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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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THE IMPORTANCE OF PILOT PLANTS FOR INDUSTRIAL DEVELOPMENT OF NEW PROCESSES[1/]

by

Iuliu Moldovan
Scientific Director in the Chemical Research Institute - Romania

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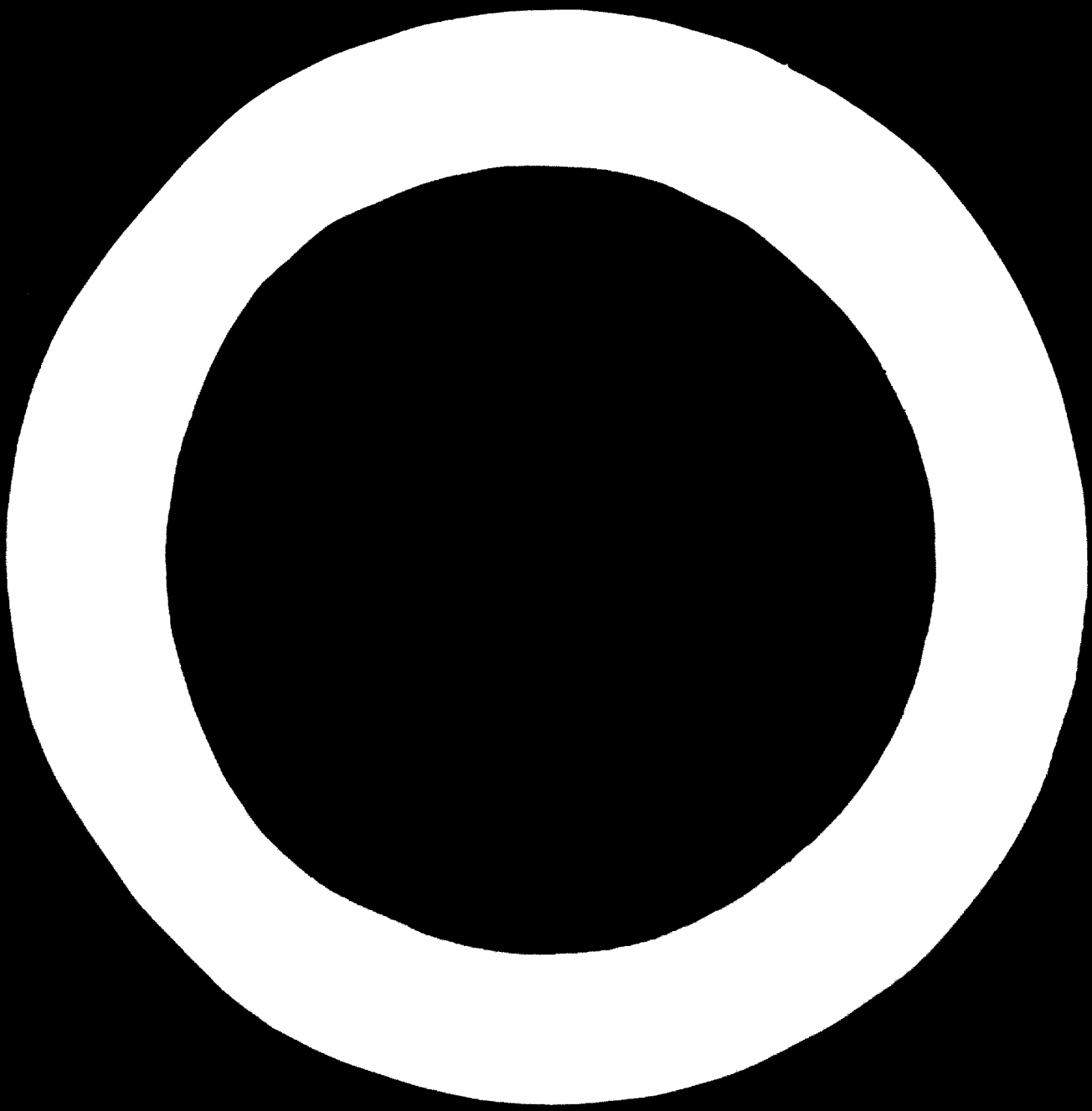

The importance of pilot plants for industrial development of NEW PROCESSES

The accomplishment of industrial plants on the basis of original research, process design and development includes the following steps : laboratory research, systematic research and design of pilot plant, building up pilot plant, pilot plant operation, design of industrial plant, building up industrial plant, starting into operation and attaining to the operational parameters.

A research and development process can be stopped at the laboratory or pilot operation steps, due to different reasons: uneconomicity, uncomplete or unsuccessfull research, the research delayed or worn out in time or high corosion.

Generally speaking, laboratory process before passing into the pilot plant step, should be studied carefully by the design groups resulting economic studies, on which basis the research can be rehandled, aiming to obtain a more economical procecs.

Generally a lab research staff involved in a process includes 13-15 people with 2,000 hours per year and person. As compared with the average cost of research hour abroad (6 dollars/hour person), we have ten times less. It can be considered that the lab research step is the cheapest, of course when the process will become industrial.

Without industrial development these expenses represent unrecuperable loss.

The pilot plant research and generally what is called development of a process represents major expenses in the world, the average cost being 150-500 dolars /pilot unit. In some countries the cost of engineering, and sistematically operation in pilot plants, is included in the cost of design hour for industrial plant, which is different from country to country; in United Kingdom 3 pounds, in West Germany 40 Marks, in United States 16 dollars per hour and designer. In Great Britain the design cost represents 9% and in United States 13% from industrial equipment value.

Sometimes it can pass directly from the laboratory to the industrial scale, the pilot plant being actually one of a semiindustrial type. This situation is represented in our country by pilot productive plants, the plant capacity corresponding to the quantities necessary for testing the products for quality and for biological efficacity in field trials.

In order to reduce the research expenses in pilot plants and especially to reduce the research period, there is the possibility of operation in the "universal" pilot plants or of reusing one pilot plant for solving many other processes with the same chemical specific.

Also it can be used the existent industrial plants with small arrangements to study at the pilot scale, some similar processes especially in the case of fertilizers.

Generally the method and the operation in the pilot plants are different in the cases of pesticides and fertilizers.

With the pesticides processes, there are certain chemical unit operations (sulfonation, alkilation, condensation etc.)

and every stage can be treated separately for mass, thermic and energetic transfer and balance. With this type of processes the problems consist in choosing and calculating the basic equipment and some small difficulties arise at the stirring reaction vessels.

In the processes with interdependent and continuous stages, for instance plants for manufacture of ammonia and generally for fertilizers, the necessity of elaborating the dynamic mathematical models is obvious. In the fertilizers field processes occur, in which the reactor is essential, and here must be taken into account not only the geometry of reactor but also the systematic kinetics and thermodinamics.

As work system we can distinguish two different methods, one used in USA and the other generally used in Europe.

In USA during the laboratory stage, begins cooperation with the industrial plant designers. In that system is accomplished a team which cooperates until the final stage, when are carried over into the work, also the technical corp belonging to industrial units which will be involved in production. The advantage of this method within systematic research is the possibility of earlier specifying the equipment, which currently can be supplied on the warranty of the specialized methalurgical companies, and of contracting certain parts of the equipment under turn-key delivery. There are also possibilities of simplifying the pilot plants, a much safer passing from the laboratory to the industrial plant and a considerably reduced research period.

In Europe where used to pass steppwise to the industrial equippment there was a sharp separation between the research

activity in the lab and pilot plant, and industrial plant development.

With small differences in Europe there are specialists concerned with research and chemical engineering in pilot plants and others concerned with chemical industrial engineering work, carried out in specialized design offices. Along the same line there are also design offices which has already a package of general data for industrial design and which can be completed with additional data after checking the processes; the cases of ammonia, urea, ammonium nitrate, phosphoric acid plants where we can talk about industrial processes already checked and known.

In Europe as a modern system for determining the similitude factors necessary for industrial dessign and therefore for selecting and sizing the equipment, is used the checking, on the equipment models in micropilot plants, equipment executed at 2 or 3 dimensional scales.

In our country the research and development for fertilizers and pesticides processes has been approached differently. In the field of fertilizers, where the processes are continuous, we use the pilot plant system, which represents at the small scale a process or a stage from the process in study.

A cooperation has been established to be necessary with the industrial plant designer, like in the US system, the main problems, the process and equipment design for the pilot plants being done by the designer of industrial plant.

The pilot plant is built up also in the factory in which it is planned to operate the new process for production, but the responsibility for the new technology until the industrial

operation of process, belongs to the research staff which elaborated the laboratory process. This method is feasible because the technological laboratory research is performed mainly by the engineers trained in chemical engineering. In that way was realized the pilot plants for manufacture of fertilizer MPK through nitric attack, for manufacture of superphosphoric acid and the alkaline pure salts by the extraction with organic solvents, for manufacture of phosphoric acid and the complex fertilizer via classical wet route.
Many of the new processes have been checked directly in the existing industrial plants, for example in the case of recovery of fluor from the phosphatic rocks processing.
In the pesticide field, at the beginning we started from the idea of similitude of processes with those for drugs and dyes, excepting the formulation stage which is proper to pesticide industry. And then we have accomplished universal pilot plants for condensation chlorination, phosgenation, etc. and also for formulation.
Our experience showed us the necessity of having pilot plants, particular for a group of products allowing the multilateral usage of the pilot plants. Similarly the industrial plants are preferably to be flexible for adapting to new processes and products. We all know about negative economic consequences in reducing the production of organochloric persistent pesticides like DDT. In USA has been accomplished the partial reutilization of the plants - manufacturing an interesting polymer on the basis of polychloral; examples of pilot plants for the groups of products there are in Romania, such as: organophosphoric insecticides, proper triazine herbicides etc.

Our experience also demonstrates in the pesticide field, also for the flexibility reason, the necessity of working in batch system with unit chemical operations. It is important also that technical products active substances to be obtained in a storing form and the formulation be carried out as possible separately in a separately formulation unit.

The formulation is a very important stage and sometimes if it is not well studied and established, it can compromise a product. It is necessary for our pesticide industry which is in full development, to have a formulation pilot plant of universal type, serving to development of new and various formulation formulae claimed by the agriculture.

The Romanian part comes with the suggestion UNIDO to set up an experimental pilot plant for the formulation of pesticides and for biological, testing within the Joint Centre UNIDO/ ROMANIA to which all interesting developing countries may have access. This suggestion comes taking into account the experience we have, the achievements obtained up to the presen as well as the future developing programme.

Concluding every new process, will have economical and industrial significance only it will be feasible at the industrial scale. Otherwise the research time and the research expenses will be lost.

On the other hand the existence of universal pilot plants can reduce considerably the research period for the application of process from the laboratory to industrial scale.

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