CHAPTER 1

INTRODUCTION

1.1 Significance of the Study

More than one-fourth of the people in the world eat rice as a major staple food. From the harvested rice crop, unmilled rice constitutes nearly 45% of the dry weight of the plant while the straw percentage is nearly 30%. From the dry unmilled rice, some 20% is made up of rice hulls. This indicates an enormous volume of residues that are generated from the production to processing of rice.

Rice hull and rice straw use is shown in Figure 1.1. But the best utilization appears to be for the production of energy and fuel. For many years, rice hulls had been used as a source of energy in rice mills, for example as heat energy for the parboiling of rice. Rice mills in Thailand use simple hull burners to produce steam to provide mechanical energy and to provide heat for rice parboiling systems. However despite such utilizations there remain significant amounts of rice hulls left unused in Thailand.

To increase quantity and efficiency of rice hull utilization, pyrolysis technology as a thermochemical conversion process which converts rice hull into a fuel has been considered. Pyrolysis has been used for centuries for the production of

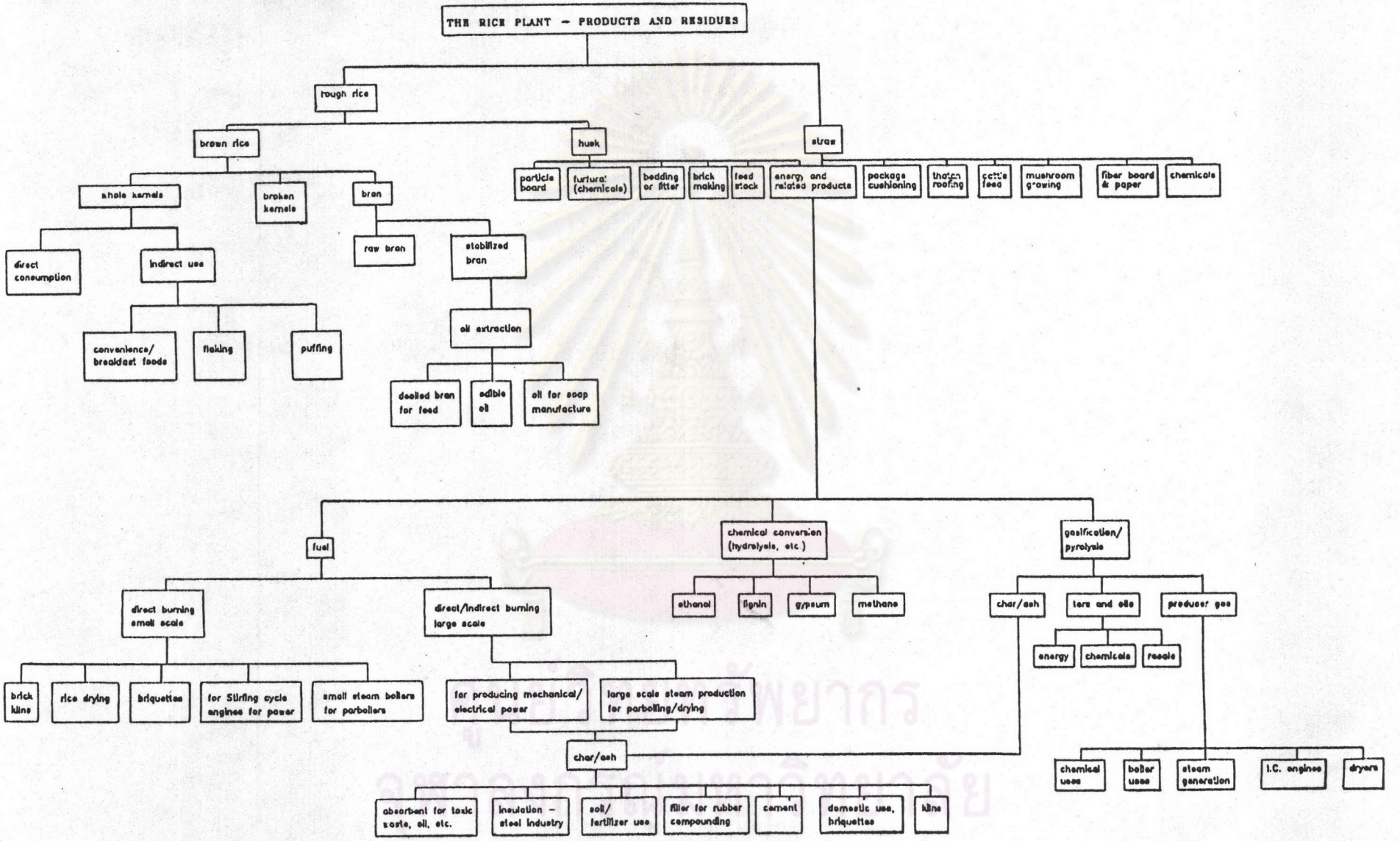

Figure 1.1 Uses of Rice Residues

charcoal, and is still important today. It was also the primary source of methanol and many other chemicals before the advent of the modern petrochemical industry.

Wood charcoal is the major economic product of the pyrolysis process. Rice hull char on the other hand must be briquetted for utilization as a solid fuel. For industrial utilizations such as small scale cement making, rice hull char could, with some modifications of furnaces, replace fuel oil. In an environmental aspect, rice hull char has very low sulfur content causing no sulfur dioxide pollution problem.

Besides being a solid fuel, the rice hull char can also be utilized in diverse applications : as an oil absorbent, a building material, an insulating material, a fertilizer, a filter media, a carbon source for water purification, or as an activated carbon, etc.

The original study originated after Professor Grover of IIT (Indian institute of technology) invented the Grover carbonizer for producing rice hull char. This carbonizer unit is made up of a drum through which is fitted a heating tube containing a grate and in which a fuel is burned to provide heat. Heat is then conducted from the heating tube to the rice hull in the drum through a set of conduction fins attached to the heating tube. As volatiles are released from the rice hull, they move through a volatiles loop and pass into the heating tube where they produce a significant portion of the overall fuel requirement. After the batch pyrolysis process, the solids in the carbonizer are converted

into rice hull char and may contain some unpyrolysed rice hulls. These unpyrolysed rice hulls are normally found in areas adjacent to the outside walls of the carbonizer. From these experiments which showed the existence of zones with low heat penetration, it was felt that a better understanding of the phenomena would be needed to design better units. The phenomena occurring is believed to be describable by a pyrolysis process. The fundamentals of the pyrolysis process involve chemical reactions and heat transfer, and a pyrolysis model would need to integrate both kinetic and heat transfer models. Many investigators (Bamford, 1946 ; Shafizadeh, 1972 ; Durvuri, 1975) have employed a simplified single first order reaction to describe the complex pyrolysis reactions in a kinetic model. The initial pyrolysis begins at the surface of the particle and progresses inward. The rate of the reaction front's progress is mainly controlled by the net rate of heat conduction. Therefore heat conduction is of great importance in pyrolysis. This work was undertaken in order to better understand the kinetics of pyrolysis and the phenomena of heat transfer during pyrolysis.

1.2 Objectives

The objectives of this study are :

1. To experimentally determine the values of various parameters of a pyrolysis model from results in a pyrolysis furnace.

2. To study the heat conduction phenomena during pyrolysis of rice hull in a cylindrical furnace.

1.3 Scope

The tasks to be undertaken in this study are as follows.

1. To study the pyrolysis process in a cylindrical furnace.

2. To determine the physical and chemical properties of rice hulls used in this study.