CHAPTER 11

Summary and Conclusion

SUMMARY AND CONCLUSION

The thesis entitled "Column Calibration Factor and Force Parameters to Predict Temperature and Composition Dependence of Thermal Diffusion Factor of Some Simple Molecules" deals with several theoretical and experimental aspects of thermal diffusion column (TDC). Role of the column calibration factor to determine the temperature or composition dependence of thermal diffusion factor α_T is examined in the earlier part of the thesis. The thesis presents a new theory to determine the molecular force parameters of the gas molecules by thermal diffusion. Occurrence of elastic or inelastic collisions among molecules are examined carefully. Furthermore, a simple, adequate and straightforward column constants are given explicitly to explain the thermal diffusion column behaviour.

The phenomenon of thermal diffusion is well known for its wide applicability in different fields of science and technology. Two bulbs, Swing separator and Thermal diffusion column are the commonly used apparatus in which separation by thermal diffusion can be made. The general theories of separation by the above instruments are well discussed in the 1st chapter of this thesis.

Several authors have engaged themselves deeply in thermal diffusion to improve the column theory while a qualitative agreement is only observed. A brief review of the previous theoretical and experimental works are thus presented in chapter 2 of the thesis.

The scope and objective of the thesis work is presented in chapter 3. It involves with the measurements of α_T by the column calibration factor in thermal diffusion column. The α_T's as measured could be shown as a function of composition or temperature of the binary or ternary gas mixture.

Chapter 4 of the thesis deals with theoretical formulation of TD factor α_T based on elastic or inelastic collisions among molecules. Furthermore, determination of experimental α_T by the existing method of Maxwell model dependent and Slieker molecular model independent column shape factor (CSF) has been discussed to compare them with the experimental α_T by the CCF method.

Composition dependences of experimental α_T of He^4 - Ar^{40}, Ne^{20} - Xe^{132} and Ne^{20} - Ne^{22} gas mixture through F_s of the column are estimated in the 5th chapter of the thesis. So far their magnitude and trends of variation with the molefraction of the lighter component are concerned these α_T's agree excellently with those α_T's by the existing methods. This suggests that the evaluation of α_T's by the CCF method is a unique one and can safely be used to study the composition dependences of α_T in both isotopic or nonisotopic molecules.

Chapter 6 of the thesis describes the temperature dependence of experimental α_T of hydrogenic trace mixtures in Helium through CCF of a given column. Experimental α_T's by the CCF method are compared with those by the existing methods as well as with the theoretical α_T's based on either elastic or inelastic collisions among molecules. Besides the role of the CCF in determining the experimental α_T this study observes the inelastic collision effect among these experimental simple molecules.

The thermal diffusion column of Roos and Rutherford has been accurately calibrated in chapter 7. Thermal diffusion factors α_T's against $\overline{T}$ of Kr, Xe, CO, CH_4 and N_2 binary isotopic mixtures have been obtained in terms of the CCF of the column. These α_T's are used to estimate the molecular force parameters of all the aforesaid molecules. Theoretical α_T's based on elastic or inelastic collisions among molecules as well as experimental α_T's by the existing method are evaluated. Comparison of the obtained results finally suggests that the technique of predicting α_T as a function of temperature is extremely useful.

In the 8th chapter of the thesis simultaneous determination of α_T as well as prediction of pressure dependence of $\ln q_e$ are made possible in terms of the CCF of a given column. Experimental α_T due to Maxwell and Slieker CSF as well as theoretical α_T based on elastic collisions among molecules are evaluated for comparison. α_T's against $\overline{T}$ as obtained by the CCF method are used to estimate the molecular force parameters of the experimental molecules. Evaluated force parameters agree excellently with the reported data. It may thus be concluded that α_T plays an important role in determining the molecular force parameters. Further, F_s is a sensitive α_T measuring parameter and its model independency is established.

From Navier - Stoke's hydrodynamical equation in cylindrical coordinates an approximate formulation of F_s at any given temperature is derived in the 9th chapter. Derived formulation is used to determine F_s of four different experimental columns and thereby to determine α_T of Ne^{20} - Ne^{22} isotopic gas mixture by the CCF method. Furthermore, molecular force parameters of Ne are evaluated from the temperature dependence of experimental α_T. The excellent agreement of the estimated force parameters with the available literature values and the comparison of the temperature variation of α_T by the CCF method with the existing experimental and theoretical α_T establish the fact that the derived relationship of F_s is more than adequate.

Relationship of F_s derived in chapter 9 is extended further in chapter 10 of the thesis. From the available $\ln q_{max}$ of four different TD column α_T of He^3 - He^4 gas molecules is obtained by the CCF method. Column parameters as obtained are used to determine the optimum pressure of the working column. Excellent agreement of the estimated optimum pressure with the experimental results and the comparison of the temperature variation of α_T by the CCF method with the existing experimental and theoretical α_T clearly signify that the column parameters acheived so far is a significant improvement over the existing theories.