

## CHAPTER V

### CONCLUSIONS

Catalytic combustion of diethylamine in excess oxygen was carried out over three commercial ceramic-honeycombed monolith catalysts. The activities of all commercial catalysts were investigated in terms of the light-off temperature, a temperature at 50% conversion. The reactions were operated in the range of 200 to 400 °C. The completed combustion products such as N<sub>2</sub>, CO<sub>2</sub>, and water were obtained as the major products within this temperature range. Among the various catalysts studied, the most active catalyst was found to be Pd catalyst and reactivity to complete oxidation of diethylamine was Pd > Pt > Rh, respectively. As a result, CO<sub>2</sub> was apparently produced as primary product without the formation of CO, indicating the efficiency of palladium in promoting the destruction of the C-N bond to complete combustion products. In this present study, N<sub>2</sub>O does not found to be a product from the catalytic combustion of diethylamine because the temperature used in this work does not exceed 400 °C. However, this product is usually found at the moderate temperature, above 400 °C. The catalytic activities were investigated in terms of CO<sub>2</sub> formation in this present study.

The lowest light-off temperature of 290 °C was found in the case of Pd catalyst. Thus, Pd is the most active catalyst and favorable for the catalytic combustion of diethylamine. For Pt and Rh catalysts, which are less active than Pd catalyst, the light-off temperatures were obtained at 340 and 325 °C, respectively. Under diethylamine oxidation, CO<sub>2</sub> formations greater than 95% were attained at 320, 400, and 380 °C in the case of Pd, Pt and Rh catalysts, respectively.

The effect of reactant concentrations on the reaction rate in terms of the rate of CO<sub>2</sub> formation was studied. The reaction rate was depended on diethylamine concentration whereas the oxygen concentration did not affect to the reaction rate. The reaction rate increases with increasing DEA concentrations. Reaction temperature was found be a significant factor. Reaction rate is increased with the temperature. The higher the temperature, the greater the destructive efficiency.

The reaction over the most active catalyst, Pd, in chemical kinetic region at the temperature of 250 and 265 °C shows a 0.56 order dependence on diethylamine concentration. The reaction order with respect to oxygen concentration was observed to be close to zero.

The apparent activation energies of the reaction were determined in chemical kinetic control, pore diffusion control and bulk mass transfer regions, respectively. The rate of CO<sub>2</sub> formation was measured at the several different temperatures. The Arrhenius plot shows three distinctly different activation energies, each related to a possible rate-determining step. The highest activation energy of 18.8 kcals/mole was observed in the region that is controlled by chemical kinetics. The intermediate value gave the activation energy of 9.9 kcals/mole which the reaction is controlled by pore diffusion. Finally, the lowest activation energy of 2.2 kcals/mole was obtained at the region of bulk mass transfer.