1. INTRODUCTION

Fertilizers have been the important horizon for several years past and from all appearances should continue to a considerable future distance. A subject that has attained as much importance as the American and soviet space programmes, fertilizers have projected themselves into an important orbit amid present day complexities. It is but common knowledge that these chemical combinations are of direct lineage to human nutrition and with recent spurt in population statistics, have been pressurized into significance, that even Vietnam crisis can stem.

Without fertilizers, so called “Green Revolution” is a farce. It is becoming an accepted fact that chemical fertilizers have a definite role to play in raising the productivity of land to provide more food and clothing to the raising population of the world.

Up to present Ammonium Sulphate has been the most popular nitrogen fertilizer among farmers. Urea is also competing with Ammonium Sulphate, where lack of sulphur is likely to be a problem. But the availability of gypsum has solved the problem to some extent.

2. FACTS AND FIGURES

The first pioneering effort to produce fertilizers in India was made at Belagula in Mysore in 1939 and a plant to produce 20 tones of Ammonium sulphate per day was set up. Since then the fertilizers industry has grown from strength to strength both in private and public sectors.

Ammonium Sulphate production in India was around 8,50,000 per annum. Following table gives the individual capacity of the existing Ammonium Sulphate.

Name of the Factory.	**Location.**	**Capacity Tones/year**
F. C. I.	Sindri (Bihar)	3,55,000
Hindustan Steel.	Rourkela (Orissa)	28,000
F. A. C. T.	Alwaye (Kerala)	2,00,000
E. I. D. Parry Ltd.	Ennore (Madras)	52,900
F. C. I.	Nemrup (Assam)	1,00,000

Apart from this 1, 00, 000 tones/year Ammonium sulphate is manufactured by Byproduct Coke oven gas.

Fertilizer consumption per acre in India today is perhaps the lowest in the world. The fact that the consumption of Chemical fertilizers is only 1.25kg of all plant nutrients per acre against world average of 7kg is indicative of the large scope for increasing the production and consumption.

The comparison of yields of different food grains in India with yields in other countries has been given bellow:

Food Grains	Yield in India Kgs/ hectare.	Yield in other Countries.
Rice	1,500	5,600(Japan)
Wheat	1,000	4,300(England)

Above two examples indicates that even in relatively better-developed countries than India where like India fertilizer usage has not been a major factor yields are not very much different from that India whereas they are significant more in countries where fertilizers usage has been well developed. The figures indicate the tremendous potential of increase in agricultural production by use of fertilizers.

But cost/yield ratio is less favorable to the Indian farmers.

This is especially true in case of food crops: as a consequence the fertilizer is used more on higher priced cash crops than on food crops. So to minimize the product cost recourse has been made to latest technology.

3.RAW MATERIALS

The raw materials for the manufacture of Ammonium Sulphate from gypsum are ammonia, carbon dioxide, gypsum and water.

Ammonia: Ammonia can be made by the famous Haber Bosch process. Synthetic Ammonia is a landmark in the history of Chemical fertilizers. The nitrogen can be got abundantly from air. The manufacture of semi water gas from Coke, the purification of the gas and oxidation of carbon monoxide content to carbon dioxide and finally the

removal of carbon dioxide from this either by scrubbing with water under pressure or with ethanol amine solution and then synthesizing to ammonia. In Sindri large producers are filled with coke and air is passed through. Producer gas it got with carbon, carbon dioxide and nitrogen as products. In the next cycle steam is blown through the producers, which produces carbon monoxide and Hydrogen. The gases in the two cycles are mixed which thus contains carbon monoxide, nitrogen and Hydrogen. This raw gas is passed through sulphide boxes to catch the Hydrogen Sulphide. Carbon monoxide in the raw gas in oxidized to carbon dioxide by the steam process using iron catalyst in the converters.

$$C + Air \rightarrow CO + N_2$$

$$C + H_2O \rightarrow CO + H_2$$

$$CO + H_2O \rightarrow CO_2 + H_2$$

Gases pass through exchangers to have maximum thermal efficiency. The gases are sent to Ammonia plant in Stoichimetric ration where they are compressed to 17 atm and carbon dioxide is scrubbed using water. The Nitrogen and Hydrogen go to the Ammonia converter, while carbon dioxide is released from water, and sent to the sulphate plant. At about 122.5 atm carbon monoxide and oxygen picked up from scrubbing water and the residual carbon dioxide are eliminated by scrubbing the gases with a complex solution of mixed salt of ammoniacal cuprous, cupric formate and

carbonate solutions. Copper solution is regenerated under atmospheric pressure and reused.

The 3:1 Hydrogen and Nitrogen mixture freed of its carbon monoxide and carbon dioxide is raised to 357.5 atm. and is mixed with re-circulated gases. The gases are then passed through the oil filter and to the Ammonia cooled condenser for residual ammonia. In the converter the gases are raised in a counter current heat exchanger to the reaction temperature and made to react in the presence of the catalyst, after which the gases is purged to prevent undue accumulation of diluents such as methane and Argon and the rest is recompressed for circulation. This purged gas is used as a fuel in the sulphate

plant. Ammonia is stored in two large Horton Spheres each capable of holding 690 tones. This also goes to the carbonization tower.

The Alwaye wood is used as the raw material. As they come off the barges the logs are slashed to 40.64 cms. Lengths and conveyed to the world's largest wood producer gas plant at the rate of 207 tones a day. Wood is charged continuously into a battery of gas producers to obtain 0.51 million cu.meter per day of producer gas containing approximately 22 percent carbon monoxide and 11 percent Hydrogen. This section includes few producers, one a spare, and 5660 cu.meter gas holder. Some of this producer gas is used to reduce the iron oxide content mass packed in the steam cross generation, two of which are spares. The rest of producer gas is burnt at the rate of 19,250 cubic meter per day to generate superheated steam. In the next operation the steam acts on the reduced iron oxide mass to liberate 8.5×10^4 cu.meter per day of Hydrogen. The burnt spent gases from the boiler are passed through a Gerbitol unit to yield 28,300 cu.meter per day of pure nitrogen and 5,660 cu.meter of carbon dioxide. A 15 percent solution of monoethanol amine is the absorbing liquid used in the carbon dioxide absorption tower.

Gypsum: At present our conservative estimate of know reverses, in the more important deposits capable of being worked today is as below:

Rajasthan

	Reserves in million tones
a. Bikaner	45.5
b. Jodhpur	16.3

Madras:

a. Tiruchirapalli	15.3
b. Sulurpet	0.6

Himalchal Pradesh		1.8
Saurashtra		4.0
Kutch		2.0
	Total	85.5

As the total amount mined in Bikaner is going to Sindri and due to heavy transportation cost, Tiruchirapalli, Gypsum can become our mainstay. It covers over and area of 22 sq.miles, occurring up-to a few cms. Deep, frequently ferruginous.

Water Supply: The question of water supply, which is so great, deserves a paragraph. The Requirement at Sindri is 12 million gallons per day. So this plant, which is about one seventh of that capacity, will require about 1.5 million of gallons per day for which a suitable riverside should be chosen.

Power Supply: There is every need for a separate station as the power requires is enormous. The factory needs lot of process steam. The steam generated can be first supplied to the turbine and then used for process work.