CHAPTER I

INTRODUCTION

The forests of the world are progressively dwindling as the countries of the world are rapidly developing and their populations fast increasing. Wood, the main product of the forests, is today the base material in the manufacture of the multiplicity of valuable products like rayon, paper, fibre boards, etc,. As a result of vast quantities of wood being use for these industries, there is a growing scarcity of wood and the price of wood is becoming increasingly prohibitive for the fields in which it is traditionally used. However, man is not too happy to dispense with the use of wood for certain traditional uses, and the result is that cheap and effective substitutes for wood panels, such as plywood, fiberboard and particleboard using cheap sources of wood, have emerged. They are made out of species of wood or wood waste which are not acceptable for use in the traditional furniture and other industries.[1]

The demand for wood is on the increase and the supply is unable to keep pace with it. Furthermore, the declining size of available logs (due to the use of younger trees) and the economic need to recover higher percentages of usable material from forest resources. Chemical modification is one of the attempts to demonstrate utility of wood.[2, 3] New sources of wood supplies have to be exploited so as to maintain the industries in which wood is the starting material. In this respect the softwood, small, and low-quality trees of the world have vast potentialities in supplying wood. These are the cheap sources of wood to effective substitutes for wood panel industries, such as plywood, fiberboard, and particleboard.[1]

A great variety of adhesives have been used as assembly glues with wood for home projects, furniture, and other nonstructural application. The greatest volume of wood adhesives or binder for structural applications are thermosetting phenol-formaldehyde (PF) or urea-formaldehyde (UF) polymers or their derivatives. Binders play an important role in the wood products industry. The use of adhesives can

increase the utilization of small and low-quality trees in a variety of bond wood products.[4] The conventional formaldehyde based binders for composite wood panel products have several shortcomings that have become increasingly important over the last two decades. For example, phenol-formaldehyde form a brittle glueline that for some end-use applications can become detrimental over time. Urea-formaldehyde resins are coming under increasing attack because of formaldehyde emissions and resulting indoor air pollution problems. Formaldehyde binders also have long pressing times, intensive energy consumption, and health risk for workers. Attempts to formulate new non-conventional bonding systems have explored ways to emulate the behavior of conventional adhesives.[5]

Lignins, tannins, and isocyanate are the new binders that would overcome these problems. They have shown the most promise as potential substitutes for conventional adhesives. Also, they have received the greater share of attention and funding.

Particleboard has rapidly gained market share since it is strong, resists warping and marring, and is easy to assemble without noticeable joints, it has quickly penetrated the flooring and furniture corestock markets. Like plywood, the construction industry is the largest consumer of particleboard. The largest application in the construction industry is for floor underlayment, particularly in small homes and mobile homes. Of the manufacturing uses for particleboard, furniture corestock is the single largest application.[5]

Rubber or para rubber trees (*Hevea braziliensis*) are hardwood species, rubber plantations of the world have vast potentialities, in supplying wood, which is at present a waste product of rubber plantation schemes. The economic life of a rubber tree is estimated to be 25 years under the present conditions. Therefore, it is necessary to replant the old rubber plantations when they turn out uneconomic with high yielding varieties.

Unlike forests, the rubber plantations are all accessible. Thus the transport of rubber wood from equivalent distances would cost less than the forest wood. Furthermore, rubber wood, unlike forest wood, is a waste product in the rubber replantation scheme, as such it would be cheaper than forest wood which has specially to be felled for a particular industry.[1]

1.1 The Roles of the Rubber Wood in Thailand

Thailand is known as an agricultural developing country and the world's largest rice exporter.[6] Nowadays, Thailand is not only the world's largest rice exporter but also the world's largest rubber exporter. Rubber plants have been a major economic plant in southern and eastern part, including in some of north-eastern part. [7, 8, 9] At present, Thailand has rubber plantation area about 11.6 million rais.[10] The rubber plantations in Thailand tend to continue increasingly every year, particularly in east-northern part.

Since the role and the importance of rubber have been increased, the government has encouraged the replantation of the uneconomic rubber trees with the high yielding varieties one. In the beginning, most of cut down rubber trees were burnt away. The rest, just a few proportion was used for fuel, which caused much of economic loss.[11]

After the government has banded forestry concession in 1989, the lack of hardwood occurred. Therefore, Thailand must imported sawlogs and sawntimber from neighbouring countries. The import values increase, as a result, Thailand must face with the money lossing. Moreover, the import of wood from neighbouring countries has been uncertain in quantities and more difficult, causes problem in production. Consequently, the rubber wood becomes more important and more demand.[10, 12]

As a result of forestry concession banding in 1989, the furniture manufacturers have lacked of raw materials from natural wood. Therefore, the manufacturers turned to develop the utilization of softwood which is rapid growth tree and non-reserved wood species, particularly rubber wood was substituted in more quantities. The

manufacturers found that it can substitute the natural wood from natural forest, the export market prefers furniture made from rubber wood. Today, rubber wood products have increasing values and make income to country not lower than 10,000 million baht for annum.[13, 14, 15]

Because the average economic life of rubber trees are 25 years, the rubber trees also can be used for substitute import sawlogs and sawntimber from the neighbouring countries. Around the country, there are uneconomic rubber trees which are cut down for about 200,000 rais for annum, equivalent to volume of wood about 9.8 million cubicmeter. If all of wood could be used, it would a very useful for the country.[12, 16]

Therefore there is every likelihood, the rubber growing countries of the world could develop wood based industries to meet their own requirements and to supply the neighbouring countries, in competition with any of the highly developed countries, specialised in these industries.[1] Thus, the use of wood chip or particle from timber, splinter, waste wood, and end tip of rubber wood in producing particleboard is one of the methods of maximum utilization of rubber wood.

1.2 Objectives of the Research Work

1) To fabricate particleboard from rubber wood flake with polymeric diphenylmethane diisocyanate (polymeric MDI or pMDI) binder by hot pressing.

2) To study the effects of releasing agents, isocyanate index (polyol content), pMDI content in surface/core layers, cure temperature, cure time, and flakes moisture content on the properties of rubber wooden particleboard.

1.3 Scopes of the Research Work

In this work, the particleboard from rubber wooden flake with polymeric MDI was prepared. Three-layer particleboard was fabricated and tested under normal and vigorous condition. The interface adhesion between particles is the main parameter affecting the properties of particleboard, because it reflected the properties of the particleboard and the utilization of particleboard. The effects of isocyanate index (polyol content) and binder content in surface/core layers on mechanical properties are investigated. Scope of the study are as follows.

1) Literature survey of the relevant research works
2) Providing of chemicals and equipments
3) Preparation of particleboard from rubber wood flakes with pMDI binder by changing the following parameters:
    a) releasing agents
    b) isocyanate index (quantity of polyol diluting agent)
    c) pMDI content in surface/core layers
    d) cure temperature
    e) cure time
    f) rubber wood flakes moisture contents
    g) binder type in surface/core layers
4) Determination of the following physical and mechanical properties:
    - water absorption
    - thickness swelling
    - modulus of rupture
    - modulus of elasticity
    - internal bond
    - 2-h boil modulus of rupture
    - 2-h boil internal bond
5) Studying the microstructure of the fracture surface of particleboards by scanning electron microscopy
6) Studying the efficiency of the pMDI binder by staining method
7) Summarizing the results.