

Modified Weibull analysis on banana fiber strength prediction

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ABSTRACT

Nowadays, the world is facing a crisis in regards to renewable resources and rising carbon footprint. In the microscopic scale of engineering, this is where natural fibers come into play. Natural fibers comprise of considerable advantages that include being lightweight, inexpensive and renewable in comparison to their synthetic counterparts. The fibers are being used as reinforcement in composite matrices, including hybrid composites. The main issue with natural fibers is the high disparity of its mechanical properties, especially tensile strength. In this study, Weibull statistical analysis is utilised in order to quantify the variation of the probabilistic strength of banana fibers. Single fiber tensile test was performed after the fiber diameters were measured at 1mm intervals along its length. The modified Weibull distribution with conical frustum model can predict the gauge length effect more accurately than the conventional Weibull distribution with cylindrical model.

Keywords: Weibull analysis; tensile strength; banana fiber; gauge length effect.

INTRODUCTION

Advances in science towards a sustainable future have been the highlight for most of the 21st century. In regards to microscopic scale of engineering, there has been a shift of interest from synthetic fibers to natural fibers. Natural fibers have many advantages over synthetic fibers; they are lightweight, renewable, and of lower cost, additionally natural fibers possess the capability to provide similar, if not better reinforcement in composite materials [1-4].

Banana fibers tend to be an unused product of the banana tree and hence its usage will contribute to the renewability factor [5]. Kulkarni et al. [6] reported that the cellulose content of banana fiber is 65%, whilst Oksman et al. [7] placed the cellulose content of banana fiber between 54% - 63%. This falls in line with the lower end of the cellulose content of jute fiber as Fidelis et al. [1] and Oksman et al. [7] placed the cellulose content of jute fibers between 61%-71.5% and 61%-72% respectively.

However, due to the climate and growing conditions of the natural fibers (depending on where the plant is grown) there may be a reduction in quality [8]. One main issue regarding natural fibers is that the tensile strengths of natural fiber cannot be