Role of the Engineering Company in the Implementation of a Urea-Based NPK Granulation Project in Malaysia

Lee D. Hoffman and Glen H. Wesenberg[1]

Abstract

This paper illustrates how a grassroots NPK fertilizer plant project can be implemented with the owner serving as the project manager. The success of such an endeavor is heavily dependent upon a high degree of cooperation among all parties. In this project, the owner, FPM Sendirian Berhad (FPM) of Malaysia, successfully managed the project from its original conception in 1979 through commercial operation, which began in 1983 and continues today.

Introduction

In this paper, I will describe how FEECO International, Inc. (FEECO) took a basic process design, developed through pilot-plant testing by the International Fertilizer Development Center (IFDC), and translated it into a functional mechanical design that then allowed FPM of Malaysia to fabricate most of the major equipment and construct a urea-based NPK granulation plant. Also, I will discuss FEECO's role in helping FPM select local Malaysian equipment fabricators and perform other critical duties, such as alignment of the rotary equipment and the supply of critical parts for the system equipment, for example, rotary drum tires and girth gears. I am not going to go into the process details, formulations, equipment design details, and such, as these items have been or will be covered in detail by others. The main point is how this project was performed in a nonconventional manner. FPM, the client, took on the role as project manager, and with the assistance of IFDC and FEECO designed and built a successfully operating urea-based NPK granulation plant.

Major Roles of FPM and IFDC

The following major activities were performed by FPM with assistance, as needed, from IFDC.

A. Determine market potential and needs.
B. Establish appropriate formulations to meet market needs.
C. Establish sourcing for the required raw materials.
D. Develop the basic process design and operating parameters suitable for use in a commercial-scale granulation plant.
E. Establish overall project feasibility.
F. Arrange for financing.

FEECO'S Role

FEECO's basic expertise deals with the design and fabrication of equipment and engineering of systems for chemical processes, predominantly in the agrichemical industry. Because of experience in the operation of urea-based NPK granulation plants, FEECO is well equipped to serve customers in the following specialized areas:

1. Equipment sizing and selection.
2. Equipment design.
3. General plant and equipment layout.
4. Equipment fabrication.
5. Selection of the appropriate materials of construction.
6. Startup assistance.
7. Training in operation and maintenance of equipment.

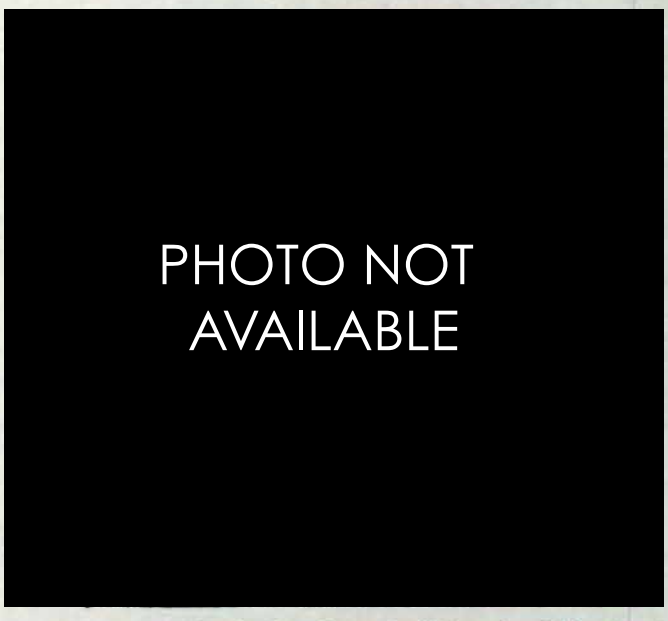
FEECO is a well-known combined engineering and equipment manufacturing firm. The term "combined" means that we have the ability to take general engineering concepts, design the appropriate equipment, and then provide drawings for fabrication either in our shop or elsewhere.

Plant Objectives

When FEECO was selected to participate in the FPM project, the following objectives were established and clarified:

- The facility should produce high urea NPK grades best suited for local needs.
- The facility should be of the highest quality and standards available in today's market.

1. Regional Sales Manager and Vice President, Process Engineering, respectively, FEECO International, Inc. – United States.



- The cost to obtain the above facilities should be kept to a minimum.

- The facility should contain as much local (Malaysian) content as possible.

With these objectives in mind, I will explain how FEECO assisted FPM with both the engineering and manufacturing of the equipment system.

First Objective – The Facility Should Produce High-Urea NPK Grades Best Suited for Local Needs

To design an equipment system to meet this objective, FEECO had to know some basic information, such as successful formulations (IFDC determined these from pilot-plant work), type and quality of raw materials to be used, and the rates of production required.

Formulations had to be known or determined for each NPK grade of fertilizer to be produced. Together IFDC, FPM, and FEECO reviewed each formulation before arriving at a set of grades that could be manufactured in the proposed granulation facility. In summary, the following data were obtained from the above review:

- A list of grades to be manufactured.

- A list of the raw materials and quantities to be used in production of the above grades.

- Projections of the quantities of each grade required per year.

- A report indicating the expected optimum production rates for each of the major grades.

Second Objective – The Facility Should be of the Highest Quality and Standards Available in Today's Market

From the information developed in the first objective, along with IFDC's assistance, we were able to do detailed plant design. To accomplish this we first worked through the following four steps:

- We prepared a flow diagram tabulating data for each of the major grades to be produced. The flow diagram consisted of the following five main systems:

1. Batch weigh and feed system:
   a. Clod breaker.
   b. Raw material elevator.
   c. Single-deck screen.
   d. Oversize chain mill.
   e. Cluster hopper.
   f. Weigh hopper.
   g. Gravity blend and surge hopper.
   h. Continuous feed conveyer.
2. Granulation loop:
   a. Recycle surge hopper.
   b. Recycle elevator.
   c. Fluid feed systems.
   d. Urea solution or melt tank.
   e. Scrubber and accessories.
   f. Rotary drum granulator.
3. Drying/cooling loop:
   a. Fuel system.
   b. Burner and controls.
   c. Combustion chamber.
   d. Rotary dryer.
   e. Air pollution equipment and exhaust fans.
   f. Transfer conveyor.
   g. Rotary cooler.
4. Sizing loop:
   a. Screen feed elevator.
   b. Single-deck oversize screens.
   c. Single-deck product screens.
   d. Oversize crushers.
   e. Product elevator.
5. Product coating loop:
   a. Surge hopper.
   b. Coating agent feed system.
   c. Coating drum.

- We then calculated and selected the proper equipment sizes to match the flow diagrams and production rates established.

- Next, we prepared a full description (specification) of each piece of equipment selected.

- We then prepared general layout drawings for the granulation plant.

Third Objective – The Cost of the Facilities Should be Kept to a Minimum

The majority of costs saved were in the following two major areas:

1. By acting as project manager, FPM was able to avoid major administrative costs often associated with large engineering firms.
2. The detailed information supplied by FEECO afforded the project team the flexibility to have much of the fabrication and construction done by local (Malaysian) companies. The following are some of the major advantages that accrued as a result of maximizing local construction content of a facility:
   a. Import duties were minimized.
   b. In the majority of cases, local labor rates were much more attractive.
   c. Freight savings were maximized.
   d. Additional jobs were created in the local market.
   e. Technology was transferred to the local marketplace during the fabrication and construction phases of the project. This technology stays long after the project is completed, thus assisting in the development of the local economy and technical resource base.

The following information is normally supplied by FEECO to facilitate local construction:

1. Detailed specifications and drawings for each piece of equipment.
2. Detailed system layout drawings.
3. Shop fabrication drawings on all equipment to be furnished, including:
   a. Rotary dryer.
   b. Rotary cooler.
   c. Rotary granulator.
   d. Product conditioning system.
   e. Chutes.
   f. Hoppers.
   g. Transitions.
   h. Guards.
   i. Ducting.
   j. Hoods.
   k. Conveyers and bucket elevators.
   l. Metering and control equipment.
   m. Electrical switchgear.
   n. Air handling and emission control equipment.
   o. Other ancillary equipment required for a complete system.
4. Determination of the most appropriate source for each equipment item.
5. Selection of the most appropriate vendors to be sent bid requests. Examples of purchased items include:
   a. Trunnion wheels.
   b. Thrust rollers.
   c. Drives.
   d. Large bearings.
   e. Screens.
   f. Other specialized equipment that would not be available locally.
6. Preparation of inquiries to be sent to the appropriate vendors and evaluation of bids and recommendations as to which supplier should be issued purchase orders. This may include the issue of purchase orders, if appropriate.
7. Inspection and expediting of items purchased for fabrication and erection.

Fourth Objective – The Facility Should Contain as Much Local Content as Possible

In addition to maximizing local fabrication of process equipment, the design/construction information provided by FEECO made it possible to perform essentially all site construction using local construction firms and labor. To facilitate construction, FEECO provided the following:

1. Specifications to be used for construction of the plant including:
   a. Concrete foundations.
   b. Support steel.
   c. Electrical wiring.
   d. Plumbing.
   e. Siding and roofing.
   f. Equipment erection.
   g. Miscellaneous civil works.
2. Drawings for construction of above items.
3. Inquiries (invitation to bid) to be sent to construction bidders.
4. Evaluation of local fabricators' facilities and abilities, including recommendations for award of contracts.
5. Supervision of construction and installation of critical equipment items as requested (for example, the rotary drums).
6. Consultation on startup relative to the equipment and process as requested.

Conclusion

As a result of the above described method of implementation, the FPM factory was constructed in a very economic way and the local economy benefited by providing the majority of equipment fabrication and construction services. An added benefit of the methodology used was that the technical skills of the Malaysian fabrication industry were expanded to include large-scale fertilizer plant equipment fabrication and construction.