CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

6.1.1 Sensitivity Analysis

From sensitivity analysis of parameters in the previously proposed mathematical model (Chaikasetpaiboon *et al.*, 2002), the interstitial velocity (v) and the effective bed voidage (ε) were more sensitive to the theoretical breakthrough curves than the effective axial dispersion coefficient ($D_{L,eff}$).

To develop the existing mathematical model, the parameters and the equilibrium adsorption isotherm constructed for each adsorbent were used in the model. The adsorption equilibrium data on the different commercial adsorbents were obtained and employed in the adsorption term in the model.

6.1.2 Adsorption Isotherm

6.1.2.1 Silica Gel

Linear model was employed to give a good correspondence with the experimental data points for the adsorption of water vapor on the silica gel.

6.1.2.2 4A Molecular Sieve with the Pellet Size of 1/8"

The adsorption isotherm model of 4A molecular sieve 1/8" was separated into two regions. The Langmuir model gave a good agreement with the experimental adsorption isotherm data in the first region, whereas the exponential model demonstrated a good representative of the experimental data point in the second region.

6.1.2.3 4A Molecular Sieve with the Pellet Size of 1/16"

The equilibrium adsorption isotherm of 4A molecular sieve 1/16" was divided into three regions. The Langmuir and the exponential model revealed a good correspondence with the experimental adsorption isotherm data in the first and the second regions, respectively. In the third region, the Freundlich model was used as a representative of the experimental data point.

6.1.2 Mathematical Model

Since the water concentration in the natural gas feed was very small, the decrease in the interstitial velocity due to the water adsorption can be neglected. Therefore, the assumption of constant fluid velocity was applied in the mathematical model.

In order to achieve the best agreement between the experimental and theoretical breakthrough patterns, the overall mass transfer coefficient of approximately 8.5×10^{-5} s^{-1} was suggested in the model for all experimental cases. The modified mathematical model for predicting the breakthrough profile of water adsorption on the multi-layer adsorber provides a good correspondence with the experimental breakthrough data under various experimental conditions. The differences of the experimental and theoretical breakthrough times were only about 3% to 5%.

6.2 Recommendations

The objective of this thesis was to develop the mathematical model for water breakthrough curve prediction under the experimental conditions. However, the ultimate goals of this work were to predict the water breakthrough time under the commercial conditions and to further estimate the life time of the commercial adsorbents. As a result, the following recommendations would be suggested for the future work in order to achieve the goals of this thesis:

1) The deactivation of the adsorbents should be studied. The mathematical model of the adsorbent deactivation should be performed and used in the breakthrough curve prediction model.
2) The commercial operating conditions should be studied for predicting the breakthrough time after the deactivation model is preformed.
3) The user friendly program such as the Visual Basic programming language should be employed for the breakthrough curve prediction.