IFDC report

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an update on the work & progress at the International Fertilizer Development Center

Urea Granulation–

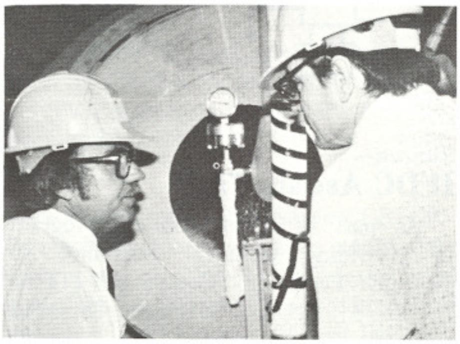
Engineering Research Project Underway

Crop response data obtained from greenhouse experiments with flooded rice at IFDC Headquarters and in field trials conducted at the International Rice Research Institute (IRRI) in the Philippines have clearly identified a relationship between fertilizer application technique (surface or deep-placement) and nitrogen recovery.

The deep-placement technique originated in Asia as the "mudball" method. Mudballs containing organic, and later chemical, fertilizer were formed by hand and allowed to air-dry and harden. The mudballs were placed in the soil between the rice plants. Although this technique achieves improved fertilizer efficiency, production of mudballs is labor intensive. Approximately 65 man-days are required to produce and place the 62,500 mudballs needed for 1 hectare of rice.

Estimates indicate that the same amount of nitrogen in the form of urea supergranules could be produced and placed using only 7 to 10 man-days of labor per hectare. Researchers at IFDC are studying the use of urea supergranules (1-3 g each) as one alternative to make deep placement of nitrogen practical. Controlled release in combination with deep placement is the best system identified thus far for improving nitrogen recovery. Supergranules can be made by granulation, briquetting, or tableting. IFDC researchers are studying the process of granulation.

The widespread adoption of the deep-placement technique for improving fertilizer efficiency and increasing yields will depend largely upon the availability of urea in a form that can be deep placed as an alternative to the labor intensive urea-filled mudballs. Although abundant supplies of prilled urea are usually available, no urea supergranules are produced commercially, and the technical problems involved with such production have not been identified.



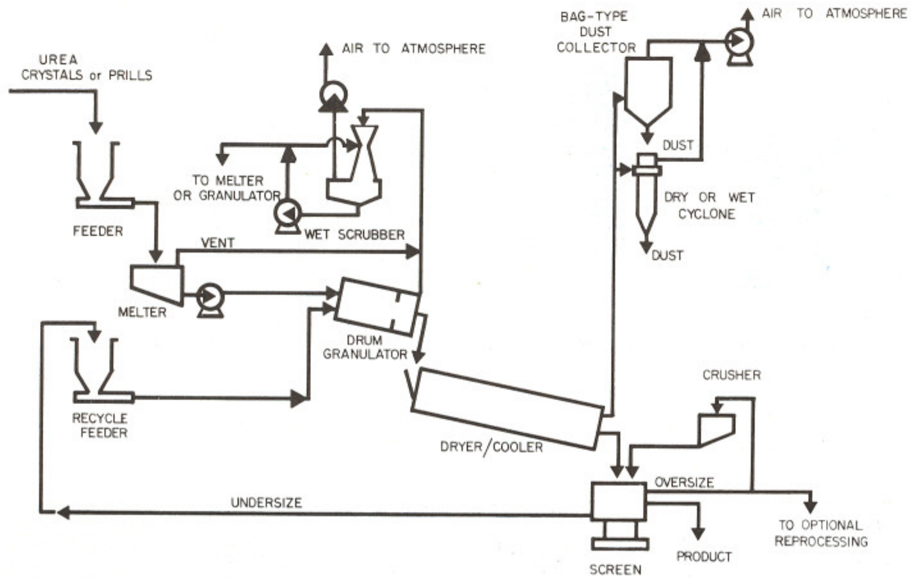
Owen Livingston, Director–Technology, and George Bolds, Pilot Plant Technician, observe IFDC's process for urea supergranule production.

During the past 2 years, IFDC in cooperation with Norsk-Hydro (Norway) and Ferro-Tech Incorporated (United States) produced experimental quantities of 1-, 2-, and 3-g supergranules. Now that construction of the pilot-scale granulation facilities has been completed at IFDC Headquarters, an engineering research program has been initiated to develop methods for producing urea supergranules that can be readily transferred to industry. Initially a modified drum granulation process is being studied. This process equipment configuration was chosen because it utilizes an equipment system similar to that used by most commercial granulation plants to produce standard NPK granular products. A major advantage of this approach is that hopefully only minor changes will have to be made to existing plants to enable them to produce this specialty product--supergranules--along with the normal production of NPK grades. This production strategy will assure widespread availability of product without the requirement for major new capital investment.

The flow diagram on the following page shows the IFDC urea granulation (standard and supergranules) process. In this process crystalline urea or prilled urea is melted in a steam-heated vessel. The molten urea is continuously sprayed onto a rolling bed of granules in the drum granulator. The molten urea solidifies almost immediately on the surface of the rolling granules causing them to grow in diameter. The ratio of molten urea to solid urea in the granulator is controlled at an optimum level by adjusting the rate of undersize solids (recycle, obtained from the screening step) fed to the granulator.

The material discharged from the granulator is cooled with air in a rotary drum before it is screened to obtain the desired product size. Undersize material is recycled to the granulator, while the oversize fraction and dust from the cooler air system and other process points may be remelted or recrystallized depending upon the particular situation. For example, a granulation unit located adjacent to a urea plant may choose to recrystallize offsize material to minimize the formation of biuret.

With this process two or more particle-size fractions can be produced simultaneously. For example, 1-, 2-, and 3-g supergranules could be obtained by selective screening. In another possible process alternative being studied, standard fertilizer-size granules (1-4 mm) are produced. Such granular urea is desired for mixing with granular phosphate and potash materials to produce high-quality, non-segregating NPK blends. These potential product alternatives would greatly



IFDC UREA GRANULATION PROCESS

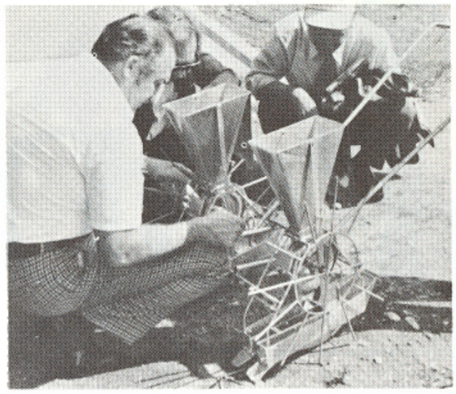
improve the production and marketing potential of an existing or new NPK granulation plant.

IFDC has produced several tons of granular urea during the preliminary phase of operation. Emphasis of the pilot-scale studies during the next several months will focus on determining and optimizing operating conditions for the production of a wide-size range of urea products--from 1-4 mm standard granules to 10-15 mm supergranules. The economics of the process alternatives will be determined as soon as enough reliable production data are obtained.

Taiwan—

IFDC Assists TFC

As part of the continuing program of providing technical assistance to Taiwan Fertilizer Company (TFC), Dr. D. L. McCune, Managing Director, and Mr. O. W. Livingston, Director, Fertilizer Technology Division, visited Taiwan in October. Their services were requested to advise TFC on the proposed establishment of a research and development center for fertilizers to serve Taiwan.



Donald McCune and Owen Livingston examine deep-placement applicator for fertilizer granules while visiting a Research Station in Taiwan.

TFC is currently engaged in fertilizer research and development but is interested in developing the proposed center not only to do research on improved fertilizers but to better use fertilizers and fertilizer byproducts for other industrial purposes.

The total research effort of TFC would be under an Institute for Fertilizer Research and Development (IFRD). With backstopping from IFDC, the Institute would be able to implement its research program quickly in such areas as improved product quality, modified and coated urea, better utilization of byproducts, and corrosion/erosion research since IFDC is already working in these areas.

Improved Urea—

Collaborative Research Project—IFDC and KIST

Research is ongoing at the Korea Institute of Science and Technology (KIST) in studying methods to control the dissolution rate of modified urea. Urea is in the form of forestry grade (4-6 mm diameter), and 1-g supergranules (12 mm diameter) that can be deep placed in rice paddies. Data gathered thus far by IFDC show that deep placement of urea improves nitrogen recovery.

Further improvement is made by controlling the dissolution rate of the deep placed particles. By using a fluidized bed, KIST is producing small quantities of experimental materials for agronomic testing by IFDC, with coatings not based on sulfur. Promising results have been obtained by using a coating formulation containing silicate and latex. A preliminary economic estimate of the process is being made.

IFDC - ICAR—

Nitrogen Fertilizer Workshop

Consultations between Indian and IFDC scientists, in collaboration with and partial funding by the Ford Foundation, resulted in the convening of a joint Nitrogen Fertilizer Workshop at IFDC Headquarters, September 25-October 24. Eight senior soil scientists and agronomists were selected by the Indian Council of Agricultural Research to participate with IFDC staff members in the workshop.

The workshop's overall aim was to develop appropriate fertilizer-use technology for different rice cultivation conditions prevailing in India and to collaborate in developing improved fertilizer materials for rice.

The workshop took the form of formal presentations and broadly scoped and intensive discussions by and between the Indian participants and IFDC staff members on the varied aspects of rice fertilization practices in India and elsewhere. The status of nitrogen fertilization research was subjected to detailed review.

The Indian participants were acquainted with IFDC's laboratories and pilot-plant facilities, as well as a visit to TVA's complex. They were provided with the opportunity of using TVA's extensive library facilities.

The scientists toured rice experiment stations in Louisiana, Texas, and Arkansas to acquaint them with research programs, facilities, and commercial rice practices in the United States. They also visited different types of fertilizer plants in Louisiana and Arkansas.

The Indian participants engaged with IFDC staff members in drafting tentative proposals to serve as a basis for further discussions on cooperative work between the Department of Agricultural Research and Education, Government of India and IFDC.

IFDC staff members and Indian scientists are shown at the completion of the Nitrogen Fertilizer Workshop—Drs. N. P. Sinha, Paul J. Stangel, Ian Fillery, H. G. Singh, O. P. Meelu, S. K. Mohanty, K. G. Pillai, Paul Vlek, Donald McCune, Dennis Parish, N. N. Goswami, and P. B. Deshpande (Not shown is Dr. S. P. Dhua).

Brazil–

CEFER Group at IFDC

IFDC Research Chemist Rex Clayton (left) explains the latest in instrumentation for fertilizer analyses to CEFER group members–Marco Giulietti, Queenie Siu Hang Chui, Caio Takagaki Yamaguishi, Decio Zylbersztajn, Paulo Breno de Moraes Silveira, and Mario Luiz Mello Mattos de Castro.

Nine professional staff members from the Centro de Estudos de Fertilizantes (CEFER), Sao Paulo, Brazil, spent 2 weeks in October at IFDC studying several different aspects of international fertilizer research and development. Two members of the group stayed an additional 5 weeks for special study and experience.

The study format included subject presentations and discussions in the morning followed by small group or one-to-one sessions on selected subjects in the afternoon. Such topics as "World Fertilizer Production and Consumption," "Methods of Assessing Fertilizer Needs and Potentials in Developing Countries," "Current and New Fertilizer Production Technology," and "Marketing, Distribution and Pricing of Fertilizers" were covered in the morning sessions.

Afternoon sessions were devoted to work by CEFER individuals with IFDC and TVA specialists. Field trips to local commercial fertilizer plants were included.

Paulo Breno de Moraes Silveira, CEFER Chemical Engineer, spent an additional 5 weeks studying "pilot plant" design and operations in preparation for pilot-plant operation, at the future CEFER facility. He also worked in the laboratory studying urea-form fertilizers and protected coating technology.

Queenie Siu Hang Chui, CEFER Chemist, concentrated on fertilizer chemical analysis and quality control programs. She also visited Purdue University to study the fertilizer quality control and enforcement program of Indiana.

Sri Lanka–

IFDC to Study Eppawala Phosphate Deposit

The Dienst Internationale Technische Hulp (DITH), Sri Lanka, and IFDC have joined forces to determine the most feasible method or methods to use the Eppawala phosphate deposit. This phosphate deposit is a potential resource to help meet the fertilizer needs of Sri Lanka for many years. DITH requested a project proposal from IFDC to study alternatives to use the ore and carry out agronomic tests with experimental products. A proposal was subsequently approved by the Dutch and Sri Lanka in November 1978.

Because the project is of strong interest to IFDC and data obtained may be applicable to other problem ores, the cost is being shared by IFDC and DITH. Plans have been made to send IFDC geologist, Dr. G. H. McClellan, to Sri Lanka in early January 1979 to obtain representative phosphate samples and other raw materials such as serpentine. The project is to be completed within 12 months from receipt of the samples.

As part of the research to assist developing countries in making better use of indigenous resources, IFDC will carry out laboratory-scale studies to define technically feasible methods to use the ore in fertilizer processes. Technical data could be used for scale-up to pilot plant, although no large-scale tests are planned now. Agronomic screening will be done cooperatively by IFDC, DITH, and Sri Lanka. Larger quantities (50 kg) of the most promising product will be made for field testing in Sri Lanka.

IFDC staff members and their involvement with the Sri Lanka project are Dr. G. H. McClellan, coordinator and characterization; Dr. A. H. Roy, thermal phosphate; Mr. J. B. Cardoso, Mr. R. A. Dittrich, and Miss Libby Stockard, beneficiation; Dr. P. H. Peng, Mr. I. T. Rusli, and Mr. William Lawton, phosphoric acid.

Annual Meeting–

IFDC Board of Directors

The Board of Directors of IFDC met during the first week of October. The Board voted to expand to a total of 12 members. Thus, three additional members from the developing countries are being sought. The Board is presently made up of three members from the United States and one each from the United Kingdom, Japan, Australia, India, Brazil, and Nigeria.

The next meeting of the Board is scheduled for May, at which time the new members hopefully will be named and will participate. The May meeting will be an in-depth review of IFDC programs with special emphasis on long-range planning.

USAID–

Feasibility of Bulk Blending in Bolivia

USAID/Bolivia engaged IFDC to study the technical feasibility of installing a bulk-blending and bagging plant. USAID's overall goal is to provide fertilizers to the small-farm sector at lower prices. Because bulk blending is only one method for decreasing the price of fertilizers, the IFDC study team--Dr. Robert Smith, Marketing Specialist, and Mr. Terry Frederick, Chemical Engineer--took as their objective the exploration of bulk handling and blending and other alternatives for supplying fertilizers in increased quantities at lower prices.

The resulting report includes a general survey of the agricultural situation within Bolivia to supplement previous reports. The IFDC recommendations are extensions from the fertilizer importing efforts by the organization of integrated cooperatives. A mixed system of bulk handling from the port to a central location, followed by blending and bagging, will effect both short- and long-term benefits to the small farmer. These benefits should be a reduction in fertilizer prices and an increase in fertilizer availability.

Terry Frederick and Robert Smith discuss farming and fertilizer practices with Bolivian farmer.

Workshop Conducted–

Sulfur in the Tropics

"Sulfur Problems in the Tropics" was the topic for a workshop sponsored in cooperation with The Sulphur Institute at IFDC Headquarters, December 12-13. The workshop is part of IFDC's continuing effort to achieve its mission to improve fertilizers and fertilizer know-how for tropical and subtropical agriculture.

Nine agronomists and soil scientists from different areas of the world discussed such topics as "Sulfur in Soil," "Sulfur in Tropical Agronomy," "Sulfur Analytical Techniques," "Sulfur Problems in Tropical Soils," and "Sulfur in Tropical Crop Production." IFDC Soil Scientist, Dr. Leo Korentajer, Workshop Coordinator, presented IFDC's proposed sulfur program to the participants. Contacts have been initiated to develop IFDC's sulfur research in tropical countries.

Participants received a draft of the publication *Sulfur in the Tropics* by Dr. Graeme J. Blair. The publication, a cooperative effort between IFDC and The Sulphur Institute, will be available for distribution within two months.

Participants included the following: Dr. M. A. Tabatabai, Iowa State University, Ames, Iowa; Dr. M. E. Probert, CSIRO Division of Soils, Townsville, Queensland, Australia; Dr. Graeme J. Blair, University of New England, Armidale, N.S.W., Australia; Dr. R. J. Swaby, CSIRO Division of Soils, Glen Osmond, South Australia, Australia; Dr. A. R. Bromfield, EAAFRO, Kikuyu, Kenya; Dr. Wenceslau J. Goedert, EMBRAPA, Planaltina, DF, Brazil; Dr. Lloyd Frederick, AID, Washington, D.C.; Dr. Eugene J. Kamprath, North Carolina State University, Raleigh, North Carolina; and Dr. Samuel L. Tisdale, The Sulphur Institute, Washington, D.C.

B. Bechon and R. Bloise, representatives of PHOSVALOR, discuss test results on Senegal slimes as IFDC Chemical Engineer Peter Peng conducts laboratory tests. More than 10 million tons, *not* 100 million tons as reported in the September issue–*IFDC Report*, of slime material has already accumulated.

PUBLICATIONS AND REPRINTS AVAILABLE FROM IFDC

Reports

"Granular Urea–Advantages and Processes," published by IFDC.

"The Potential for Regional Cooperation in Fertilizer–A Methodology Study of the ASEAN Group," published by IFDC.

"Supplying Fertilizers for Zaire's Agricultural Development," published by TVA.

"West Africa Fertilizer Study (Volumes I-VII)," published by IFDC.

- Volume I–Regional Overview
- Volume II–Senegal
- Volume III–Mali
- Volume IV–Upper Volta
- Volume V–Niger
- Volume VI–Chad
- Volume VII–Mauritania

"Economic and Technical Aspects of Fertilizer Production and Use in West Africa," T. Zalla, R. B. Diamond, and M. S. Mudahar, IFDC/MSU Working Paper No. 22, 1977.

"Ghana–Progress in Fertilizer Production, Marketing, Education," published by TVA.

"Suggested Fertilizer-Related Policies for Governments & International Agencies," published by IFDC.

"Progress Report, 1976-1977," published by IFDC.

"The Bangladesh Fertilizer Sector, 1978," published by IFDC.

Papers and Reprints

"Needed Information and Economic Analysis for Fertilizer Policy Formulation," M. S. Mudahar, Presented at FAO/FIAC Seminar on Fertilizer Pricing Policies and Subsidies, Bangkok, Thailand, 1978.

"A Simple Chemical Method for Evaluating the Agronomic Potential of Granulated Phosphate Rock," S. H. Chien and L. L. Hammond, *Soil Science Society of America Journal*, Vol. 42, No. 3, May-June 1978.

"Dissolution of Phosphate Rocks in Flooded Acid Soil," S. H. Chien, *Soil Science Society of America Journal*, Vol. 41, No. 6, Nov.-Dec. 1977.

"Interpretation of Bray I Extractable P from Acid Soil Treated with Phosphate Rocks," S. H. Chien, *Soil Science*, Vol. 126, No. 2, Aug. 1978.

"Thermodynamic Considerations of the Solubility of Phosphate Rock," S. H. Chien, *Soil Science*, Vol. 123, No. 2, 1977.

"Dissolution Rates of Phosphate Rocks," S. H. Chien, *Soil Science Society of America Journal*, Vol. 41, No. 3, May-June 1977.

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