# CHAPTER VI

# DISCUSSION

## 6.1 Equipment and Experimentation

Since the proposed design equations of a spouting column were obscure and required further study; the design of the column used in the present study followed one made by Kugo et al.[8] Their column for spouting wheat was of 4-inch diameter, with 60° cone angle, 0.3-0.6 inch air-inlet diameter and 4-9 inch bed depth. Since the specific density and size of wheat are very close to that of shelled corn, the spouting column for shelled corn was designed by following the column geometry of Kugo. The constructed column with 60° cone angle, when being firstly carried out, failed to spout the bed; however, after the cone angle was changed to 35° , the column gave good spouting. That confirmed the statement of Elperin et al (1967)[8] who had stated that the limiting cone angle for most materials appears to be in the region of 40°.

Concerning with the air compressors, firstly the reciprocating type was started alone, but poor spouting was obtained so the other which was straight lobe type was then co-operated. Both of them established spouted bed of about 40 cm for about 800 gm of shelled corn. With both compressors, the compressed air temperature rised up to 70°C without heating, resulting that the heat exchanger was needed to remove the heat evolved. It was unnecessary to employ such a large heat exchanger, but it was the only one available in the laboratory.

The minimum drying temperature was intended to be set at 30°C ; unfortunately, in spite of using only one electric heating unit, the temperature came out to be as high as 40°C. Therefore, the minimum drying temperature was unavoidably set at 40°C. The limited drying temperature is 54°C [15] [17], which causes no damage in nutritive values; the drying temperature under investigation was limited to 50°C. Since at least three drying temperatures should be investigated for graphical evaluation and for convenience in temperature setting, a temperature of 45°C was also carried out.

Since continuous feeder available in the laboratory failed to work efficiently, the experiments for continuous system were impossible.

## 6.2 Result

From the calculation in Appendix B, air velocities were in the range of 8.56 - 9.23 ft/sec, and at the same condition, the theoretical minumum spouting velocity was 6.73 ft/sec. This indicates that experiments were carried above the flow regime required for spouting.

From the plot of k against $\sqrt{\theta}$, a linear relationship was established, having a negative slope -b. Therefore, it can be shown that the experimental behaviors follow the given assumptions.

The surface moisture content was calculated to be 0.1518 gm/gm dry basis at 40 - 50° C, 75 % relative humidity. This result was very close to that obtained by Hall and Rodriguez - Arias (1958)[10] performing the experiment at 37.8°C (100°F), 75 % relative humidity and giving the moisture content at the bounding surface of 15.35 % dry basis. Thus, the result obtained was proved to be reliable.

The investigation also gave the value of diffusion coefficient which then resulted in obtaining the diffusion constant and the activation energy in the Arrhenius - type equation. It is unfortunate that the data of diffusion coefficient of shelled corn were unknown, so that it could not be proved of its correctness.

The drying equation obtained was useful for a spouted bed. The equation involves three variables: feed moisture content, bed temperature, and residence time. To use the drying equation, feed moisture content must be specified, and surface moisture content must be known. Since the maximum particle temperature is limited to 54°C, a bed temperature of 54°C is recommended for corn drying. From both specified variables: feed moisture content and bed temperature, residence time can be evaluated. From this step, it leads to the calculation of feed rate, thermal energy requirement, and inlet air temperature (see Appendix C). Therefore, from the drying equation and the necessary data of spouting conditions, outlet particle temperature, feed moisture content, some physical properties of the drying particles, and all the performances needed to carry out in the operation of larger scale can be obtained.