สำนักงานวิทยทรัพยากร จุฬาลงกรณ์มหาวิทยาลัย

CHAPTER I
INTRODUCTION

Systems involving multiphase flow have been found widely in nature and industry. The phases involved include liquid, gase and solid. In the case of two-phase flows, like gas-liquid flow and liquid-liquid flow, both phases flow simultaneously in the system. Systems involving gas-liquid flow are widely found in many processes and equipment such as chemical and nuclear reactors, heat exchanger and in oil and gas wells.

In concurrent vertical gas-liquid flow, there are a number of different flow regimes, of which different flow patterns will be produced by varying the inlet gas and liquid flowrates. The most important regimes are bubble, slug, churn and annular. The gas-liquid slug flow is one of the most complex with unsteady intermittent characteristics. This flow pattern is encountered in numerous practical situations, production of steam and water in geothermal power plants, emergency core cooling of nuclear reactor, the simultaneous transport of gas and oil in vertical wells, and heat and mass transfer between gas and liquid in chemical reactors. It is of great importance to investigate the hydrodynamic characteristics of gas-liquid slug flow in both industrial and academic fields.

Packed towers operated in a two-phase countercurrent manner have maintained an important role in today's chemical industry. Introduced early in the twentieth century, the general concept has constantly evolved around the progress of various packing shapes that are stated to increase the tower's efficiency as well as to reduce the operating costs. Currently, columns containing packing materials, such as raschig rings, are used for several purposes, especially in distillation, absorption, and stripping processes. Because the operation of packed towers is considered to be cheap, they are of great interest for pollution control. However, their effectiveness will suffer if the design do not suit the operating conditions.

Flooding, a physical phenomenon emerges and must be investigated first, as its level of importance which will inevitably influence many parameters; for example, mass transfer coefficients, flow behavior, liquid holdup, pressure drop across the bed. The flooding capacity consists essentially in a determination of fluid in the bed at which the liquid starts to overflow. The flooding capacity can only be observed, hence there is no accurate definition to describe this phenomenon. However, it can be interpreted in two distinguishing categories. The first method involves visual inspection of a column undergoing flooding and the second method relies on a graphical detection of "slope inflation" in pressure drop and liquid hold-up diagrams as a function of the gas flow rate. Consequently, the operating point beyond which a small increase in gas velocity produces an extensively large change in pressure drop and liquid hold-up in the column is the basic definition for flooding.

The experiments of this research are focused on the slug-flow regime in two-phase flow (air-water system) and flooding in the column with the same system. These are important in a variety of chemical engineering applications. The major works in this research are studying the rise velocities of single air slugs and continuously generated slugs moving steadily in rising water in vertical tubes, and investigating the shape of slugs and rise velocities of slugs in stagnant liquid compared to ones by the finite-element method. Finally, study of the limit of upward flow of air and the downward flow of water in packed column containing two different types of packing materials and three different heights of packing were determined by visual inspection and graphical detection.