CHAPTER I
INTRODUCTION

Environmental concerns from consumers and the limitation of future fossil fuels impel efforts to search for alternative polymers to replace synthetic polymer. Abundant renewable cellulose fiber based materials are paperboard and paper. Nowadays, paper is reported to be the most widely used material in versatile applications thanks to its characteristics of printability, recyclability and biodegradability. However, the ever-increasing demand, especially of the advanced countries has resulted in continued denudation of forests causing severe environmental imbalances.

One of the materials found to be promising is the waste banana trunk, which is a very good source of cellulose. Banana plant is one of the most common crops grown in almost all tropical countries, including Thailand; therefore it is an abundant and cheap agricultural product. Dry residue is produced from this huge production, all of which goes waste due to non-availability of suitable technology for its commercial utilization. Therefore, the large availability of banana trunk waste is suitable to be alternatives to forest wood products.

However, cellulose has a porosity structure and hydrophilic property, typically its products provides low barrier and poor water resistance properties. Traditionally, petroleum-based materials coating or laminating has been used to improve its water resistance. Unfortunately, the cost of these materials is relatively high and they are difficult to degrade after using because they are obtained from fossil fuels.

Natural rubber, cis-1,4-polyisoprene, is a natural product from Hevea brasiliensis trees. Due to the outstanding properties such as water resistance, elasticity, toughness, impermeability, adhesiveness, and electrical insulation, natural rubber is one of the most appropriate materials for coating on paper to improve its water resistance.

Zinc oxide (ZnO) is one of bivalent metal oxides that can be used as a crosslinking agent for carbonyl groups, especially carboxylated nitrile rubber. The crosslinking of elastomer occurs via the reaction of its carboxylic groups with zinc

oxide, resulting in the formation of carboxylic salts, considered to be ionic crosslinks.

In this study, the dielectric barrier discharge (DBD) plasma technique is chosen to enhance the coating capability of the natural rubber on the cellulose fibers. The DBD plasma was used for surface modification by introducing new chemical groups and depositing thin layers of various polymers on the surface of materials. DBD plasma enables dry surface modification only on the outermost surface layer of the substrate without altering bulk properties. Moreover, DBD plasma technique also provides many advantages such as environmentally friendly, inexpensive, and easy to operate (Geyter *et al.*, 2007) which make the DBD plasma become a favorable green technology.

In the present work, cellulose sheets were prepared from inner core of banana trunks by paper-making process. Natural rubber solution was used to coat the surface of banana cellulose-based sheet to improve water resistance. Natural rubber-coated banana cellulose-based sheets were accomplished with the aid of dielectric barrier discharge (DBD) plasma and Zinc oxide (ZnO). The optimum condition for DBD plasma treatment was chosen based on the results of water contact angle measurement, thermogravimetric analysis (TGA), scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), X-ray diffraction spectroscopy (XRD), UV-Visible Spectroscopy and Fourier-transformed infrared (FTIR) spectroscopy.