

The chicken feather can be separated into two parts, the quill and the fiber [11]. The keratin, distinctively fiber keratin and quill keratin are two forms of microcrystalline keratin in the feathers [12]. The quill is a hard and dense central stem while the fiber is of soft fiber branches from the quill stem. Both the quill and the fiber can be utilized as reinforcements in the composites [7-8]. Uzun and co-workers [7] have attempted by using thermoset as matrix to produce chicken feather based composites, namely vinlyester and polyester to discover the impact properties of vinlyester and polyester composites at 10wt% chicken feather fiber were improved by 25% and 300% respectively. Reddy & Yang [8] works with grounded chicken feather quill (processed) and whole chicken feathers (raw) to couple with polypropylene. They found that the whole chicken feather is better than processed chicken feather in terms of acoustic, flexural and tensile properties. Besides, the amino acid sequence of feather keratin from chicken feather contains 60% of hydrophobic amino acids and the remaining hydrophilic amino acids [10]. This allows the chicken feather to have some compatibility with thermoplastics such as polyethylene, polypropylene or thermosets such as epoxy resin and polyester resin. Recently, Bullions *et al.* [9] used maleic anhydride modified polypropylene to increase polypropylene/keratin fiber interactions.

There is an increasing interest in utilizing chicken feather fiber as dielectric materials due to its hollow honeycomb structure that contains air, where air provides optimum dielectric value at 1.0 [6]. The research conducted by Zhan and co-workers[11-12] realizes the potential of chicken feather fiber for electronic applications, which is generally comparable or lower than the dielectric properties of the commercial PCBs. Unsaturated polyester is easily available and hydrophobic in nature. Maleic anhydride has been commonly utilized by researchers [13-16] to improve the bonding between natural fibers and thermoplastics such as polypropylene and polyethylene. A better bonding created hindrance in the dipoles movement, leading to the increase of the dielectric relaxation time.

In this paper, a type of chicken feather called semiplume feather is used as the reinforcement fiber by incorporating it into unsaturated polyester matrix at various fiber loading from 0 wt% to 40 wt%. In addition, the polymer matrix is modified with maleic anhydride to show the effects on the electrical resistivity and permittivity resulted from the changes in composite fiber-matrix adhesion.

MATERIALS AND METHODS

Materials: The matrix material used in this study was based on the Unsaturated Polyester (UP) with the trade name "Reversol P9509". For curing, the matrix needs to be mixed with a catalyst, namely Methyl Ethyl Ketone Peroxide (MEKP). The maleic anhydride with mw of 98.06g/mol is supplied by Aldrich. All other chemicals used were of analytical grade obtained from local commercial sources.

Chicken Feather Fiber: The chicken feathers were obtained from a local poultry farm. Generally, there are contour feather, down feather and semiplume feather that can be used as reinforcement fiber. The chicken feathers were soaked, washed in a water soluble ethanol and sun-dried for 7h. To ensure that the materials were completely dried, the chicken feathers were left in convection oven at 80°C for 24h. For this experiment, the semiplume feather as shown in Figure 1 was used as reinforcements. The semiplume feathers obtained after the convection oven were cut into sizes of approximately 3 - 6mm.

Specimen Preparation

Maleic Anhydride Modified Unsaturated Polyester: The matrix material, unsaturated polyester was modified with maleic anhydride with a molecular weight of 98.06g/mol. 1 wt% of maleic anhydride was added to 1000ml of unsaturated polyester by mechanical mixing at 70rpm at room temperature for 1h until the maleic anhydride was completely dissolved into the matrix. The modified unsaturated polyester resin was then bottled and stored under ambient temperature before experiment. The proposed chemical reaction between maleic anhydride and unsaturated polyester is shown in Figure 2.

Chicken Feather Fiber Composites: Unsaturated polyester reinforced with Chicken Feather Fiber (average length 3 - 6mm) (CFF) composites and Maleic

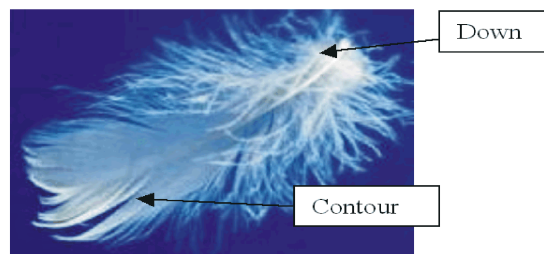


Fig. 1: Semiplume Feather