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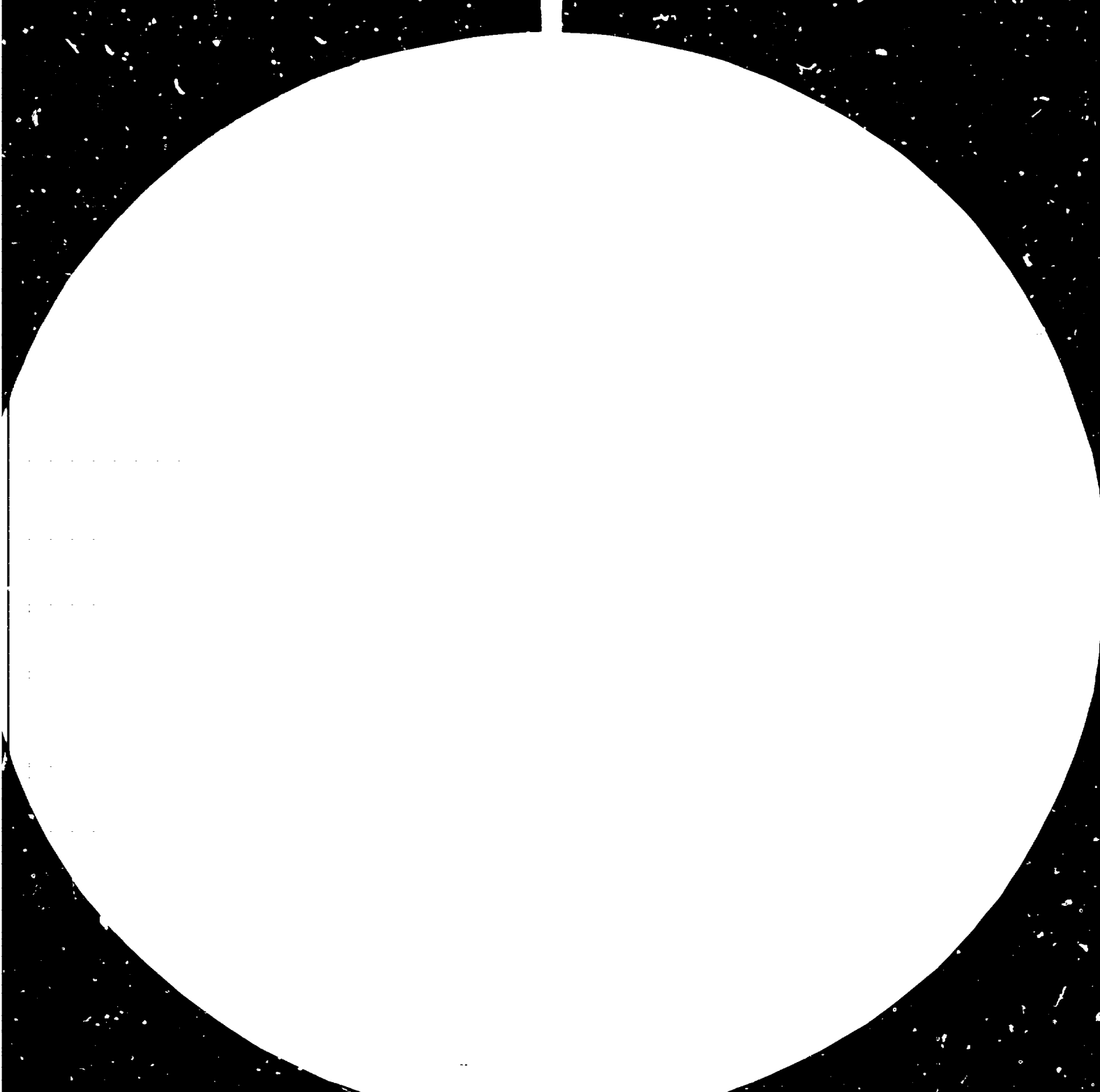

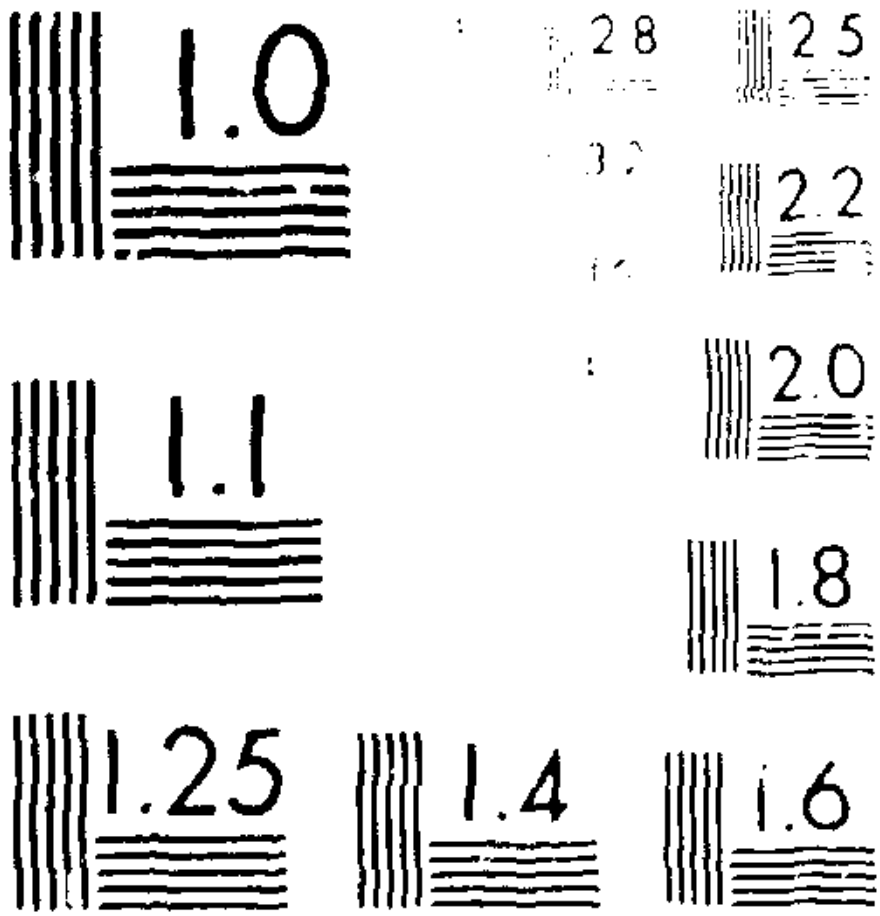
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FERTILIZER PRODUCTION IN ZAMBIA
FACILITIES AND PROBLEMS *

by

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NITROGEN CHEMICALS OF ZAMBIA LIMITED

Zambia has one fertilizer production plant. This is located in Kafue fifty kilometres South of Lusaka the capital of Zambia. The site was chosen because of its proximity to (a) the main agricultural areas in Southern, Central and Eastern Zambia, (b) the coal mines which supply the raw material for the ammonia production, (c) the Kafue river which provide water for chemical reactions as well as for cooling, and (d) the developed road and railways as well as telecommunication system.

PROCESS

The factory was at first supposed to produce ammonium nitrate as a blasting agent. Feasibility studies, however, indicated that the demand for explosive grade ammonium nitrate would not result in an economic size plant. The capacity of the planned plant was increased to produce ammonium nitrate for both explosive manufacture and fertilizer. The installed capacity of the first ammonia plant which was commissioned in 1970 is 95 tonnes per day.

The ammonia is produced from coal using Krupp-Kotzek entrained bed gasification process. The coal is finally ground and transported to the gasifier where it reacts with steam and oxygen to form 11.3% carbon dioxide 58.3% carbon monoxide, 27.8% hydrogen, 0.8 Hydrogen Sulphide, 1.2% Nitrogen, 0.6% Argon and 0.2% carbonyl sulphide. Most of the ash is removed as slag in the gasifier, the rest of the ash is entrained with the raw synthesis gas.

The raw gas is washed with water to remove the ash and sent to the sulphur removal section where the hydrogen sulphide is removed by the stretford process. The sulphur free gas is sent to the first shift converter, then to carbon dioxide removal. The carbon dioxide is removed by using a carbonate solution. From the CO_2 removal the gas goes to the second shift converter where further conversion of carbon monoxide to hydrogen and carbon dioxide takes place. The gas then goes to the second CO_2 removal using monoethylamine solution. The gas from this section passes to the methanator where traces of CO and CO_2 are converted to methane.

The gas from the methanator is mixed with nitrogen from the air separation plant and compressed to 350 bars, and sent to the ammonia converter, where conversion of hydrogen and nitrogen into ammonia takes place. The unreacted gases are recycled, while the ammonia is cooled and refrigerated and sent to storage.

In 1975 it was decided to increase the capacity of the ammonia plant to 300 tonnes per day. This was achieved by an addition of a 220 tonnes per day ammonia plant. The range and quantity of products was also increased. In addition to the products mentioned earlier, ammonium sulphate, methanol and NKP fertilizer were added to the production programme. Table 1 below gives the combined installed capacity for the various products from the two plants.

TABLE 1:	ANNUAL CAPACITY TONNES/YEAR
PRODUCT	
Ammonia	90 000
Nitric Acid	121 000
Ammonium Nitrate	139 000
Ammonium Sulphate	50 000
NPK	142 000
Methanol	1 650
Carbon Dioxide	1 000
Flacked Sulphur	4 360

RAW MATERIALS

The feed stocks for the ammonia plant are coal, air and water. The coal is available in Zambia at Maamba 300 kilometres from the factory. Coal is normally transported to the factory by rail trucks and in absence of rail trucks, road haulage is used. This is three times as expensive as the latter. Water is available from the Kafue river which is two kilometres from the factory. The air is available from a fairly clean atmosphere. The production of compound fertilizers requires the availability of phosphate intermediates. The phosphates required are single superphosphate, diammonium phosphate, triple super phosphate.

In addition to the phosphates potassium chloride, potassium sulphate, boron and coating agent are required. Phosphate deposits have been discovered but the size of the deposit is still being investigated. The phosphate and potash intermediates must be imported.

TRANSPORT

Zambia is a land locked country which depends on sea ports in Angola, Kenya, Mozambique, South Africa and Tanzania. At the moment port facilities in Angola are not available to us due to political problems in that country.

The facilities in Kenya are also not available to us due to the closure of the border between Kenya and Tanzania. The port of Beira in Mazambique is not fully available to Zambia because of some internal problems in Mozambique. The South African ports sometimes provide fast movement of goods to Zambia. But again this route is frequently faced with disruption due to disputes between South Africa and Zimbabwe or to industrial problems in either South Africa or Zimbabwe. These transportation problems cause a heavy burden on the Zambian fertilizer manufacturer.

He must make sure that the various raw materials are available all the time. This means ordering imputs some two years in advance. Delays in moving goods from the ports incur heavy warehouse charges. This takes up scarce funds and increases the landed cost of the raw materials and subsequently that of the finished product.

TECHNOLOGY

The processes used in both the original and the expansion plants are imported from other countries. Table 2 below shows the supplier of the processes that are used to produce various products. It is worth noting that the expansion plants are using different technologies from the original plants except for the gasification process.

TABLE 2

UNIT	ORIGINAL PLANT	EXPANSION PLANT
Air Separation	Kobe Steel Limited	L'' Air Liquide
Coal Preparation	Kobe Steel Limited	Loesche
Gasification	Krupp-Totzek	Krupp-Totzek
Sulphur Removal	Stretchford	Linde & claus
CO-Conversion	Ube Industries Limited	Krupp- Koppers
CO_2. Removal	Ube Industries Limited	Rectisol
Ammonia Synthesis	Ube Industries Limited	Ammonia casale
Methanol Synthesis	-	Ammonia casale
Nitric Acid	Kobe Steel Limited	Societe Chimique de la Graude Paroisse
Ammonium Nitrate	Sumitomo	Kestner
Ammonium Sulphate	-	Kestner
Compression	Kobe Steel Limited	Borsig Demag Sofrair
NPK	-	Caf Chimie
Carbon Dioxide	-	Ube Industries Limited.

The introduction of new technologies requires retraining of operators and maintenance personnel. Fifty seven employees were sent to France and Germany to familiarise themselves with the new technologies. The training they were given was generally below standard.

The trainees spent a lot of time in leactures where they were being taught about the nature of the atom and the molecule. This was a waste of time as all the employees had reached the University entrance standard and a few were university graduates. The trainees were not allowed to operate the plants as these units were in commercial production and none of the companies were willing to have unknown people mess up their production.

The other problem associated with imported technology is language. The contract for the expansion plant project stated that all communication should be in English. This was followed in all written communication. At commussioning time , some of the technicians from France, Germany and Italy could not communicate effectively in English and this led to misunderstanding and delays in executing certain tasks.

The manufacturing sector of the Zambian economy is still in its early developmental stages. Fabrication of process equipment, except for the simplest, cannot be carried out in the country. Damage to one of the major items such as a waste heat boiler on the nitric acid train means prolonged shutdown of the whole unit while a new unit is being ordered form an overseas supplier who might have closed his works for the annual summer holiday. Even when the factory is open, the vendor might have a book full of orders.

MANPOWER

Operating a chemical complex like ours requires availability of trained and experienced manpower. Unfortunately this commodity is not readily available in the country and is in short supply throughout the world. For the little manpower available in the country we must compete with the copper mines who offer better conditions of service than we do. We must also compete with the rest of the industries the government and the University. The government and the university are offering the same, if not, better conditions of services as we do. We do carry out on-the-job-training for people coming from the colleges and the Universities. Some of these people do not stay long with us after gaining industrial experience.

They often offer their skills to the highest bidder. We find it difficult to "poach" from other manufacturers as they donot operate to our level of sophistication.

FINANCE

The main foreign exchange earlier in Zambia is copper. The prices of this commodity on the international market have been very low for the past few years. This has been due to a recession in the western countries who are the main consumer of the Zambian copper. The low copper prices mean low availability of foreign exchange for the paying for capital items such as plants and machinery. In our case the expansion of the factory which started in 1975 and scheduled for commissioning in 1978 was not complete until 1981. As a result of the delay the cost of the expansion has increased from US $ 87,000,000 to US$ 359,000,000. This figure does not include revenue lost ~~in lost~~ in lost production between 1978 and 1981. Lack of foreign exchange makes it difficult to obtain critically needed spares at a short notice.

The delay in commissioning the expansion plants brings a question of vendor's guarantees. While commissioning the expansion plants we experienced two transformer failures. The first to fail was an auto transformer for the air separation unit. A vendor's representative was called to examine the unit. He found that the unit was damaged beyond repair by a transportation "fault". A new unit had to be ordered and airfreighted from Berlin. The second transformer to give problems was that for the NKP plant. The manufacturer's representative found that the unit was damaged during transportation, it could however be repaired but no guarantee would be given unless the repairs were carried out in the manufacturer's facility in France. Again we were forced to order a new transformer and airfreight it from Paris. The third example is the failure of a waste heat boiler on the nitric acid plant.

The boiler shall buckled after being in operation for less than seven days. We cannot get any redress from the vendor because the guarantee is over.

CONCLUSION

A question is often asked if it was worth it to put up the factory in the face of these problems. Fertilizer can be obtained on the international markets at prices less than those offered by the local manufacture, why make it locally? The setting up of the fertilizer factory was a good move and the problems of manpower, technology, transport and finance must be faced with and appropriate solutions found. In the case of manpower, the co-operation of developing countries like India has helped our company to prosper. We look forward to co-operation in the fields of design, fabrication and above all, training of technical personnel from other developing countries.