Sample Abstract

(เป้าหมายการทดลอง) This report presents the separation of a 10%mol ethanol-water mixture with a 28-stage distillation column.

(ทฤษฎีและวิธีการทดลอง) Both finite and infinite reflux runs were performed, each at a high supply steam pressure (80 kPa) to the reboiler and at a low pressure (70 kPa). Murphree and point efficiencies were calculated for the active stages sampled after steady-state operation had been achieved. The values obtained fluctuated greatly because of inaccuracy associated with determining the ethanol composition. Because of these fluctuations, we did not observe an increase in efficiency as steam pressure increased. We also did not observe an increase in efficiency for infinite runs in comparison with the finite runs. Global efficiencies, calculated for each run, ranged from 56% to 88%. Also for each run, mass and energy balances were performed.

(ข้อค้นพบสำคัญ) The significant heat losses obtained were mostly likely because of the absence of insulation and the presence of air drafts near the column. Energy balances over the condenser and reboiler showed actual heat gains from the environment which is unlikely and probably due to error associated with stream enthalpy estimations.

(ส่วนสำคัญในการอภิปราย) For all runs, heat transfer coefficients were calculated for the condenser and reboiler units. Values for the reboiler ranged from 271 to 561 Btu/ft2/hr/deg-F and were higher than the literature range of 160 to 350 Btu/ft2/hr/deg-F. Condenser values ranged from 20 to 83 Btu/ft2/hr/deg-F.

(ข้อสรุป) Economic analysis performed on the column indicated an increase in net profit of more than $1.2 million per year using a supply steam pressure of 80 kPa rather than 70 kPa.

Sample Introduction

(**ความสำคัญของการประลองและพื้นความรู้สำคัญ)** This report discusses an experiment to study the relationship of temperature and pressure of an ideal gas (air) that was heated in a closed container. Because the ideal gas was in a closed container, its volume remained constant.

(**เป้าประสงค์/วัตถุประสงค์)** The objective of the experiment is to test whether the ideal equation of state holds.

(สมการและตัวแปรสำคัญ) In the equation,

$$pV = mRT$$

where p is the pressure the gas, V is the volume, m is the mass, R is a constant, and T is temperature.

(**การนำเสนอ**) This report presents the procedures for the experiment, the experiment's results, and an analysis of those results.

Sample Procedures

(อุปกรณ์และวิธีการทดลอง…สามารถแยกหัวข้อได้) In this experiment, air (an ideal gas) was heated in a pressure vessel with a volume of 1 liter. Attached to this pressure vessel was a pressure transducer and thermocouple to measure the pressure and the temperature, respectively, of the air inside the vessel. Both of these transducers produced voltage signals (in Volts) that were calibrated to the pressure (kPa) and temperature (K) of the air (the atmospheric pressure for where the experiment occurred is assumed to be 13.6 psia). (แนวทางการคำนวณตัวแปรที่ต้องการจากสิ่งที่วัดได้) In addition, the theoretical temperature (K) of air was calculated as a function of the measured pressured values (kPa).

Sample Results and Discussion

This section analyses the results of the experiment. The experiment went as expected with no unusual events that would have introduced error.

(ผลการทดลอง) The voltages as measured for the pressure and temperature transducers appear in Table A-1 of the Appendix. Also included in the Appendix are the equations used for calibrating those voltages with the actual pressures and temperatures. These equations led to the values of pressure and temperature that are shown the third and fourth columns of Table A-1. From these values, a graph between temperature (K) and pressure (kPa) was created (Figure A-1). As can be seen from the graph, the relationship of temperature versus pressure is roughly linear.

(อธิบายเปรียบเทียบระหว่างการปฏิบัติกับทฤษฎี) As part of this experiment, the theoretical values of temperature were calculated for each measured pressure value. In this calculation, which used the ideal gas equation, the volume and mass were assumed to be constant. These theoretical values of temperature are shown in the final column of Table A-1. From this final column arose Figure A-2, a graph of ideal temperature (K) versus pressure (kPa). As shown in this graph, the relationship between temperature and pressure is exactly linear. A comparison between the graph showing measured data (Figure A-1) and the graph showing theoretical data (Figure A-2) reveals differences. In general, the measured values of temperature are lower than the ideal values, and the measured values are not exactly linear. Several errors could explain the differences: precision errors in the pressure transducer and the thermocouple; bias errors in the calibration curve for the pressure transducer and the thermocouple; and imprecision in the atmospheric pressure assumed for the locale. The bias errors might arise from the large temperature range considered. Given that the temperature and pressure ranges are large, the calibration equations between the voltage signals and the actual temperatures and pressures might not be precise for that entire range. The last type of error mentioned, the error in the atmospheric error for the locale where the experiment occurred is a bias error that could be quite significant, depending on the difference in conditions between the time of the experiment and the time that the reference measurement was made.

Sample Conclusion

Overall, the experiment succeeded in (ผลสำคัญที่ได้) showing that temperature and pressure for an ideal gas at constant volume and mass follow the relation of the ideal gas equation. (อธิบายปรากฏการณ์สำคัญ) Differences existed in the experimental graph of temperature versus and pressure and the theoretical curve of temperature versus pressure. (ระบุเรื่องความคลาดเคลื่อน) These differences, however, can be accounted for by experimental error.