CHAPTER I

INTRODUCTION

1.1 Research motivation and rationale

Advent of natural fiber (NF) composite materials and also the discoveries of new materials with unusual properties have opened up the design space to such an extent that possibilities of designing structures that can adapt to the environment are now contemplated by research community particularly for space applications defence equipments, automobiles parts and varieties of other structural components including medical appliances. Natural fibers, in particular, have attracted the attention of scientists and technologists due to their tremendous advantages over conventional synthetic fibers. For the past few years, people are trying to develop new natural fiber composite materials because of their superior specific properties as compared to those of other conventional fibers. Therefore, natural fiber reinforced composites have been commercially used in various fields starting from household utensils to aircraft structures.

Although extensive reforestation programmes are initiated, the balance existing in century old eco-systems remains disturbed, threatening the environment and the conservation of the biodiversity of plants and wildlife. Hence, natural fiber composites can be an important substitute for timber-wood, reducing the need to cut down trees. Now a day, energy crises are major global problem. This forces the material scientists to search for lightweight materials which are also strong and stiff to compete with metals. Therefore, composite material, specially polymers reinforced with natural fibers, is a good alternative. Recently, extensive studies have been carried out on preparation and properties of polymer matrix composite (PMC) replacing the synthetic fibers with natural fibers like jute, sisal, pineapple, bamboo, kenaf and bagasse. These plant fibers have many advantages over glass or carbon fibers such as renewable, environmental friendly, low cost, low density, lightweight, high specific mechanical performance and low abrasive wear of processing machinery.

Among various polymers the thermoplastic polymers have been proved as a good matrix material for production of natural fiber-thermoplastic composites because they possess many advantages, such as good processability, high cost-performance ratio, low processing temperature and resistant to fatigue. Further, they are relatively –

resistant to chemical attack and offer substantial reductions in flammability, smoke and toxicity performance. Because of the above advantages, natural fiber reinforced thermoplastic composites are used in various fields.

The date palm tree is a member of the palm tree family (*Phoenix dactylifera*) which is a perennial with an average life of 150 years. It is normally seen in the Middle East, Northern Africa, the Canary Islands, Pakistan, India, and also in the United States particularly, in California. There are more than 100 million date palm trees in the world which produce approximately 1,130,000 tons of date palm fiber per year [1]. In many parts of the world people make crates, robes, baskets and mats using the leaves obtained from date palm trees. But, this accounts for a small percentage of the total world's production. The bulk of the material is discarded as waste. Therefore, proper utilization of this natural resource would have a positive impact on the environment. Keeping in view of the above facts, the aim of this research work is to design and develop a new natural fiber composite material reinforcing date palm leaf fiber in thermoplastic polymers, particularly polyvinyl alcohol (PVA) and polyvinyl pyrrolidone (PVP) and explore their properties which can find their application including, but not limited to packaging, sports goods, interior and exterior parts of automobiles etc.

1.2 Aim and objectives

The main objectives of the present work are:

(i) To give various surface modifications to date palm leaf fibers in order to have good compatibility with two thermoplastic polymers (i.e. polyvinyl alcohol and polyvinyl pyrrolidone) and to find out the best method on the basis of maximum tensile strength for composite fabrication.

(ii) To synthesize date palm leaf fiber reinforced polyvinyl alcohol and polyvinyl pyrrolidone (i.e. PVA/DPL and PVP/DPL) composites at different weight percentages of fiber loadings (e.g. 10%, 20%, 30% and 40%) by injection moulding process.

(iii) To determine the contribution of various fiber contents over the composite strengths and to find out the optimum weight percentages of fibers in both the cases and to fabricate PVA/DPL and PVP/DPL composites at optimum fiber loading.

(iv) To study various properties such as mechanical, thermal, rheological, biodegradable, and tribological properties of both the composites.

(v) To analyze compare the overall result of both the composites.

1.3 Organisation of thesis

The contents of this investigation are presented through seven chapters. The first two chapters present an introduction and a brief review of literature**.** Chapter-3 describes the materials used, the detail fabrication procedures adopted to prepare the composites and different testing methods employed to study their properties. Chapter-4 presents the results of mechanical, thermal, rheological, biodegradable properties of both the composites and their detail analysis. Chapter-5 specifically devotes to abrasive wear study of PVA/DPL and PVP/DPL composites whereas, Chapter-6 describes their solid particle erosion behaviour in order to suit them for tribological applications. Finally, concluding remarks and a discussion of possible future work have been presented in Chapter-7.