CHAPTER VIII

CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

To serve the objectives of this research, the conclusions were implicated by the assessments in the aspects of waste management and economic concern.

1. Regarding waste minimization, at least 30% of rice husk waste could be transformed to a more value-adding product in the form of amorphous silica. The rice husk silica extracted by acid leaching contains more than 90% silica content, which is worth for utilizing as silica source for the synthesis of MCM-41. The estimated value of the extracted silica retrieved from 1 kg of rice husk was 720 Baht.

2. The mesoporous molecular sieve, RH-MCM-41, was successfully synthesized from rice husk silica with the molar compositions $1SiO_2$: 1.1NaOH: 0.13CTAB: $0.12H_2O$. The optimal synthesis conditions were 48 h of aging at a pH value of 10. The synthesized MCM-41 possessed the well-defined hexagonal structure with a pore diameter of 29.0 Å and the BET surface area of about (800 ± 8) $m^2\ g^{-1}$, which agreed very well with the parent MCM-41. The economic cost of 1 kg of MCM-41 produced from the rice husk silica was approximately 26,000 Baht.

3. The RH-MCM-41 applied to the adsorption studies of some CVOCs such as trichloroethylene (TCE), tetrachloethylene (PCE), and carbon tetrachloride (CT) showed excellent results. RH-MCM-41 adsorbed a similar amount of TCE, PCE and CT, but the adsorption of CT was stronger than that of TCE and PCE. The amount of adsorbed TCE on RH-MCM-41 was greater than that on activated carbon and mordenite. However, PCE and CT adsorbed on RH-MCM-41 as much as activated carbon but more than mordenite. This indicated the potential of utilizing RH-MCM-41 for the treatment of CVOCs in liquid state.

4. The gaseous phase isotherms of CT at 25 °C and nitrogen at 77 K on the RH-MCM-41 particles using the magnetically coupled microbalance were classified as reversible Type V and Type IVc isotherms, respectively. Pore size distributions (PSD) of nitrogen and CT adsorption isotherms for the RH-MCM-41 calculated by using the BJH and Naono methods showed quite narrow pore diameter distributions, centered around 27 and 29 Å, respectively. Similarly, the peak pore diameters calculated from CT isotherms using the BJH and Naono methods were 24 and 28 Å.

5. Application as a support (RH-MCM-41) on supported palladium for catalytic activity of the hydrodechlorination of chloroform performed with good activity up to 80-90 % at 150-200 °C and low probability of chain growth, which are comparable to other kinds of supports (SiO_2, SiO_2-Al_2O_3). By means of this method, the RH-MCM-41 can be used for the treatment of CVOCs in gaseous phase.

8.2 Recommendations and Future Works

The recommendations shown below were evaluated from the experimental data. These interesting points would encourage more research works, which ought to be conducted continuously in order to achieve a success in the actual waste management practices.

1. Even it has a lower silica content than rice husk, rice husk ash in its blackish form could be utilized for a silica source. After using rice husk as fuel for heat production, its ash would provide the advantages if used as a source for the extraction of silica. However, the condition for rice husk burning and the process of silica extraction should be studied.

2. Other agricultural wastes containing high silica content such as corncobs, bagasse and also flyash, have the potential to be alternatives for silica source. The most appropriate methods for increasing the economic value for different agricultural wastes through their lifecycles should be investigated. Moreover, the sensitivity of impurities from the raw materials on the property of MCM-41 should be taken into account.

3. Due to an expensive commercial surfactant, which is the main cost of the RH-MCM-41 synthesis, the replacement of a commercial surfactant (CTAB) is recommended. It would be greatly beneficial if the surfactant could be produced from natural products or recycled wastes.
4. Instead of MCM-41 production, the extracted silica should be utilized for the synthesis of other silica-based materials to serve specific purposes.
5. The effectiveness and limitations of MCM-41 synthesis and its applications must be determined and demonstrated for large-scale production.