CHAPTER I
INTRODUCTION

1.1 Rationale and background

Rubbers are indispensable materials, being required for manufacturing of such products as vehicle tyres, hoses, belts, gloves, and condoms. Natural rubber (NR) is a main economic crop for many people in Thailand and the sharp drop in rubber prices will certainly affect their livelihoods. Thailand is the world's number one producer of natural rubber. Natural rubber is still of great technical importance for the rubber industry. The main reason is the combination of superior basic properties of NR, making it difficultly to replace it with synthetic rubber in such as heavy tyres and engineering products as motor mounts and shock absorbers. Over the last few decades (1990s) general purpose type of synthetic rubber has improved tremendously in consistency and the specifications. Thereby, in rubbers compounding, various additives are added to enhance the properties and processability of the vulcanisate (Amin and Scott, 1974), these additives have been found to be mostly from petrochemicals sources. Blending of different rubbers with natural rubber has also been considered to be an alternative method of enhancing processability or improving on some of inherent limitations of natural rubber. These development about blending of rubbers has shown epoxidized rubbers been used as a copolymer with NR during compounding (Okel et al., 1994). These demands, which are all of equal importance for developing of the rubber industry and for meeting the customer's requirements on quality and cost, need among other things consistent raw material to avoid disturbances in the process due to material variations (Coran et al., 1978). In general, the elastomer formulation comprises a base elastomer, process oil, plasticizer, fillers (carbon black or mineral filler), and additives such as stabilizer or process aid and curatives. However, additives for rubber are purchased from many countries such as plasticizer and processing aids, which cause high cost of products. Nowadays, the application of modified plant oils in chemical industry are becoming more and more

interesting and desirable because of their availability from renewable resources (Dasgupta et al., 2007).

Jatropha curcas Linn. is a tropical tree belonging to the family *Euphorbiaceae* which is cultivated in Central and South America, South-east Asia, India and Africa. The plant is commonly known as physic or purging nut. It is well adapted to arid and semi-arid conditions and can be grown in most regions of Thailand, especially in the North-eastern area. *Jatropha curcas* is a multipurpose plant with many attributes and great potential. The oil extracted from *Jatropha* seeds is potentially the most valuable product. Depending on the variety, *Jatropha* seeds contain 43-59% of oil used for lighting, as a lubricant and for making soap. *Jatropha curcas* have good burning potential as the seeds burn and emit energy for a considerable period of time. Since *Jatropha curcas* oil cannot be used for nutritional purposes without detoxification, its use as an energy source for biodiesel presently becomes more attractive. *Jatropha curcas* oil is regarded as a potential additive for rubber such as plasticizer and processing acids (Canakci et al., 2001; Ghadge et al., 2005; Gan et al., 1995; Wool et al., 2000). These components are separated from one another by a series of distillations. The oil fraction predominantly contained 78.4% unsaturated fatty acids mainly oleic acid (42.4%) and linoleic acid (35.2%) and 21.7% saturated fatty acids mainly consisted of palmitic acid (14.7%) and stearic acid (6.9%). Both palmitic acid and stearic acid were used as activator in the rubber industry. In case of oleic acid and linoleic acid, unsaturated lipid, they can be chemically modified to zinc soap. Moreover, they have used as plasticizer which can be made moulding easily. In rubbers compounding, various additives were added to enhance the properties and processability of the vulcanisate (Amin et al., 1974; Menon et al., 1994; Okieimen et al., 2002), these additives have been found to be mostly from renewable natural sources (Cole et al., 1966; Guang et al., 2002).

Therefore, the aims of this work developed method to syntensize plasticizer and processing aids from *Jatropha curcas* oil for cost effective and time-consuming to reduce the import of these substances from abroad. In addition to the compatibility of its in natural rubber and rubber blends was investigated, cure characteristics and mechanical properties of rubbers with different concentrations of *Jatropha curcas* oil

have been studied in comparison with the same dosages of paraffinic oil, the results of which are presented in this thesis.

1.2 Objectives of the research

1.2.1 To synthesize additives chemical for rubber from *Jatropha curcas* oil.

1.2.2 To study and compare the effect of physical and mechanical properties of rubber compounds from blends with *Jatropha curcas* oil and paraffinic oil.

1.2.3 To investigate the possibility of using the *Jatropha curcas* oil as replacement or alternative plasticizer and processing aids in the rubber industry.

1.3 Scope of the study

1.3.1 Study on the potential plasticizer and processing aids of natural vegetable oils in rubber.

1.3.2 Characterization of zinc soap from *Jatropha curcas* oil by using FTIR, EDX and XRD.

1.3.3 Design and analysis of experiments in preparation rubber compounds.

1.3.3.1 Preparation of rubber compounds.

(1) Mixing was carried out on a two-roll mill at 70 °C and 1:1.25 speed ratio according to ASTM D 3182.

1.3.3.2 Measurement of curing characteristics.

(1) Determination of the optimum cure time by using an oscillating disk rheometer (ODR) as described in ASTM D 2084.

1.3.3.3 Preparation of rubber sheet after mixing the materials were compression moulds at 150 °C from cure time, t_{c90} under a pressure of 15.2 MPa. The sheets were punched into specimens for test mechanical property measurement.

1.3.4 Characterization

1.3.4.1 Tensile and tear strength were according to ASTM D412 and ASTM D624, respectively.

1.3.4.2 Measured Aging properties were carried out by placing in air circulating oven at 100 °C for 22 h. Then, the specimens were cooled at room temperature for at least 16 h before testing.

1.3.4.3 Hardness value was measured according to ASTM D2240.

1.3.4.4 Equilibrium swelling measurement of the rubber vulcanizetes was measured by using toluene as solvent.

1.3.4.5 Filler dispersion was investigated by scanning electron microscope (SEM).

1.4 Anticipated outcomes

1.4.1 The database information of physical and mechanical properties of rubber compounds.

1.4.2 The optimum conditions for preparation of rubber additives from *Jatropha curcas* oil in rubber.

1.4.3 The processing information of some elastomer blends of additives prepared from *Jatropha curcas* oil in elastomer blends.