

Design, Fabrication and Testing of an Impact-Type Hand Operated Cocoa Pod Breaker

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Abstract

A manually operated impact-type machine for breaking cocoa pods was designed, fabricated and tested. The major components of the machine include a frame, rail, hammer, pulley, bearings and rope. The machine requires rope tension, tensile stress and cross sectional area of 128.7 N, 728 kN/m², 1.77 x 10⁻⁴ m² respectively. Impact energy of 30.9 J is required to break one pod while 78.6 J is required for five pods at a time. Hammer speed was determined to be 3.13 m/s. The total load on the pulley shaft was 143.52 N. The machine requires a shaft diameter of 14.6 mm and a shaft of 15 mm was used. The machine has a power requirement of 201.6 W.

The pods used for testing the performance of the machine were classified into small (5.00 – 6.40 cm), medium (6.50 – 8.00 cm) and big (8.10 – 9.60 cm) sizes according to the dimension of their mid-diameters. The machine was tested using 1 to 4 pods per loading. The parameters measured for testing the performance of the machine include the average number of hammer drops/falls required to break the specified number of pods, time required to break the pods, number of broken pods per operation, machine capacity, percentage bean damage and machine functional efficiency. The machine had less than 1% seed damage with its efficiency and capacity ranging from 93 to 100% and 377 to 738 kg⁻¹ respectively. The best results of 0.34% seed damage, 738 kgh⁻¹ capacity and 100% efficiency were recorded for two big pods of cocoa loaded at once. It is affordable to peasant cocoa farmers with the production cost less than ten thousand Naira (N 10,000.00), less than one hundred dollars (\$100.00).

Keywords: Cocoa, machine, capacity, efficiency, bean damage