BRUISE PREVENTION APPARATUS

A.G. Ibrahim
Department of Physics, Federal University of Technology, Minna.
E-mail:akubrahim@yahoo.com

Abstract

The work employs the fundamental principle of elasticity in putting together an apparatus comprising a network of both spiral and helical springs attached to an aluminium frame and embodied in a padded cotton fabric. Hookes law provided the theoretical guide for the choice of spring constant for both spiral and helical spring as 23.33Nm`1 and 7.78 Nm^{-1} respectively. A prototype was designed using the Sweet Orange (citrus cinensis) as a case study. At the height of 5.9m ± 1m, the spiral and helical springs effectively played the role of cushioning effect and rebound prevention respectively.

Keywords: Bruise, prevention, fruits, Hooke's law, spiral and helical springs

Introduction

The concept of fruit bruises and its consequences include softening, change in colour, change in taste and in certain cases injury on affected portions with the overall effect of a decline in available fruits (Ibrahim, 2006). This concern led to a separate work in which a bruise detection apparatus was designed and constructed using state of the art electronic components. The said device, a fruit transducer, provides a yardstick for the measurement of bruises inflicted on fruits especially during harvesting (Ibrahim eta al, 2006) and (Ibrahim, 2009a). Testing was carried out using fruits of interest at various heights. The bruise data collected was analyzed and a bruise prediction model arrived at (Ibrahim, 2009b). Beyond detection and prediction of fruit bruises is an important phenomenon, which is, bruise prevention. In this work, a bruise prevention apparatus was designed to help save the disturbing phenomenon of fruit bruises.

Methodology

The basic principle applied here is the fundamental principle of elasticity as put forward by Robert Hooke and generally known as Hooke's law. The law is stated mathematically as;

$$F = -Kx \quad (1)$$

Where F, is the spring force and x, the displacement. The minus sign indicates that the spring force is always opposite in direction from the displacement. The constant K is called the spring constant (force or stiffness constant) and is a measure of the stiffness of the spring (Halliday etaal, 2006).

In this work, an arrangement of basically springs of appropriate spring constants were systematically put together in order to help overcome bruises inflicted on fruits during harvesting. These springs are, the spiral spring, to serve as compression spring and the helical spring to serve as expansion spring.

Equation (1) can be rewritten as,

$$Mg = Kx \quad (2)$$

Where M, is the average mass of the fruit of interest and g, is the acceleration of free fall taken to be 10ms^{-1}.

Let K_s be the spring constant of the spiral spring and K_h be the spring constant of the helical spring. Therefore, equation (2) can be written for the spiral and the helical spring respectively as,

$$Mg = K_s x \quad (3)$$

$$Mg = K_h x \quad (4)$$

The design is such that the displacement (compression in case of spiral spring and extension in case of helical spring) under the action of a falling fruit is the same. Secondly, the points at which they experience a restoring force after being compressed (or extended) are the same. Therefore, we can combine equation (2) to (4) as,

$$Mg = K_s x = K_h x \quad (5)$$