

A Study to Evaluate Some Physical and Mechanical Properties, Relevant in Estimating Energy Requirements in Grinding the Palm Kernel and Coconut Shells

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Abstract : Based on the need to modify palm kernel shell (PKS) and coconut shell (CNS) for some engineering applications, the study evaluated some physical characteristics and fracture resistance, relevant in estimating energy requirements in comminution of the nutshells. The shells, obtained from local processing mills, were washed, sun-dried and sorted to remove kernels, nuts and other extraneous materials. Experiments were then conducted to determine the thickness, density, moisture content, and hardness of the shells. Fracture resistances were characterised by the average compressive load, stiffness and toughness at bio-yield point of specially prepared section of the shells, under quasi-static compression loading. The densities of the dried PKS at 7.12% and the CNS at 6.47% (wb) moisture contents were 1291.20 and 1247.40 kg/m³, respectively. The corresponding Brinell Hardness Numbers were 58.40 ± 1.91 and 56.33 ± 4.33 . Close shells thickness of both PKS and CNS exhibited identical physical properties although; CNS is relatively larger in physical dimensions than PKS. The findings further showed that both shell types exhibited higher resistance with compression along the longitudinal axes than the transverse axes. With compressions along the longitudinal axes, the fracture force were 1.41 ± 0.11 and 3.62 ± 0.09 kN; bio-stiffness; 934.70 ± 67.03 kN/m and 1980.74 ± 8.92 kN/m; and toughness, 2.17 ± 0.16 and 6.51 ± 0.15 KN mm for the PKS and CNS, respectively. With the estimated toughness of CNS higher than that of PKS, the study showed the requirement of higher comminution energy for CNS.

Keywords : bio-stiffness, coconut shell, comminution, crushing strength, energy requirement, palm kernel shell, toughness

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