PERFORMANCE OF RECYCLED PAPER PULP TRAYS IN RELATION TO IMPACT DAMAGE IN APPLE CARTONS

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ABSTRACT

Excessive bruising during transit of Count 88 apples packed in cartons using paper pulp (Friday) trays is of major concern to the apple industry. The literature shows that this has been observed since at least 1962. Many experiments have been conducted but these have generally involved small quantities of fruit and been directed to specific issues. The object of this project was to review the literature and to examine the performance of Friday Trays directly by the study of their physical properties and indirectly through the experimental bruising of a significant amount of fruit under carefully defined conditions.

The carton configurations of Count 88 and Count 100 apples were assessed through visual observation and by computed tomography to determine the spatial relationships of fruit within the packs. Count 88 cartons had fruit in a 2x2 configuration and the apples were tightly packed. The fruit were close proximity with two contact points above and below for central fruit and one for those on the ends of the pack. Count 100 cartons had fruit in a 3x2 configuration. The apples were more widely spaced on the trays, with the fruit being, to some degree, 'hammocked' by the Friday Tray with less direct pressure on adjacent fruit in the static state. However, under dynamic loading it was shown that force was transmitted between fruit at four contact points above and below for central fruit and at a lesser number for those on the periphery of the pack.

Cartons of Count 88 and Count 100 apples were dropped under standardised conditions from a height of 600mm and the amount and distribution of bruising recorded. Prior experimental work defined the relationship between energy absorbed and bruise production so that it was possible to calculate the energy absorbed by the fruit and other mechanisms in both configurations. With Count 88 cartons the packaging material and other mechanisms absorbed 87% of the energy whilst in Count 100 cartons 97.5% was absorbed

The tensile strength of samples of Friday trays were measured at two moisture contents (MC), based on the MC when trays are first placed in the cartons (8 % MC) and after a minimum of 24 hours in coolstorage (15 % MC). Samples were 16% stronger at 8% MC than 15% MC.

The distribution of energy absorption was assessed using trays at 8% and 15% MC. Whilst tray splitting was more common with trays at 8% MC, the total energy absorbed was not altered and variation in another physical property, such as the ability to stretch, must have been responsible for this.

The study suggests that there is a relationship between excessive bruising and carton configuration. The previously described 'hammock effect' appears to be a protective mechanism in Count 100 packs but the closer spacing of Count 88 packs precludes this. Bruising in the Count 88 configuration may be reduced if a five layer pack similar to Count 100 were adopted or more energy absorptive trays used that would reduce the force transmitted between adjacent fruit. Such changes could have adverse effects in terms of carton overfill and would need further investigation.

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