CHAPTER I

INTRODUCTION

1.1 Statement of Purposes

Rice husk is an agricultural solid waste which is abundantly generated from rice–producing countries. In Thailand, the local annual rice production in 2001 reported from the Department of Agricultural Extension was approximately 24 million metric tons, which generated about 5 million metric tons of husk waste. The husk has been used as animal feed and fuel in the combustion process to produce heat for paddy drying, while the left has been normally disposed by dumping and landfill. However, ash residue from the open burning still causes air and water pollution [Ramboll, 1998]. The fugitive dust generated from landfill associated with burning residues brings about nuisance problems and health effects to human communities located nearby the sites. Up to date, it has been realized that rice husk waste management should be conducted more effectively in order to gain the highest value from the husk before it is discarded. According to waste management policy, waste minimization has been increasingly campaigned for all over the world. The transformation of agricultural wastes into a value-adding product, or waste recycling, has been also widely implemented. These agreements encourage the utilization of husk waste become more interesting concept. Rice husk ash contained more than 96% by weight of hydrated amorphous silica. Furthermore, the process of silica extraction is very simple and inexpensive; making it beneficial to use rice husk as a natural source of silica, instead of commercial silica [Iler, 1979; Paya, 2001].

Silica is a major chemical which is used to synthesize silica-based molecular sieve materials such as zeolite, a microporous molecular sieve. Commercial zeolites are currently being produced from chemical silica. Recently, low-cost zeolite was successfully synthesized from rice husk silica [Hamdan, 1997 and Paul, 1998]. Different from zeolites, a mesoporous molecular sieve MCM-41, has not been commercialized yet. This material possesses outstanding properties such as a well-defined pore size in the range of 2-50 nm, a uniformly hexagonal structure and high thermal stability. The active surface area of approximately 700-1200 $m^2 g^{-1}$ provides many advantages in terms of adsorption and catalytic reactions. However, the study of MCM-41 synthesis using rice husk silica has yet to be reported on. Thus, there is no doubt that the conduction of this study could induce novel advances in the comprehensive knowledge of environmental management and also encourage a worth challenge in economic aspects.

The interesting application of MCM-41 is as a catalytic support in the hydrodechlorination of some hazardous substances, such as chlorinated aliphatic and aromatic compounds [Ordonez, 2000; Chen, 2002; Mori, 2002]. Approaches for eliminating chlorinated hydrocarbons can be direct incineration, catalytic combustion, biodegradation, photo-catalytic decomposition, and catalytic hydrodechlorination [Farrauto, 1997; Chen, 2002; Finocchio, 2002]. Among these treatments, hydrodechlorination is the most promising process [Chen, 2002]. Chlorinated hydrocarbons can be converted to harmless and more useful hydrocarbons compared to other techniques. Hydrodechlorination provides a clean procedure and satisfactory performance for the treatment of chloroform, which is widely used as solvent and dry cleaning agent, and has also been considered a hazardous environmental pollutant and human carcinogen. The U.S. Environmental Protection Agency has identified chloroform as a hazardous waste. The release of chloroform into the environment contributes to air pollution and subsurface contamination, so the disposal of chloroform is regulated and currently subjected to more stringent regulations [ATSDR, 1997].

Overall, the utilization of rice husk silica as a raw material for the synthesis of mesoporous catalyst support MCM-41, and its application in the treatment of chloroform via hydrodechlorination are alternative treatment methods in waste management. Not only are environmental aspects concerned, but its economic merits were also taken into account. In this study, each experiment was written separately, chapter by chapter, beginning with silica extraction and followed by the synthesis of parent MCM-41, which was a prototype of MCM-41 material. Afterward, the synthesis of MCM-41 from rice husk silica (RH-MCM-41) was carried out. In order to utilize this synthesized material as a catalyst support for the hydrodechlorination of chloroform, its sorption characteristics were studied by the adsorption and desorption of some chlorinated volatile organic compounds. Finally, cost effective of MCM-41 produced from rice husk silica was evaluated and compared to that of commercial molecular sieve.

1.2 Research Objectives

The main objectives of the research are to utilize rice husk waste as an alternative silica source for MCM-41 synthesis and apply it as a catalyst support for chloroform treatment over the hydrodechlorination reaction.

1.3 Scope and Limitation of the Study

1. Silica was extracted directly from rice husk waste by means of acid digestion.
2. Parent MCM-41 was synthesized following the Kumar Method (2001). The studied parameters were aging time and pH.
3. The synthesized MCM-41 was employed as a catalyst support of palladium for the hydrodechlorination of chloroform, which was performed in gaseous phase. The efficiency of the reaction was determined by considering the variations in the catalyst loading and reaction temperatures and compared with commercial catalysts.

1.4 Expected Outcomes

1. *Waste minimization:* the introduction of an alternative abatement method of rice husk and rice husk ash by means of mesoporous MCM-41 synthesis.

2. *Hazardous waste treatment:* new information on the catalytic hydrodechlorination of chloroform over MCM-41 synthesized from rice husk silica.

3. *Economic aspect:* a cost analysis of synthesized MCM-41 from rice husk silica determined through a comparison with commercial porous silica.