SOME ASPECTS OF THE HEAVY CHEMICAL INDUSTRY IN INDIA.

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(*Read at Symposium, April 19, 1941.*)

Chemical industries are generally grouped under two main headings:—

(*a*) Heavy chemical industries.

(*b*) Fine chemical industries.

'Heavy chemicals' is a term that applies to such products as the common acids, soda ash, caustic soda and those salts and other chemicals that are produced in large quantities and at relatively little cost. The manufactures of sulphuric acid, synthetic ammonia, ammonium sulphate, caustic soda, soda ash, etc., may be cited as typical heavy chemical industries. Besides, there are a number of products which, though produced by definite chemical reactions in large quantities and at low cost, are by convention not grouped under the term 'heavy chemical industries'. One such group, for example, the manufacture of coke, gas, tar and tar products, is generally classified under metallurgical industries.

'Fine chemicals' are generally manufactured in relatively smaller amounts. Further, the manufacture requires greater skill and care in each operation under scientifically and technically trained control. Purity of the substance is much more important than the price, which is generally sufficiently great, so that it may not be necessary to take special precautions with reference to the saving of heat and power in its manufacture. Typical examples of 'fine chemicals' are some of the photographic chemicals and some highly specialised pharmaceutical products. India is backward both in the field of 'heavy chemical industries' and 'fine chemical industries'. In the present article we are concerned with heavy chemicals only. It should, however, be stated that the development of the heavy chemical industry is a pre-requisite for the development of fine chemical industry.

About 12 or 13 years ago, when the Indian Tariff Board examined the position of the heavy chemical industry in India, we were producing, throughout India, the following (shown overleaf) estimated amounts of certain heavy chemicals. Aûthoritative statistics are not available about the present production and demand. It may safely be put down at twice these figures.

Considering the above figures it is evident how hopelessly backward the position of India is in the field of manufacture of heavy chemicals. Taking the case of only one heavy chemical, namely, sulphuric acid, countries like U.S.A., England, Germany, France and Belgium,—every one of these countries

Name.	Estimated production (average of five years 1923–1928).	Estimated demand.
Sulphuric acid	20,000–22,000 tons.	23,000 tons.
Hydrochloric acid	500– 600 ,,	600 ,,
Nitric acid	500– 600 ,,	600 ,,
Phosphoric acid	13·5 tons average production per year. Nobody else makes it.	300 ,,
Zinc chloride	Our production 5·5 tons average.	1,200 ,,
Epsom salt	2,500–3,000 tons.	5,000 ,,
Alum of potash	800–1,000 ,,	4,000 ,,
Copperas	800–1,000 ,,	1,500 ,,
Copper sulphate	100 tons	700 ,,
Glauber's salt	1,000 ,,	3,000 ,,
Soda sulphide	Not definitely known. We made 12 tons per year average.	1,500 ,,
Alumina ferric	1,000 tons.	....
Bone superphosphate ..	300 ,,	....
Bone meal	100,000 ,,	....
Mixed fertilisers	3,000 ,,	....
Pure products	Not definitely known. 35,000 lbs. is our annual average.	....
Alumina sulphate	....	4,000 ,,
Chemical fertilisers ..	....	30,000 tons. Demand is increasing every year.

was preparing sulphuric acid over a million tons per year. It has often been stated that foremost of the many indications that point to the industrial prosperity or otherwise of a country is the quantity of sulphuric acid produced. From this point, India perhaps occupies the bottom-most position in the world. Apart from the meagre production of the chemicals mentioned above, India is importing large quantities of heavy chemicals required by textile mills and other industries. The above figures bring out another important point, namely, that the only heavy chemicals that were manufactured in India belong to the group of sulphuric acid and articles that could conveniently be manufactured from sulphuric acid. This was due to the fact that freight on acids from foreign countries to India was very heavy and it paid the manufacturers in India, even with inefficient methods, to manufacture sulphuric acid and some other allied industrial chemicals. The absence of manufacture of alkali and alkali products is significant.

Things have changed during the last fifteen years. New industries have come into existence in India and these are making demands for heavy chemicals and their production has increased to an appreciable extent. The flotation of two large companies, one in Northern India and the other in Western India, for the manufacture of caustic soda, soda ash, bleaching powder, chlorine and some other chemicals, fills à very big gap in the region of heavy chemical industries in India. The alkali industry will be complementary to the acid industry and this consummation was long in being realised in India.

If India is not self-contained in respect of cheap alkali or alkali products, industries like glass manufacture, soap manufacture, aluminium manufacture, paper manufacture, cannot hope to thrive and prosper in the country. The textile mills also will benefit by this development. To keep pace with the combined output of alkali by these two companies, it will become necessary to increase the production of commercial acids throughout India. Many of the manufacturers of these acids are already making additions to their plants. For example, if India is to be self-contained in respect of galvanising and tin-plate industries, and also in respect of superphosphate, ammonium sulphate, etc., greater amounts of acids will have to be manufactured in the country. It is hardly possible in a short article like this accurately to estimate and describe the beneficial results that accrue to a country by the production of cheap acid and alkali in promoting a ramified and diversified system of chemical industries and also industries that require chemicals in their various processes. Without cheap acid and cheap alkali, we can never hope to start a 'Rayon industry' in India. It may be necessary to start producing carbon bisulphide—if the viscous process is to be adopted. Otherwise, we shall have to produce more acetic acid and its derivatives.

India's prosperity is ultimately bound up with agriculture. With the population, according to the 1941 census reaching four hundred million people, the problems of agriculture has become more and more insistent and important. Agricultural production in India can increase only to the extent we use artificial fertilisers, notably, ammonium sulphate, superphosphate and some others. The production and use of artificial fertilisers for increasing the agricultural production in the country are going to be the biggest factors in the national programme of reconstruction.

It has been the fashion to make this statement for over half a century, but progress achieved is negligible. To attain the desired ideal, we must increase the production of ammonium sulphate and superphosphate, which entails an enhanced production of ammonia and sulphuric acid. India is poor so far as deposits of phosphatic minerals are concerned, but by carefully conserving the bones available in the country, it is possible to manufacture all the superphosphate required by the agriculturists in India. Regarding ammonium sulphate, the present demand is estimated to be between a hundred-thousand and a hundred-and-twenty-thousand tons, and it is rapidly going up. In the by-products recovery coke-oven plants at the two iron and steel works in Northern India and in one gas-making plant at Calcutta, we are producing round about twenty thousand tons of ammonium sulphate. Recently in Mysore, the first synthetic ammonia plant has been installed with a productive capacity of 7,200 tons of ammonium sulphate. It is thus evident that even under the present conditions we are not producing all the chemical fertilisers which our country needs.

Whether for the manufacture of superphosphate or ammonium sulphate, sulphuric acid is necessary, unless the anhydrite process of manufacture is

adopted in the case of ammonium sulphate. More investigation is necessary before we can depend on this process.

The most important thing to remember in this connection is that India should establish a greater number of synthetic ammonia plants, well distributed all over the country to satisfy the regional demands. The importance of synthetic ammonia lies in the fact that during peace-time it can give us ammonium sulphate, the most important chemical fertiliser, and during war-time nitric acid, without which there may be no modern explosive industry.

Therefore, the manufacture of sulphuric acid and synthetic ammonia constitutes a key industry, in every sense of the word, to serve the needs of a country both in peace and war. The modern explosive industry requires cellulose (generally in the form of cotton), glycerine, nitric acid and sulphuric acid in large quantities. Accurate statistics are not available as to the quantity of explosives used in India for civil purposes (like dynamite) and also the explosives used for military purposes. So far as is known, there is only one factory in India, under military control, for the manufacture of cordite. By all accounts, this is a very small factory. In the scheme of national defence, sooner or later, probably sooner than we think, we shall have to provide for the manufacture of explosives both for civil and military purposes. The manufacture of modern explosives is a typical heavy chemical industry, even though on account of its immense proportions and military importance it is classified under its own special name.

The manufacture of synthetic ammonia requires nitrogen and hydrogen. In the cost of production of synthetic ammonia, the cost of production of pure hydrogen will be the single biggest item. In the scheme which I had submitted to the Government of Mysore and which was subsequently adopted by them, I had recommended the production of hydrogen by the electrolytic process, on account of special conditions obtained in Mysore and also on account of the forward policy of the Government of Mysore in promising this concern electric power at a remarkably cheap rate unheard of in India till now, i.e. 0·125 of an anna per unit. The present concession given by the Government of Mysore is tantamount to a perpetual subsidy of three to three and a half lakhs of rupees to the Mysore Chemicals and Fertilisers, Ltd. But for this generous help of the Government of Mysore, this first synthetic ammonia plant in India would not have come into existence three years ago.

Generally, in Western countries, hydrogen is obtained by water gas process in all large plants and by other gas recovery processes in smaller plants. It is stated on good authority that nearly 75 to 80% of the synthetic ammonia plants in the world obtain their hydrogen by the water gas process. Along with any expansion of the Mysore Plant will also have to be seriously considered this source of hydrogen, since on the expansion of the present plant, it may be cheaper to obtain hydrogen by the water gas process. The new synthetic ammonia plants that will come into existence in India will, therefore,

have seriously to consider the possibility of getting their hydrogen by the water gas process. Suitable sites should be available in Bihar near the coalfields, where production of hydrogen by water gas process may be exceptionally cheap. A further inducement for the establishment of the next synthetic ammonia plant in Bihar will be the ready market for the ammonium sulphate in the extensive sugarcane fields of the Province. It is a matter for some satisfaction that the first synthetic ammonia plant and the second contact sulphuric acid plant in India, which I erected and started working, are going on smoothly under the management of technical staff consisting only of Indians. The success achieved in this plant at Mysore should hearten and stimulate other similar enterprises in other parts of India.

With ammonia obtained at a reasonable cost, nitric acid can be produced by the ammonia oxidation process easily. Sulphuric acid of the requisite strength and purity can be manufactured by contact process. Cotton of requisite quality is available in India. The only gap in this region is lack of adequate supplies of glycerine and toluene. During the last quarter of a century, India had witnessed a remarkable development in the soap industry. But with the exception of two factories, all the others are medium sized factories which do not recover the by-product glycerine. (By way of passing, it may be remarked that pure glycerine is required in fairly large quantities by the rapidly growing pharmaceutical industry in India.) So far as is known, Messrs. Tata Oil Company, Bombay and Ernakulam, and Messrs. Lever Bros., Ltd., Bombay, are the only two concerns that are producing glycerine, since their scale of operations in the field of soap-making permits them an economical recovery of glycerine. If we should start the manufacture of explosives in India, as we have to do in the near future, the manufacture of larger quantities of glycerine will have to be tackled without delay. It is for chemical engineers to find out if at all it is possible to devise some method of glycerine recovery even in medium sized factories. It will not be an exaggeration to say that the amount of glycerine that is now wasted in Indian soap factories is more than the demand for glycerine to satisfy the needs of India for explosives for the next 10 to 20 years. If on account of the special industrial conditions obtaining in India it is not possible to recover glycerine from the small and medium sized soap factories, we shall have to obtain the product by the fermentation process. The sooner the bio-chemist in India tackles this problem, the better and safer it will be from the national point of view. We shall have to import toluene from abroad (Borneo petroleum may be one of the sources) or we should develop the coal tar distillation industry in India. It has been stated that production of toluene will commence in Northern India very shortly.

There are a number of imported chemicals which can be manufactured in India, but the pre-requisite is the existence of a healthy and vigorous heavy chemical industry. For example, the improvement of leather tanning and manufacture depends on the use of chemicals. It is only recently that the

Government of Mysore pioneered the bichromate factory with a small output sufficient to cater to the demands of South India. Apart from the synthetic dyes, textile mills require a variety of chemicals and these in turn depend on cheap acid and cheap alkali.

It has not been possible in an article like this to do more than give a bird's-eye view of some of the aspects of heavy chemical industry in India. I am quite sure that other contributors to the symposium will have done justice to the subject from other points of view.