

## **THESIS INFORMATION**

Thesis title: **STUDY PARTICLE COATING TECHNOLOGY FOR SMART UREA FERTILIZER PRODUCTION**

Major: **CHEMICAL ENGINEERING**

Major code: **62.52.03.01**

Doctoral candidate: **NGUYEN HUU TRUNG**

Supervisors: **ASSOC. PROF. DR. TRINH VAN DUNG**  
**DR. TRAN NGHI**

Training instisute: **UNIVERSITY OF TECHNOLOGY, VIET NAM NATIONAL UNIVERSITY HO CHI MINH CITY**

### **1. Abstract:**

The smart fertilizers or controlled-release fertilizers was one of the enhanced efficiency fertilizers which has been increasingly used in modern agricultural production. The nutrient release of these fertilizers could be controlled to suit the needs of the crop. Therefore, they do not only help reduce production costs, save raw materials and natural resources, but also improve the productivity and quality of agricultural products, reduce emission and avoid environmental pollution. The smart fertilizers were produced by particle coating technology with suitable coating material. The coating technology will not change the current production technology because the manufacturers simply implement this technology to the existing production system, thus reducing investment and production costs. However, the data and method of the coating particle process in general, and coating fertilizers to produce smart fertilizers are still limited. Therefore, the addition of data and the development of the methods to calculate the particle coating process is problems which many researchers were interested. The object of study was to develop an empirical mathematical model of the particle coating process by a disk coater to use for simulation, design calculations, optimization, and improvement of the production process. The study subjects are the process and technology of particle coating according to the wet-coating mechanism by a disk coater. It is a simple, efficient and suitable coating equipment system for smart fertilizer production. In particular, the study

scope is the particle coating process to product smart urea fertilizer with biodegradable and environmentally friendly polymer materials.

The results of study shown that the coating material is a mixed polymer which includes a cross-linked polymer synthesized from phosphate modified starch, poly vinyl alcohol, and poly acrylic acid, was biodegradable, durability, permeability, and chemical and physical properties suitable for use as coating. An empirical mathematical model was built by dimensional analysis and described all three basic processes of particle coating technology including the spray process, the movement of particles and coating formation, and the thermodynamic process. The mechanism of diffusion was also determined by experiment, thereby establishing a mathematical model of the diffusion process based on Fick's law II, calculating empirical parameters and the influence of factors on the release of nutrients.

## **2. New contributions of the thesis:**

- Finding new coating materials was biodegradable from phosphate-modified starch, biodegradable poly vinyl alcohol and poly acrylic acid, and whose physical parameters were consistent with wet-coating technology by a disk coater. These coating materials have not mentioned in previous studies.
- Used modern imaging methods and tools such as high-speed recording (1000 frames per second), image analysis techniques to determine the parameters of the spraying process, the particle coating process quickly, reliably and efficiently.
- An empirical mathematical model has been developed in the form of the dimensionless equations that described the spray coating process and the pan-coating process for smart urea fertilizer production. They can be applied for calculation, adjustment, control and optimization for actual production system.
- The studied model of the pan-coating process can be applied to the development of other products such as micronutrient supplements, stabilized fertilizers, etc. and in other fields such as pharmaceuticals, food and environment.

**Supervisors**

**Doctoral candidate**

**Assoc. Prof. Dr. Trinh Van Dung**

**Dr. Tran Nghi**

**Nguyen Huu Trung**