CHAPTER V
CONCLUSIONS

5.1 Conclusion

In this work the hydrogenation of ethylene and acetylene was studied on a Pd-Ag/ Al_2O_3 catalyst containing 0.03 wt % Pd and 0.235 wt % Ag. The ethylene hydrogenation was investigated in the temperature range of 60-90 °C. At 3 mol % hydrogen, and 30 mol % ethylene, an apparent activation energy of 38 kJ/mol was found, in excellent agreement with the work of Bos et al. (1993) Cortright et al. (1991) and Zaera et al. (1984) reported in the literature. The reaction order with respect to hydrogen was found to be 1.60, while the order with respect to ethylene was -0.98. The hydrogen concentration range used was 2-5 mol % and ethylene concentration range was 15-30 mol %.

It was found that the relative degree of catalyst deactivation decreased with increasing hydrogen concentration and decreasing ethylene concentration. Operation at 90 °C was found to be beneficial for activity maintenance, while at lower temperatures the catalyst deactivated quite severely, losing about 60 % of its initial activity before reaching a steady state operation. The lower degree of catalyst deactivation at 90 °C is attributed to the more effective removal of carbonaceous deposits from the catalyst surface by hydrogen.

Acetylene hydrogenation experiments were conducted in the temperature range of 70-100 ° C , hydrogen concentration range of 1-4 mol % and the acetylene concentration range of 0.6-1.5 mol %. The obtained apparent

activation energy was 40 kJ/mol. This value is in agreement with Bos et al. (1993) and Moses et al. (1984) studies. Hydrogen order was found to be 1.15 and acetylene order was -0.65.

The degree of deactivation was found to decrease with an increase in hydrogen concentration and an increase in temperature. The degree of deactivation was independent of acetylene concentration which may be due to the rather small range of acetylene concentration used. Operating at higher temperature results in less deactivation, and this, in turn, prolongs the catalyst life which is industrially of interest.

5.2 Comment

It must be noted that, in this work, the acetylene hydrogenation was conducted in the absence of ethylene. Typically, the extent of ethane formed by further hydrogenation of ethylene, which is the product of acetylene hydrogenation, can be neglected. As a result, almost 100 % selectivity toward ethylene was observed in this work. However, in industrial practice, the hydrogenation of acetylene takes place in a mixture of acetylene and ethylene so selectivity toward ethylene is of concern. Higher temperatures are beneficial for catalyst activity maintenance but decreases the selectivity toward ethylene which is economically undesirable. This suggests that the kinetics of acetylene hydrogenation in the presence of ethylene on Pd - Ag /Al_2O_3 should be studied to obtain a better understanding of this reaction and better control of process operation .