Research and Development in Fertilizers

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FERTILIZER PRODUCTION AND CONSUMPTION in the United States has increased rapidly in the past decade, and every indication is that this increase will continue. However, the increases in production of each kind of fertilizer have not been uniform. A number of new kinds of fertilizers and new fertilizer processes have made their appearance, and some of the older kinds and processes have not held their proportionate share of total production.

As an example, the Department of Agriculture figures (see table) give the United States production of phosphate fertilizers for 1945–46, 1952–53, and estimates for 1953–54, and the relative amounts of the major kinds of phosphate fertilizers.

Since the end of the war, total production of phosphate fertilizers has almost doubled. But normal superphosphate has increased only about 30% while triple superphosphate has increased by about 500%. Also other types, such as nitrophosphate, have increased their proportionate share.

Factors discussed elsewhere in this issued, such as development of new market areas and growing demand for higher analysis fertilizers, have been influential in the changing picture. The difficult situation with sulfuric acid also has played a part.

The rapidly changing fertilizer production trends and the severe competition between the many processes for producing fertilizers and fertilizer ingredients point up the important place of research and development in the industry, particularly chemical engineering process development. Behind every new process is a long period of research and development. The fertilizer industry has been considered by some to be relatively nonresearch minded. Perhaps this was true in the past, and one reason may have been that the industry was made up of a large number of relatively small companies. However, more and more research and development is being done by the industry today, and the need for even more intensive research and development in the future seems very clear.

As in any industry, both basic and developmental research are needed. Not all, by any means, of the basic chemistry of the preparation and properties of the important fertilizer compounds is known. As a small example, the author was recently struck by the scarcity of data on the dissociation pressures of various nitrogen compounds at different temperatures.

In addition to basic research, the industry needs endless process development and evaluation. Changing economic conditions will continue to bring about changes in the relative economic feasibility of various present and new processes.

In recent years we have seen the development of many new processes, some of which are remarkable for their ingenuity. Among these are the various nitrophosphate processes, the TVA continuous ammoniation process, the Martenet mixing process, the Stengel ammonium nitrate process, the Daniels thermal nitrogen fixation process, and the various modified urea processes. Most of these are either in successful production or will be used in plants now under construction.

There are many other processes in a high state of development that are not in general use because they are not considered to be competitive by the industry under present economic conditions or for other reasons. Among these are the electric furnace process and the blast furnace process for production of triple superphosphate, production of calcium metaphosphate, and the various fused phosphate processes.

It is easy to point out at least a few of the areas in which further research and development should be well worthwhile. Indeed, work is already being done in these areas in some cases. The entire field of new sources of sulfur and sulfuric acid is a promising area. Despite differing opinions as to Frasch sulfur reserves, it seems to be generally agreed that sulfur prices are likely to continue to advance. Alternative sources of sulfuric acid such as pyrites, gypsum, and stack gases may become very important within a few years.

The final answer has not been reached in the basic problem of acidulating phosphate rock and mixing the resulting superphosphate with other ingredients. Present processes are complex and awkward. Certainly curing of both superphosphate and mixed fertilizers by pile storage can be advantageously replaced by quick-curing methods. A single integrated process which achieves both acidulation and mixing is a desirable goal.

Fertilizer plants are notoriously dirty and dusty, and working conditions are among the least desirable of any industry. In the author's opinion this is not a necessary evil but could be largely overcome by proper engineering development. Parallel with this problem are others having to do with waste disposal.

Many processes still have major by-product utilization problems. For example, every wet process phosphoric acid plant is confronted with the necessity of storing its by-product calcium sulfate. Could not intensive research find a profitable use for this material?

Is a Research Institute Needed?

Where should this research and development be done? Much of it is being done by government laboratories. Some, but all too little, is being done in university laboratories. The fertilizer industry itself must support the bulk of research and development and is doing so already in the various company laboratories and pilot plants. The fertilizer industry does not support a research institute such as many industries find desirable. Neither is the fertilizer industry as apt as many other industries to support research on fertilizer production in universities. These are possibilities that might well be thoughtfully considered by the industry.

	1945–46	1952–53	1953–54 (estd.)
Tons of available P_2O_5	1,576,000	2,447,000	2,700,000
% normal superphosphate	88	72	67
% triple superphosphate	8	19	24
% other phosphates	4	9	9
	100	100	100