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EXPLOSION IN UREA FERTILIZER FACTORY GHORASAL[1/]
A CASE HISTORY

by

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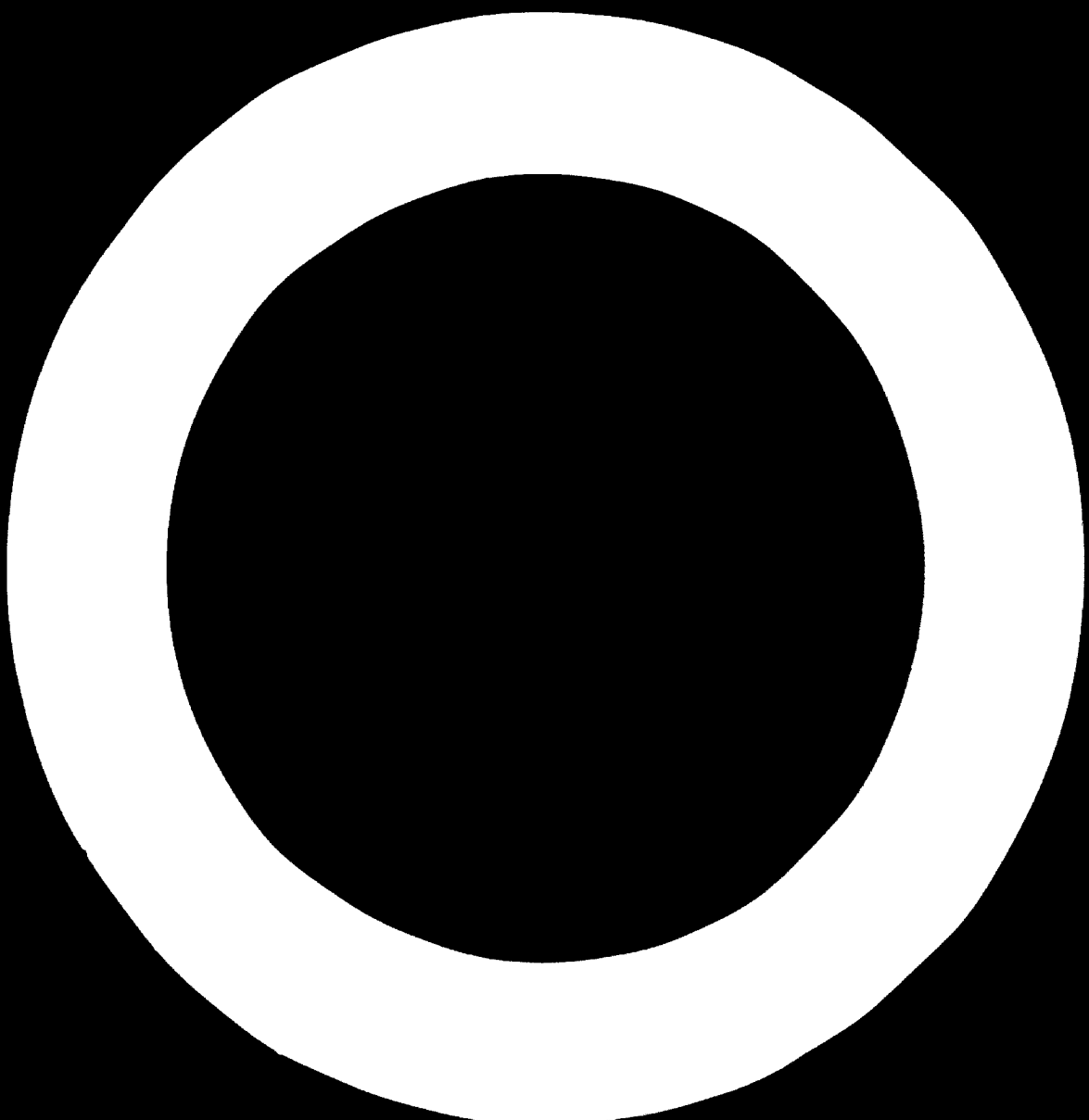


EXPLOSION IN UREA FERTILIZER FACTORY CHITTAGONG: A CASE HISTORY

INTRODUCTION

Bangladesh ranks as one of the poorest and most deprived nations of the world. It has been a food deficit country for many years and the acuteness of the problem has increased with the growth of population at an annual rate of three percent. Yearly per capita income is about $ 70. About twenty three million acres is under cultivation. Floods affect a third of this acreage each year. Some land can be and is cropped up to three times during a year but production still is inadequate to meet total food demands. Fertilizer use is relatively new. During the 1962/63 crop year only twenty seven thousand tons of nutrient were used. Use increased to over one hundred and seventy five thousand tons in 1972/73. More would have been used if the fertilizers had been available. Lack of foreign exchange, decrease in domestic production of fertilizers, inadequate transport facilities and many other factors have been responsible in the limitations in fertilizer use.

FERTILIZER INDUSTRY

There are four fertilizer production units in Bangladesh. The plant at Fenchuganj produces both urea

and ammonium sulphate and the plant at Ghoraasal produces urea. Two triple superphosphate plants are located at Chittagong. The Fenchuganj urea plant produced at about 87 percent of the design capacity of 106,000 tons from 1962 to 1970 but performance dropped to 30 to 60 percent after liberation. The plant now needs modernization and balancing, and replacement of some of its worn out sections. The Ghoraasal plant having an annual capacity of 340,000 tons was closed down during the war of liberation from 1970 when acceptance tests were completed until August 1972 when it was restarted. Production has been 80 to 85 percent capacity for short-time periods. Long operation has not been possible because of mechanical problems and its effective capacity has come down to about 80 percent of the rated capacity. The ammonia control room of the plant suffered a severe explosion in September 1974 when the plant was being restarted after a planned overhaul. It remained out of commission for almost a year for replacement and installation of the control room equipment and instruments and reconstruction of the control room building. The plant resumed production in the middle of June 1975. The production of triple super-phosphate have not been very encouraging and successful. The smaller plant having a capacity of 32,000 tons per year was not able to handle phosphate rock from Jordon because of the high chloride content of the rock. Therefore this plant has been closed since the trial runs in 1968, as the type of rock for which the plant was designed, namely, Florida rock phosphate, could

not be procured. The larger plant having an annual capacity of 120,000 tons, though completed just before the war, started trial production in June 1974 and commercial production in September after similar rock phosphate were obtained from Morocco. Indigenous production of the four plants as well as imports of fertilizers are given in Tables.

Despite the triple superphosphate plants at Chittagong, and in spite of the fact that the larger plant had been in production since September last year, most of the phosphate fertilisers, as well as all potash fertilisers, are imported. Also prior to recommissioning of the Ghorasal plant in 1972 one-half or more of the nitrogen fertilizer were imported. Almost all fertiliser is imported in lined jute bags, either through the port at Chittagong or at Chalna, however, in 1966, 10,000 tons of triple superphosphate was received in bulk at Chittagong.

GHORASAL PLANT

This paper is concerned with the explosion of the ammonia control room of the Ghorasal fertilizer plant in September 1974.

Construction of the urea fertilizer plant at Ghorasal was started in September 1967 and the first test run made in July 1970. The plant was designed and commissioned by the Toyo Engineering Corporation and achieved design conditions of 600 metric tons of anhydrous ammonia and 1,137 metric tons of urea per day (340,000 mt/year), during the performance run from August 21 - 27 1970.

The urea factory is located on the River Sitalakhya at Khanepur, Kolasa, in the district of Dacca and is a self-sustaining community village with housing, schools, a shopping center, recreation facilities, utilities and other accommodations needed by the personnel operating the plant. The factory covers about 240 acres and cost TK 33.32 crores ($ 44.4 million) at 1970 prices.

The ammonia-urea plant is completely automated and has one ammonia train with two ammonia synthesis converters and one urea train with two urea synthesis reactors. Natural gas from the Titas gas field is piped to the plant site and is used as the raw material for the production of ammonia synthesis gas as well as a source of power for operating gas turbine which produce the plant electrical needs. The gas which is primarily methane is converted into a mixture of nitrogen and hydrogen in the proper proportions of purity for synthesizing to ammonia by treatment in the reforming and purification sections of the ammonia plant.

A portion of the carbon dioxide needed as feed stock for the production of urea is obtained from the reforming and purification steps during ammonia production. However, additional carbon dioxide must be obtained in order to satisfy the needs for urea production, and this is absorbed from flue gas leaving the reformers.

Liquid ammonia and carbon dioxide are reacted under pressure in an autoclave to form ammonia carbamate which dehydrates to form urea and water. Several purification steps are carried out to seperate and reprocess the dissolved gases and the unconverted ammonium carbamate from

the urea solution.

The Ghoraasl plant was committed to product prilled product with a low biuret (less than 1%). To meet this requirement, the urea solution (75%) is first vacuum crystallised, then remelted and concentrated to about 99.5% before being prilled into a cooling tower about 56 meters in height. Exhaust fans provide air movement up through the tower for cooling and hardening of the prills moving downward through the tower.

The prills leaving the tower are screened to remove plus 6 mesh oversize material then cooled in a rotary cooler and conveyed to bulk storage or direct to the bagging facility. A dehumidified storage area is provided for about 50,000 metric tons of bulk product. The bagging facility has sufficient capacity to bag three shifts product in two shifts of operation and has storage for 10,000 metric tons of bagged product. Prilled urea is bagged in 25 or 50 kg polyethylene lined jute bags which are sealed by sewing machines. The polyethylene bag liners are produced in the plant.

Bagged product from the plant can be shipped either by railway, coastal ships, or barges from the plant wharf. A five mile spur railway connects the plant bagging facilities with the Bangladesh railway system at Tongi where rail shipment is convenient to most sections of Bangladesh east of the Brahmaputra, Padma, and the lower Meghna Rivers. Rail shipment to the west of this river system must be unloaded, ferried across the river, and reloaded in rail cars with different tract gauge.

The plant output of bagged product can be loaded on barges or coastal ships from docks connected to the bagging facilities by a conveying system. However, the handling at the wharf needs improvement. The loading conveyer which transfers the material from the wharf to the ship or barge is not easily adjustable to make allowances forcharges in the river level. Quite often bags are broken because they are allowed to fall several feet from the discharge end of the conveyer to the deck of the barge being loaded rather than making necessary adjustments to the conveyer height to prevent this fall.

Although the Ghorasal urea plant satisfactorily passed the acceptance test in 1970, it has not performed up to expectations since that time. The plant was shut down during the war and was not restarted until August 1972. Production was disappointing and in May of 1973 the Tokyo Engineering Corporation, Japan, was given a technical assistance contract to advise in-plant operation. Operation at this plant is still not acceptable. The highest efficiency rates obtained have been only 80 to 85% of capacity and these could not be maintained for extended periods because of mechanical failures and other troubles.

CONDITIONS OF PLANT

The explosion occurred when the plant was being restarted after a planned overhaul. At the time of the explosion, condition of the plants were as follows:-

(a) In Urea Plant, Inmert Gas Generation Plant and two numbers of Urea Boiler (13 Kg/cm ^{2}G) were running.

(b) In Ammonia Plant, Instrument Air Compressor was running and the Auxiliary Boiler (100 Kg/cm^{2}G) was under steam flushing operation at a pressure of about 60 Kg/cm^{2}G. About 20 to 30 tons per hour steam was venting through temporary pipe installed for this purpose. The Auxiliaries for the Boiler e.g. Boiler Feed Water Pump Forced Draft Fan (Turbine Driven) and Dearator were under normal operation.

All the Catalyst Vessels except Desulfurisation Catalyst Vessel e.g. 1st Reformer, 2nd Reformer, High Temperature Shift Converter, Low Temperature Shift Converter and Methanator were sealed with Innert Gas at a pressure of about 1 to 4 Kg/cm^{2}G. The Desulfurisation Catalyst Vessel was sealed with Natural Gas at a pressure of about 4 Kg/cm^{2}G.

The temperature and pressure of Natural Gas at different sections of the plant were as follows at the time of explosion:-

(a) To Boiler:- Fuel Header Pressure was 27 Kg/cm^{2}G. Pressure is reduced to 7.0 Kg/cm^{2}G and then to about 0.2 to 0.6Kg/cm^{2}G.

(b) To Reformer:- Fuel NG Header pressure was about 27 Kg/cm^{2}G. Pressure is reduced to 7 Kg/cm^{2}G and then to about 0.2 to 0.6 Kg/cm^{2}G.

(c) To Power Plant:- Fuel NG pressure was about 27 Kg/cm^{2}G. Pressure is reduced to about 11 Kg/cm^{2}G before using in the Turbines. The corresponding temperature at different Pressures of fuel NG were as given below:

I) 27 Kg/cm^{2}G about 25°C.

ii) 7 Kg/cm^{2}G - about 19.5°C.

iii) 3 Kg/cm2G - about 15°C and

iv) 11.0 Kg/cm2G - about 15°C

v) 0.2 - 0.6 Kg/cm 2G - about 15°C.

(d) The Water Treatment Plant and the Power Plant were running normally.

PROBABLE CAUSE

The cause of the accident is not very much clear. Possible causes may be any of the following:-

(a) by explosive materials with a view to sabotaging the plant.

(b) natural gas explosion and Natural Gas might have come in Ammonia Control Room through Instrument Air Line. Natural Gas Line in Power Plant has got Inter-connection through Valves with Instrument Air Line and pressure of Natural Gas in that line was 27 Kg/cm^2G whereas Instrument Air Pressure was about 7 Kg/cm^2G. If somebody opens the valve of the Inter-connection Line, although the possibility of which is very very rare because this valve has not been operated since the inception of the factory, Natural Gas might come through Inter-connection in the Instrument Air Line and ultimately in the Ammonia Control Room through normal bleeding or Pneumatic Instruments and cause explosion when somebody lighted a match stick for smoking. The possibility of operating the Inter-Connection Valve is nil except intentional operating with a view to sabotage the plant.

IMPACT ON ECONOMY

As a result of the explosion the Ammonia Control Room and most of the instruments inside the Control Room were damaged necessitating total replacement of the instruments.

Four people were killed and about eleven others were injured. Some of them have been incapacitated. The Plant remained idle from 11 September 1974 to 12 June 1975, during which period the new Ammonia Control Room was constructed, instruments imported and erected. The following costs were involved in the process:-

(a) the cost of Control Room Tk 0.12 million

(b) cost of instruments and service charge Tk 1.0million provided an UNDP grant.

During the period in which this was being done the Plant suffered a loss of 250 thousand tons of production. It would have produced at least 1.25 million tons of food grains the cost of which at the then international price would have been about Tk 5 hundred million. Thus the loss to the national economy including loss of production and the depreciation of the Plant amounted to Tk 525 million besides the cost of replacement and reconstruction of the Control Room.

PREVENTIVE MEASURES

In order to prevent recurrence of such explosion in future whether due to technical or other reasons the following remedial actions have been taken:-

(a) Inter-connection between Natural Gas Line and Instrument Air Line in Gas console unit of Power Plant has been removed and in other plant also where direct inter-connections were not there but provision for temporary connections with rubber hose were there, have also been removed permanently.

(b) Security measures have been tightened. During entering

and leaving the factory premises, physical checking are being done of all the employees and Officers of the factory.

(c) Patrol of Security Staff have been made more frequent inside the Plant.

(d) All employees permanent and Contractor's Labours of the factory have been provided with tokens and identity cards for their identification.

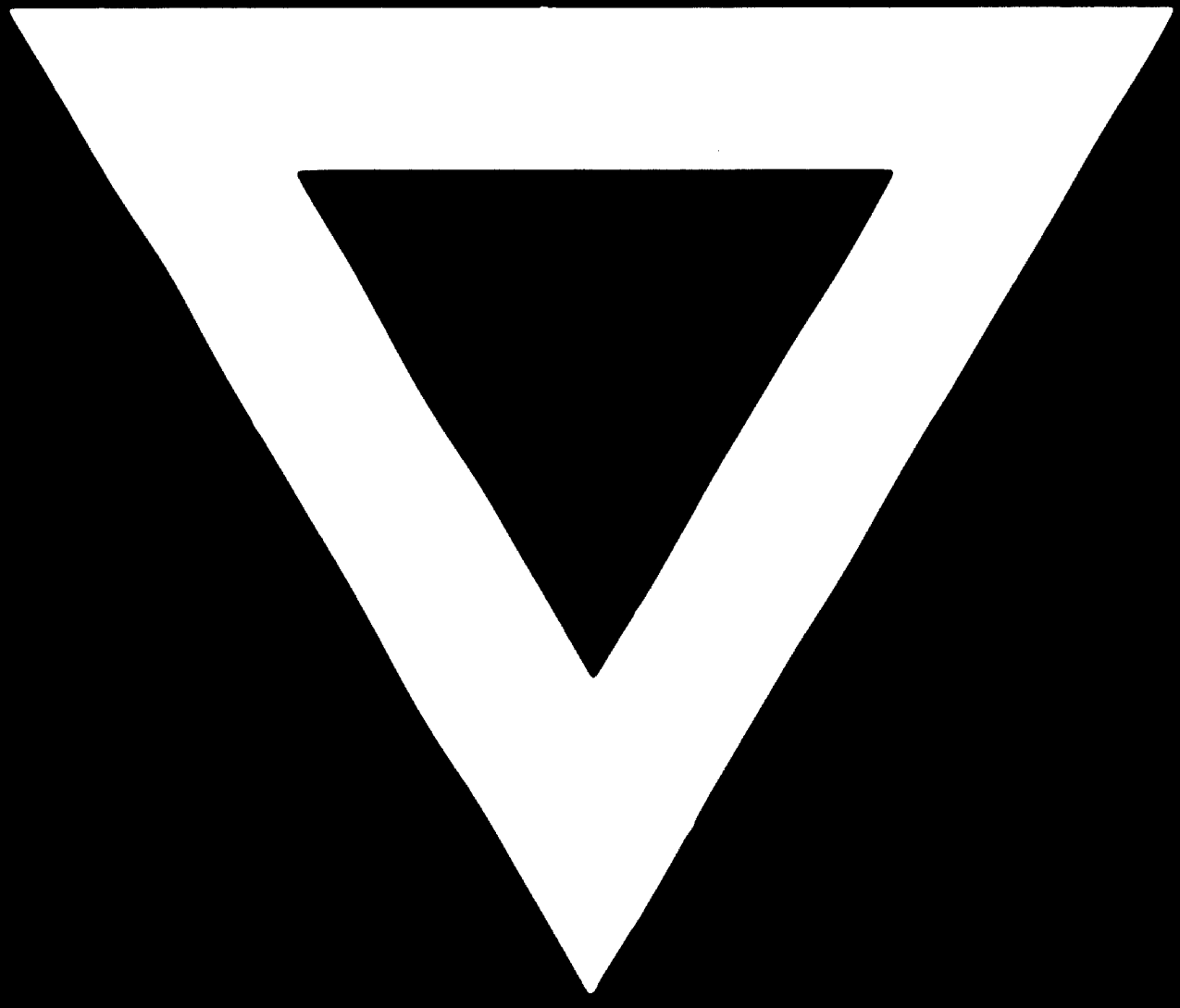
(e) K.F.I. recommendations about security of this factory which were not implemented previously have been taken up and work already been started/going to be started very soon.

(f) All the employees of the factory have been motivated to check for themselves any suspicious movement of any personnel inside the plant.

(g) Smoking stopped in Control Rooms.

CONCLUSION

The explosion at the Chorasal Fertilizer plant shook the entire economy of Bangladesh. The real cause is a mystery though there appears to be hardly any technical reason. But its reconstruction was difficult. Equally difficult was the availability of foreign exchange for replacements, even though these were made available on grants. There was an agonising delay of several months before these were made available. However, the Government is looking forward to a period of prolonged operation of the plant following the burial of the debris and the loss the country suffered.



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