CHAPTER II

SURVEY OF THE LITERATURE

Since the pioneer of Van der Waals in 1873, there have been many equation of state proposed for predicting the P-V-T behavior of gases. Many of this equation contain several constants which must be determined empirically or semi-empirically. Martin(1967) pointed out that if a high order of precision is required in predicting experimental data for large temperature and pressure range, as many as forty-four constant may be necessary; however, two or three constant often sufficient over small range. The two constant equation developed by Redlich and Kwong predict the P-V-T behavior of gases in reasonable accuracy. The Redlich-Kwong equation of state, first introduced in 1949, has been wide use in computer procedure for predicting real gas behavior. It is generally concede to be one of the best generalized two parameter equation of state available. The ability of this equation to predict experimental data has been substantiated by Henley and Seader(1976). They calculated pressure as a function of molal volume with 190 F isotherm for the GRK equation of state and for the ideal gas law and compared them to the experimental data that measured by Sage and Lacey(1986). The calculated value show that at 190 F for pressure up to 30 psia, both the GRK and the ideal gas law are in very good agreement with experimental data. For 30 psia up to the saturation pressure, the GRK equation continue to agree with experimental data, but the ideal gas law shows increasing deviations. And for liquid phase, the GRK equation consistently predicts liquid molal volume larger than those measured. The deviation are much larger than for the vapor region. Another case is applied to the mixture of propane and benzene over wide ranges of temperature and pressure by using the

GRK equation to calculate compressibility factor(Z) and a specific volume of a vapor mixture. The specific volume from calculation is 2.95% higher than the measured value. In 1968, Edmister calculated vapor pressure from the GRK equation of state. The results are plotted in reduced from of vapor pressure and temperature. The GRK vapor pressure curve does not satisfactorily represent data for a wide range of molecular shapes as witnessed by the experimental curve for methane, toluene, n-decend and ethyl alcohol on the same plot. This failure represent one of the major shortcoming of the GRK equation.

Most modification of Redliche-Kwong equation incorporate, in addition to Tc and Pc, a third corresponding states parameter, usually the acentric factor ω; this improves the performance of the equation for nonsimple fluids. One such modification is that of Soave(1972) who retains the original expression for *b*, but replace the original expression for *a* by adding the acentric factor. In 1973, West and Erbar shown the ability of the SRK correlation to predict K-value for the multicomponent system of 10 species studied experimentally by Yar-bolough. Also, the SRK correlation appears to be particularly well suited for predicting K-value and enthalpies for natural gas system and for the methane-propane system at over a pressure range of 25 to approximately 200 psia. Van Ness and Abbott(1982) presented as examples the results of some VLE calculation done with Soave's 1972 modification. They calculated VLE of the methane/n-decane system by using SRK and GRK equation of state and compared them to the experimental data from Sage and Lacey(1950). Significantly, both equation of state are able to produce qualitative description of VLE of this kind. However, the SRK equation is clearly superior.

The Soave-Redliche-Kwong is rapidly gaining acceptance by the hydrocarbon processing industry. Future development, such as that of Peng and Robinson(1976)are likely to improve prediction of liquid density and phase equilibrium in the critical region.