

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

1) Ambient VOC concentrations in Bangkok appeared to be different during the southwest monsoon season than during the northeast monsoon season. At all 4 monitoring stations around Bangkok, the average VOC concentrations during the southwest monsoon were higher than the concentrations during the northeast monsoon. This was apparently caused by the difference in atmospheric conditions between the two seasons. During the southwest monsoon, the weather was cloudy and rainy. During the northeast monsoon, weather conditions were dominated by clear sky with strong sunshine so that air pollutants can react photo-chemically. Clouds can also absorb the wavelengths of solar radiation important to photochemical reactions. As a result of these 2 factors the depletion of VOCs as the precursor substances occurred less during the southwest monsoon than during the NE monsoon.

(2) The CMB7 receptor model results showed that during the southwest monsoon season, all 4 stations downwind from the industrial area south of Bangkok, in Samut Prakan province, had ambient VOC concentration contribution mostly from fuel oil boilers contributing 22% of VOCs. The other significant sources found were exhaust gas from both gasoline vehicles and diesel vehicles at 26%, vapor of gasoline at 12%, vapor of paints and thinners at 8%, biomass burning at 19% and food barbequing at 2%. Unexplained sources were 7%.

During the northeast monsoon season, the most important source of VOCs was exhaust gas from gasoline vehicles at 50%. Other significant sources were exhaust gas from diesel vehicles at 6%, fuel oil boilers at 2%, vapor of gasoline at 12%, vapor of paints and thinners at 3%, food barbequing at 5%, municipal waste disposal at 12%. Unexplained sources were 8%. In this season, up until the month of February, biomass burning did not affect VOC ambient concentrations.

The CMB7 receptor model results show the average source apportionment of VOCs of around 42% were from the exhaust gas of vehicles. Other VOC sources of concern are area sources and fugitive sources which contributed to Bangkok ambient air as follows: refueling at 12%, usage of solvent containing products at 5%, biomass burning at 10%, food barbequing at 3%, and municipal waste disposal at 8%. VOCs from the point sources: flue gas from fuel oil boilers, contributed to Bangkok ambient air at 12%.

(3) In comparing the source contribution of VOCs from this study to Bangkok's emission inventory base year of 1997, the results indicate that in addition to the known inventoried sources such as vehicle exhaust gas and boilers, the control strategy must put greater emphasis on area sources: refueling, usage of solvent containing products, and fugitive sources: municipal waste disposal, biomass burning and food barbequing.

6.2 Recommendations

The results indicate that for the effective control of VOCs which are ozone precursors, target sources such as area sources: refueling, usage of solvent containing products, and fugitive sources: municipal waste disposal, biomass burning, and food barbequing need to be included in amelioration programs. These sources are difficult to include in VOC inventories and thus until now, have not been included in mitigation measures.

VOC sources from biomass burning and food barbequing have a high benzene fraction. Controlling these sources can also reduce the benzene in ambient air.

6.3 Future Works

For future works, VOC species in ambient air and emission source profiles should be investigated more thoroughly, especially low molecular weight VOCs to cover all constituents at each source. The more unique the individual source, the easier the model can indicate the source's contribution.

VOCs in ambient air should be collected in canisters for low molecular weight VOCs from C2 to C4 as the instruments become available.

More emission source profiles should be added, such as vapor degreasing, dry cleaning and the petrochemical industry.

The additional research concerning the human exposure to benzene should be conducted on food barbequing vendors.