CHAPTER I

INTRODUCTION

A phase is simply one of the states which can be a gas, a liquid, or a solid. In a multiphase flow there are several phases coexisting, such as smoke, snow, fog, and etc. A two phase flow is the simplest of a multiphase flow.

Two phase flows like gas-liquid flow are most commonly used in many processes such as chemical, heat exchanger, steam generators and the simultaneous transport of oil and gas in vertical wells.

In a vertical gas-liquid flow, there are four important flow regimes caused by varying gas flow rate. The flow regimes are bubble, slug, annular and mist. The flow regimes influence the heat transfer rate, the momentum transfer, and the pressure gradient. In a study of the motion of a single gas bubble rising in a stagnant liquid, one is concerned with the following effects: inertia of the gas and the liquid; viscosity of the gas and the liquid; density difference and buoyancy; and surface tension and surface contamination

The behavior of a single gas bubble released in a column of liquid within in a vertical tube depends on the size of the bubble. When the bubble is quite small, it remains spherical and rises along a vertical rectilinear path. Larger bubbles become ellipsoidal and irregularly shaped and tend to rise along helical or zigzag paths. When increasing the gas flow rate, large cap-shaped bubbles are formed by collisions, and when the diameter of the bubbles is nearly the same as the tube diameter it is the start of the slug flow. The churn flow, which is the transition between the slug and annular regimes is highly disturbed and has large waves flowing up the channel and is interspersed with regions of falling liquid films. In the annular flow, part of it is the liquid film and the rest is dispersed in the gas core in the form of fine droplets. And when increasing the gas flow rate, the liquid film will be thinner while the number of droplets is increased. The mist flow starts when the liquid film is removed from the wall.

For predicting the behavior of two phases flowing in a vertical tube, we need to study the pressure gradients because of the pressure losses occur during a

concurrent vertical gas-liquid flow. They are very important for the design of the wellhead pressure and tubing size in a production system. Therefore, the pressure gradients in a two phase flow are very important factors for petroleum industries.

This work is focused on the study of the pressure gradient, the bubble size and velocity, and slug size and velocity in vertical pipes air-liquid in flows in various two-phase flow regimes. The scope of the work is to study the effect of pipe diameter and surface tension by adding surfactants. In particular, we are interested in investigating the effect of carbon length of the cationic surfactants (Benzalkonium chloride) dissolved in water as the working liquid on the pressure gradient. Moreover, the pressure gradients measured from the experiments will be compared with those predicted from the theories proposed in the literature.