, designation Chemist

b. One Assistant Shift-in-Charge, designation Asstt. Chemist

One shift of the granulation plant consists of the following eight members.

a. One Section-in-Charge, designation SAC(Sub-Asstt. Chemist) or Foreman

b. One Granulator Operator

c. One Furnace/Dryer Operator

d. One Dedusting System Operator

e. One Boiler Operator

f. Two Payloader Drivers

g. One Helper for taking samples

Furthermore there are 10 contract labours per shift for the following purposes :

2 Labours for handling green TSP and product TSP

2 Labours for screen decks.

2 Labours for granulator

4 Labours for green TSP hopper.

Designation of the Operators are HSO, SO or SSA (High Skilled-, Skilled-or Semi Skilled -Operators)

During initial start-up each of the four Operators is assisted by an Operator of the next shift, who is therefore working on overtime, and moreover the training of the operators is more effective.

ANNEX VII-A
MANUALS AND OPERATING INSTRUCTIONS
FOR GRANULATION PLANT OF
TSP COMPLEX LTD. CHITTAGONG

The following manuals and operating instructions for the granulation plant of TSP Complex Ltd, which have been distributed to the personnel of the granulation plant, are :

A. Manuals

1. Granulation plant, process description

2. Annex to granulation plant, process calculation

3. Equipment specification list

Co-writer of these manuals is Mr. Md. Sadeque, Additional Chief Operation Manager

B. Operating Instructions

1. Dryer operation

2. Granulator operation

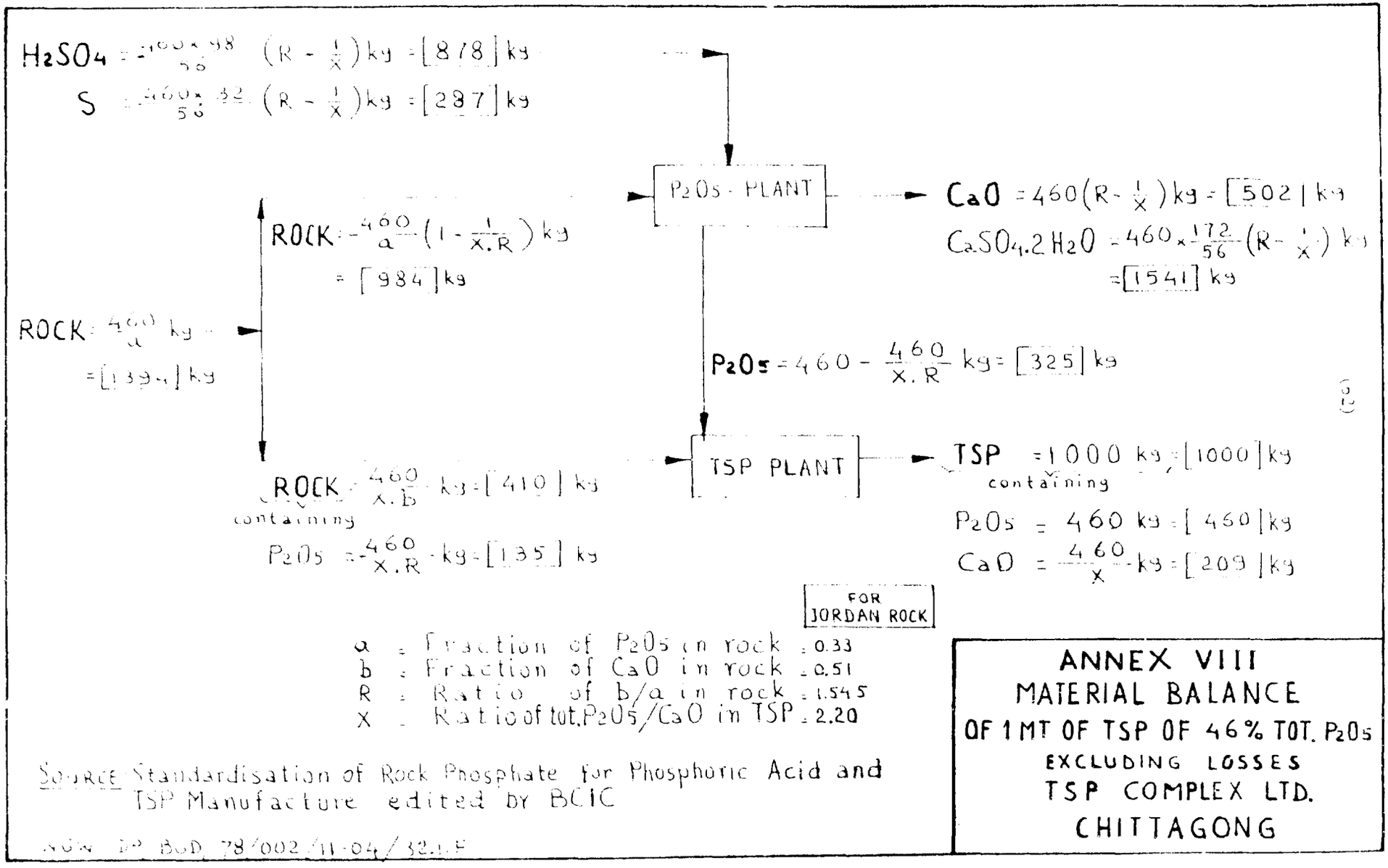
3. Dry section operation

4. Boiler operation

5. Operation of pressure system of boiler

6. Operation of temp. indicator controllers of furnace

7. Deaerator operation.



Source: Standardisation of Rock Phosphate for Phosphoric Acid and TSP Manufacture edited by BCIC

NOW DP BoD 78/002/11-04/32.1.F

ANNEX VIII
MATERIAL BALANCE
OF 1 MT OF TSP OF 46% TOT. P_2O_5
EXCLUDING LOSSES
TSP COMPLEX LTD.
CHITTAGONG

ANNEX IX
INFORMATION FROM OCP OF MOROCCO
(OFFICE CHERIFIEN DES PHOSPHATES)

1. Analysis of phosphoric acid or orthophosphoric acid

Percentage of P205 : 52 % minimum

Free acid as S04 : 3.5 %

Solids content : 0.50 % maximum

Specific gravity : 1.650

2. Vessels to transport phosphoric acid

OCP has its own fleet which transport the phosphoric acid all over the world. The transportation capacities of phosphoric acid solution of the fleet are as follows :

2 vessels of 6,000 MT of solution each

2 vessels of 10,000 MT of solution each

4 vessels of 20,000 MT of solution each

2 vessels of 22,000 MT of solution each

All of the vessels are proceeding with a speed of about 14 knots per hour.

All vessels are in the possession of pumps to unload the phosphoric acid at a rate of 200 cubic meters per hour against a head of 60 meters liquid column.

3. Material of construction

Tanks to be made of MSRL, Mild Steel Rubber Lined, and piping made of epoxy resin stratified with glass fiber.

The pumps on board of the vessels are made of UB6, HV9 or CASTEROUME

The agitator of the tank should be of the top entering type.

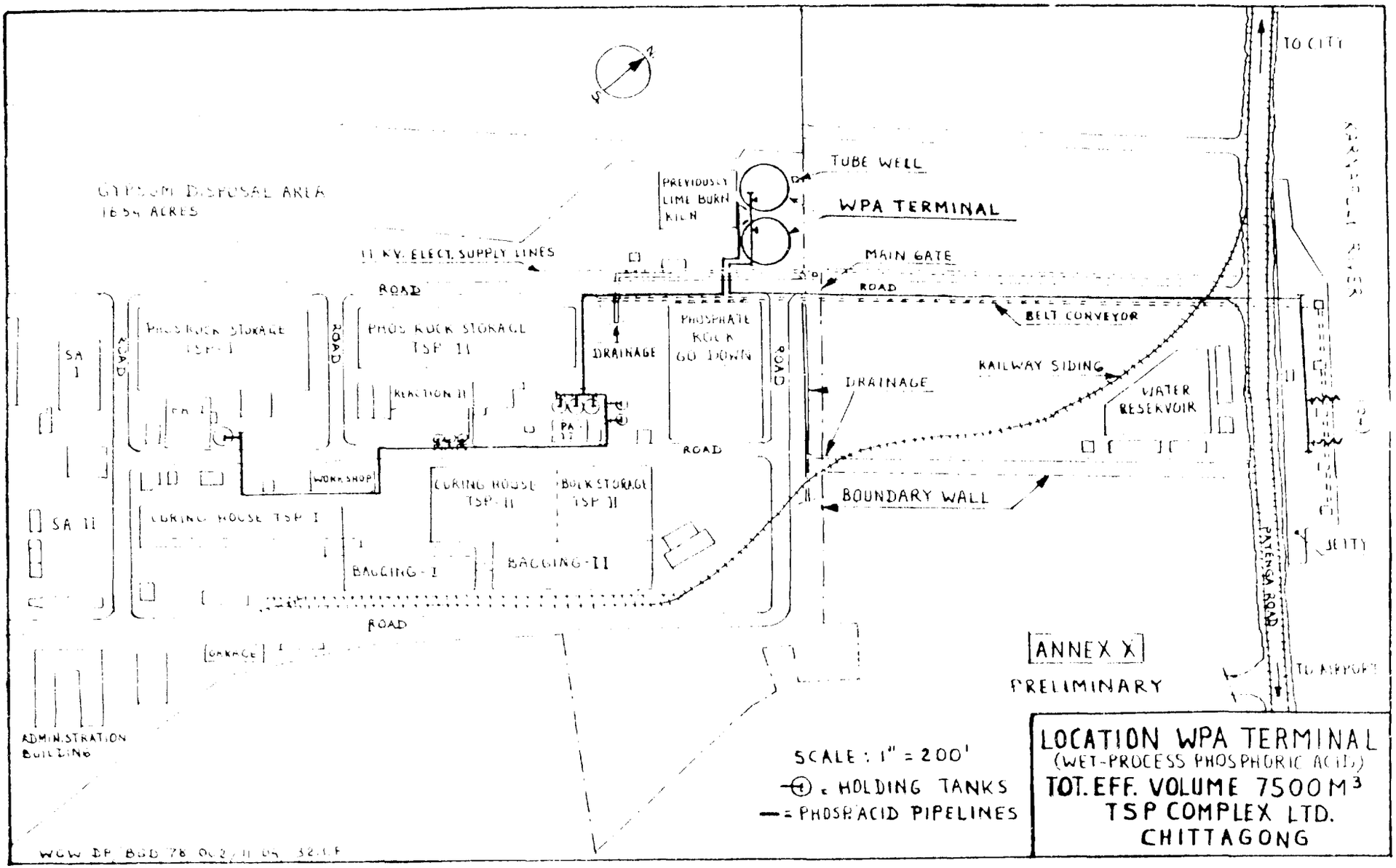
4. Price

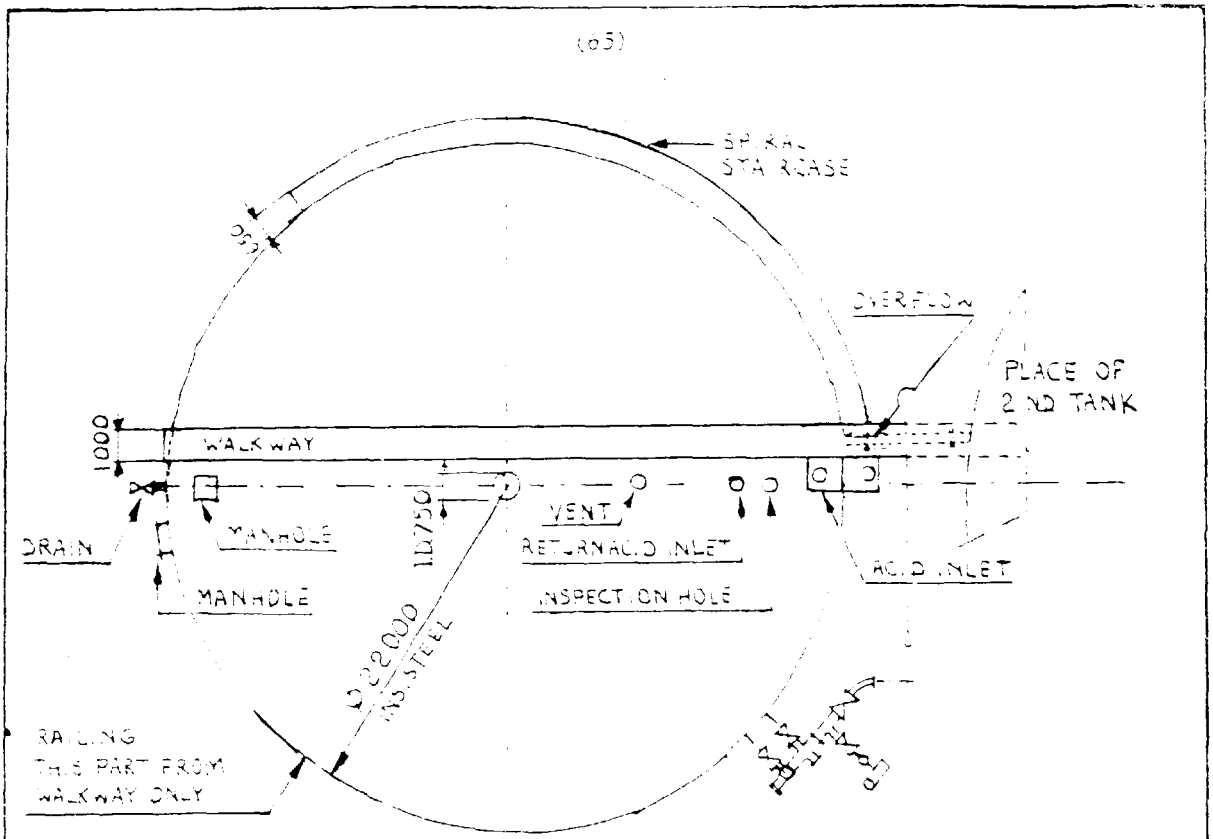
In the second half of the year 1983 the C and F Chittagong harbour price is :

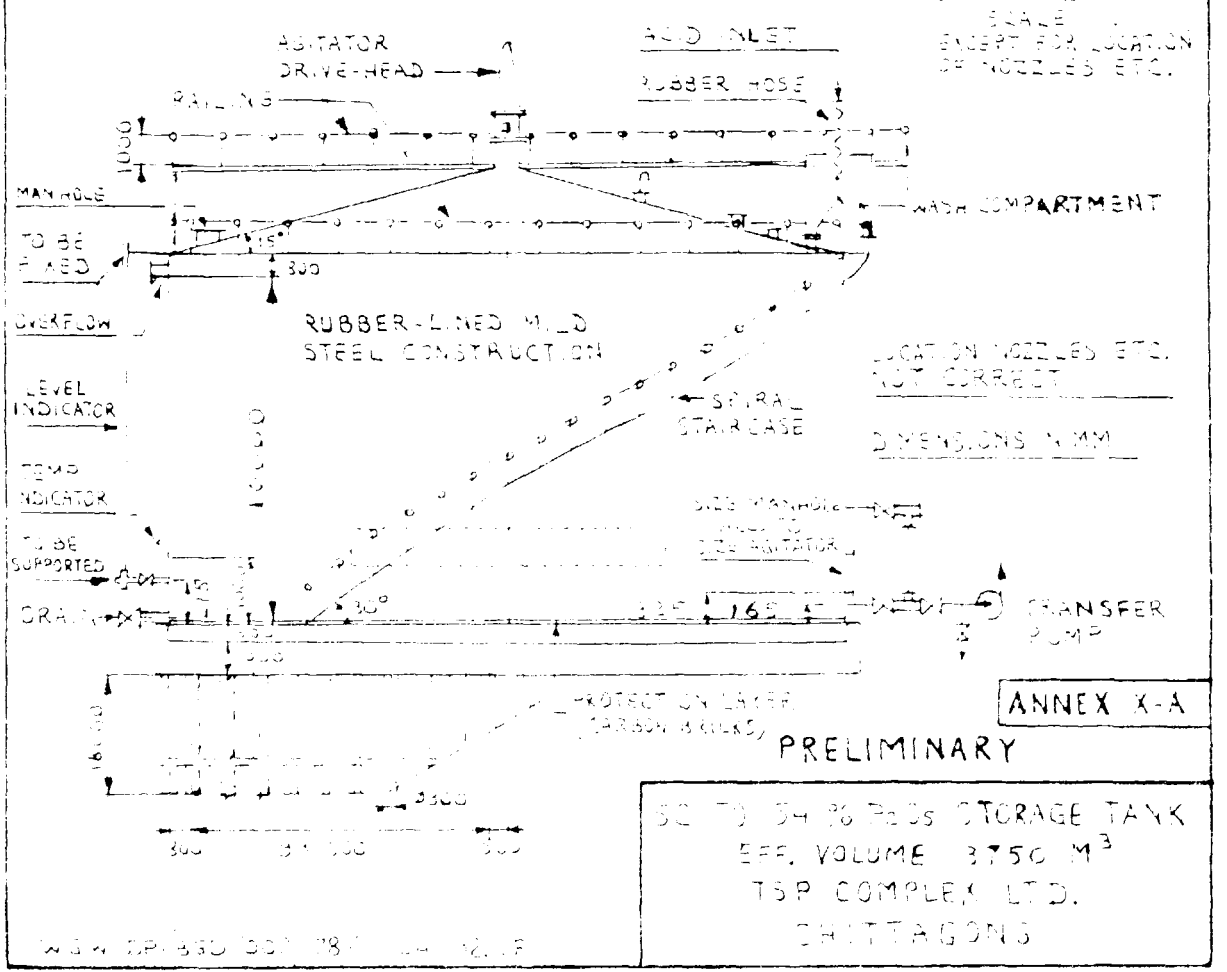
US$ 370 to 380 per MT of 100 % P205

for shipments of 10,000 MT and of 20,000 MT of phosphoric acid solution, containing 52 % P205 min.

Insurance cost should be considered for total loss coverage being 1 % of Cost and Freight value.


GYPSUM DISPOSAL AREA
16.54 ACRES
11 KV. ELECT. SUPPLY LINES
ROAD
PREVIOUSLY LIME BURN KILN
TUBE WELL
WPA TERMINAL
MAIN GATE
ROAD
BELT CONVEYOR
TO CITY
PHOS ROCK STORAGE TSP I
PHOS ROCK STORAGE TSP II
DRAINAGE
PHOSPHATE ROCK GO DOWN
ROAD
RAILWAY SIDING
DRAINAGE
WATER RESERVOIR
SA I
REACTION II
PA
ROAD
WORKSHOP
CURING HOUSE TSP II
BULK STORAGE TSP II
BOUNDARY WALL
SA II
CURING HOUSE TSP I
BAGGING-I
BAGGING-II
JETTY
ROAD
PATENGA ROAD
GARAGE
TO AIRPORT
ADMINISTRATION BUILDING
ANNEX X
PRELIMINARY
SCALE : 1" = 200'
⊕ = HOLDING TANKS
— = PHOSPHACID PIPELINES
LOCATION WPA TERMINAL
(WET-PROCESS PHOSPHORIC ACID)
TOT. EFF. VOLUME 7500 M3
TSP COMPLEX LTD.
CHITTAGONG
WCW DF BGD 78 002/11 09 32.1 F


SPIRAL STAIRCASE
OVERFLOW
PLACE OF 2 ND TANK
1000
WALKWAY
DRAIN
MANHOLE
MANHOLE
VENT
RETURN ACID INLET
INSPECTION HOLE
ACID INLET
RAILING THIS PART FROM WALKWAY ONLY
LOCATION NOZZLES ETC. CORRECT
0 1 2 3 4 METERS



ANNEX X-A

PRELIMINARY

98 % H2SO4 STORAGE TANK
EFF. VOLUME 3750 M3
TSP COMPLEX LTD.
CHITTAGONG

ANNEX XI
WATER REQUIREMENTS
TSP COMPLEX LTD.

	TSP I MT/Hr	TSP II MT/Hr	Granulation Plant MT/Hr	Total TSP Complex Ltd MT/Hr
Make up water	20.0	81.0	-	101.0
Process Water	21.0	53.0	2.5	76.5
Demi(neralized) water	8.0	32.0	6.0	46.0
Sanitary water	-	-	-	50.0
Sub-total low saline water	49.0	166.0	8.5	273.5
River water used as wash water or scrubber water	330.0	970.0	25.0	1325.0
Total	379.0	1136.0	33.5	1598.5

Note : The plants of TSP Complex Ltd. are designed for low saline water of max. 220 ppm chloride ions and this water is used as make up -, process-, demi-and sanitary water.

ANNEX XI -A
ANALYSIS OF KARNAPHULI RIVER WATER
COLLECTED IN WATER RESERVOIR

Month	Cloridas as Cl ppm			Turbidity degree			Total Hardness ppm		
	Max.	Min.	Avg.	Max.	Min.	Avg	Max.	Min.	Avg
Nov. 1981	392	8	163	31	8	14	230	59	123
Dec. 1981	508	52	205	33	10	16	210	60	122
Jan. 1982	747	130	245	85	10	21	160	100	135
Feb. 1982	598	22	285	24	11	15	225	80	153
Mar. 1982	433	70	181	22	9	15	186	56	112
Apr. 1982	418	37	151	24	8	16	191	59	102
May 1982	400	17	109	21	8	13	138	66	95
Jun. 1982	360	17	130	26	9	14	193	49	104
Jul. 1982	35	8	17	26	9	16	123	44	68
Aug. 1982	17	6	11	63	9	21	89	55	73
Sep. 1982	28	5	10	75	12	28	105	48	64
Oct. 1982	175	19	58	50	19	31	114	62	86

NOTE : RIVER WATER COLLECTED DURING LOW TIDE OF 2.5 TO 3.0 HRS PER 24 HRS A DAY.

(67)

ANNEX XI - B
DEMI - WATER PRODUCTION
DURING 1982 -1983

Month	Quantity in cubic meters	Average Chloride ions in ppm
July 1982	11,366	16.1
August 1982	15,869	9.0
September 1982	13,170	15.9
October 1982	16,044	65.7
November 1982	7,210	103.9
December 1982	2,856	90.5
January 1983	1,760	83.6
February 1983	3,080	86.9
March 1983	2,371	162.7
April 1983	11,935	68.1
May 1983	11,236	25.1
June 1983	10,323	29.9

The quantities are not representative for the capacity of the water treatment plant, due to :

1. All plants were not running during, the erection of the granulation plant from half November 1982 through March 1983.

2. During April, May and June 1983 the plants were not running at 100 % of their rated opeacities and plants had their shut-downs.

The capacity of the water treatment plant at 220 ppm chloride ions is :

34.5 (MT/hr) x 19 (hrs/day) x 30 (days/month) = 19,665 MT/month.

ANNEX XII
QUALITY OF
TRIPLE SUPERPHOSPHATE, RUN-OF-PILE
AS PER USA - AID STANDARDS

SPECIFICATION

Phosphorus content

Available	44.0 to 46.0%[a] as P_2O_5, min.
Water soluble	75% of guaranteed P_2O_5, min.
Free acid content	5.5% as H_3PO_4, maximum
Moisture content	6.0% as H_2O, maximum
Screen size (Tyler)	90.0% - 6 mesh, minimum
Physical condition	Free - flowing

ANALYTICAL METHODS FOR QUALITY CONTROL

Chemical	A.O.A.C. Number, or as noted
Total	2.026c, 2.027 and 2.028b
Citrate insoluble	2.036, 2.037 and 2.038
Available	2.040
Water soluble	2.032 and 2.033
Free acid	No. 11 Section XI (AFPC[b])
Moisture	2.013

Physical	T. F. I. Method Number
Sieve analysis	500

a. Offers should be made on guaranteed minimum and it will be evaluated on basis of lowest landed cost of P_2O_5.

b. AFPC - Association of Florida Phosphate Chemists, 5th Edition (1970)

Source : Document SBM - 77-3 dated August 12, 1977 :
"AID Fertiliser Specifications"

ANNEX XII - A
QUALITY OF
TRIPLE SUPERPHOSPHATE , GRANULAR GRADE
AS PER USA - AID STANDARDS

SPECIFICATION

Phosphorus content

Available	44.0 to 46.0%[a] as P_2O_5, minimum
Water soluble	75% of guaranteed P_2O_5, minimum
Free acid content	5.0% as H_3PO_4, maximum
Moisture content	4.0% as H_2O, maximum
Screen size (Tyler)	90.0% - 6 + 16 mesh, minimum
	100% - 4 mesh; 98% + 28 mesh
Physical condition	Granular, free-flowing

ANALYTICAL METHODS FOR QUALITY CONTROL

Chemical	A.O.A.C. Number, or as noted
Phosphorus	
Total	2.026c, 2.027 and 2.028b
Citrate insoluble	2.036, 2.037 and 2.038
Available	2.040
Water soluble	2.032 and 2.033
Free acid	No. 11 Section XI (AFPC[b])
Moisture	2.013

Physical	T.F.I. Method Number
Sieve analysis	500

a. Offers should be made on guaranteed minimum and it will be evaluated on basis of lowest landed cost of P_2O_5.

b. AFPC - Association of Florida Phosphate Chemists, 5th Edition (1970)

Source : Document SBM - 77-3 dated August 12, 1977 :
"AID Fertilizer Specifications"

ANNEX XIII
PRODUCTION COST 1982-1983
PRODUCTION : 68602 MT

	Elements of Cost	1981-82 Cost per ton in Tk.	1982-83 Cost per ton in Taka.
	ACTUAL COST OF SULPHURIC ACID :		
A.	Variable Cost.	1739.98	1431.01
B.	Fixed Cost	235.99	545.37
	Total Cost (A + B) :	1975.97	1976.38
	ACTUAL COST OF PHOSPHORIC ACID (50% P205)		
A.	Variable Cost	5816.00	5226.66
B.	Fixed Cost	332.70	1401.71
	Total Cost (A + B) :	6148.70	6628.37
	ACTUAL COST OF TSP FERTILIZER :		
A.	Variable Cost	5346.99	4892.33
B.	Fixed Cost	693.88	1273.81
	Total Cost (A + B) :	6040.87	6166.14

Sales Price

1 US$ = Rk 24. =

ANNEX XIII - A

PRODUCTION COST OF TSP PER 1982-1983

PRODUCTION : 68,602.94 MT.

Elements of Costs	Unit	Usage Ratio	Qnty Consumed	Price per Unit	Total Cost in Taka	Cost per MT in Tk.
A. Variable Cost						
1. Rock phosphate	MT	0.48	33,046.94	1650.21	5,45,34,567.67	794.93
2. Damaged TSP	MT	-	950	1677.73	15,93,847.39	23.23
3. Power	kWh	39.66	27,20,713	1.65	42,44,312.28	61.87
4. Furnace oil	gallon	0.45	31,023	24.12	7,35,100.40	10.71
5. Spares & Accessories	-	-	-	-	45,27,352.52	65.99
6. Consumable stores (lubricants, paint)	-	-	-	-	4,63,984.90	6.76
7. Other Factory Over-head	-	-	-	-	16,15,363.99	23.55
8. Hessian bags	No.	20.11	13,79,736	9.43	1,30,12,796.48	189.68
9. Polythene bags	No.	20.11	13,79,936	5.13	70,75,418.56	103.14
10. Jute twine	lb.	0.03	2,039.50	5.97	12,169.13	0.18
11. Sewing thread	lb.	0.04	2,984.50	33.21	99, 116. 99	1.44
12. Sewing needle	lb.	0.003	181	11.43	2,069.60	0.03
Sub - total					8,79,16,099.91	1281.52
13. Reallocated cost of 50% P205 acid	MT	0.69	47,393.08	5226.66	24,77,12,219.51	3610.81
Tot. Variable Cost					33,56,28,319.42	4892.33
B. Fixed Cost						
1. Overhead cost	-	-	-	-	2,09,54,726.40	305.45
2. Reallocated cost of 50% P205 acid	MT	0.69	47,393.98	1401.71	6,64,32,615.71	968.36
Total Fixed Cost					8,73,87 ,342.11	1273.81
Total Prod. Cost					42,30,15,661.53	6166.14

Sales price : Tk 5735.00

1 US$ = Tk 24.00

ANNEX XIV
SALES STATEMENT OF PRODUCTS
FOR 1981-1982 OF
TSP COMPLEX LTD.

Month	Bagged TSP in MT	Sulf. Acid in Lbs	Phosph. Acid in Lbs	Oleum in Lbs	Gypsum in MT
July' 81	4,581.50	5,30,004	-	-	21.000
Aug' 81	7,140.50	2,97,040	-	-	1,622.500
Sept' 81	4,609.00	3,68,135	-	-	335.250
Oct' 81	10,060.25	6,31,085	-	-	1,758.500
Nov' 81	6,721.50	4,91,350	-	-	1,176.000
Dec' 81	11,388.50	5,87.194	-	2,20,400	155.500
Jan' 82	2,344.00	4,33,700	-	-	1,289.500
Feb' 82	4,332.50	8,79,292	-	4,40,800	1,203.000
Mar' 82	5,070.25	5,84,218	-	4,40,800	2,856.015
Apr' 82	2,972.75	36,22,682	-	600	1,161.000
May' 82	4,364.50	4,38,413	1,682	4,40,800	1,246.000
June'82	2,733.50	7,86.413	44	55	260.000
Total		98,48,392	1,726	15,43,455	
Total in MT	66,318.75	4,468.417	0.7831	700.297	13,084.265

1 MT = 2204 lbs.

ANNEX XIV - A
SALES STATEMENT OF PRODUCTS
FOR 1982 - 1983 OF
TSP COMPLEX LTD.

MONTH	Bagged TSP in MT	Sulf. Acid in Lbs	Oleum in Lbs	Phosph. Acid in Lbs	Gypsum in MT	Sulfur Sludge in MT.
Jul'82	629.814	3,03,800	-	-	165.000	25.0
Aug'82	4,374.936	6,11,660	-	-	1,408.000	-
Sep'82	8,227.500	3,05,980	-	-	966.000	-
Oct'82	11,898.00	1,36,800	4,40,800	-	623.000	-
Nov'82	9,740.000	3,60,697	400	-	944.000	-
Dec'82	9,472.500	1,51,641	4,40,800	-	1,959.850	-
Jan'83	4,264.500	4,51,815	-	-	1,397.833	-
Feb'83	4,726.500	5,17,759	-	-	733.000	-
Mar'83	2,141.500	3,55,775	4,40,800	-	2,449.510	-
Apr'83	490.000	3,25,600	-	583	4,793.80	-
May'83	4,852.000	3,14,812	4,40,800	-	401.000	74.0
Jun'83	6,503.750	3,26,707	-	-	2,126.50	-
Total		41,63,046	17,63,600	583		
Total in MT	67,321.000	1,888.859	800.181	0.2645	17,967.493	99.0
Sales Price Tk/MT	5,735.00	6,612.00	6,612.00	14,414.00	300.00	125.00

1 MT = 2204 lbs.