CHAPTER 1

INTRODUCTION

1.1 Background

The rapid expansion of a supercritical solution (RESS) process is a novel technology applied for coating small particles by fine particles. The RESS process using supercritical carbon dioxide (CO_2) as the solvent is an innovative and promising technology that can produce fine particles [Tsutsumi, A, 2001]. For cohesive particles such as drug of fine particles, RESS process makes it possible for coating without particle agglomeration because of the absence of binder droplets. Moreover, carbon dioxide is also low-cost, widely available material, nontoxic, nonflammable and has relatively low critical temperature and moderate critical pressure. These advantages make RESS process very attractive for particle coating in pharmaceutical application.

The RESS process is simple and easy to implement especially in a small scale where a single nozzle is used. Never useless, due to some information reported, scale up of RESS process to the industrial production requires either a multi-nozzle system or a porous sintered disk in which pulverization occurs. In either case, particle size distribution is still controllable. However, the real implementation of a rapid expansion of a supercritical solution (RESS) unit for industrial applications is complicated and predictability of the result is still unavailable. Therefore, understanding the influence of all relevant process parameters is important. These lead to a motivation to apply simulation technique for investigating the phenomena of RESS by taking EOS into account.

1.2 Objectives of the thesis

1. To investigate the equation of state suitable for evaluation of the carbon dioxide properties.
2. To develop a suitable mathematical model and computer program for simulation of rapid expansion of supercritical carbon dioxide using the two-dimensional rectangular coordinate system.
3. To simulate the effect of inlet temperature, inlet pressure and inlet velocity on the rapid expansion of supercritical carbon dioxide, especially near the nozzle area.

1.3 Scopes of the thesis

1. Investigate equations of state which can be employed for evaluating the properties of carbon dioxide.
2. Investigate a mathematical model suitable for representing fluid dynamics and then encode it as a computer program for simulation of rapid expansion of supercritical carbon dioxide using two-dimensional rectangular coordinate system.
3. Investigated system consists of chemically non-reactive substances.
4. High velocity inlet fluid is injected from a nozzle at the central part of the bed.
5. Initially, atmospheric stable condition is mainly assumed.
6. Investigate the effect of inlet temperature, inlet pressure and inlet velocity on the rapid expansion of supercritical carbon dioxide, especially near the nozzle area.

1.4 Obtained benefits

1. Obtain the suitable equation of state for evaluation the properties of carbon dioxide.
2. The suitable mathematical model for the simulation of rapid expansion of supercritical carbon dioxide is obtained.
3. Obtain a new tool for design and simulation the rapid expansion of supercritical carbon dioxide.
4. Get better understanding of the effect of inlet temperature, inlet pressure, and inlet velocity on the rapid expansion of supercritical carbon dioxide, especially near the nozzle area.