Optimizing the compression/briquetting of fibrous agricultural materials☆

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Abstract

A compression ratio model and a repeated compression concept have been used to analyse the effect of chopping and grinding material samples, hold time and initial charge density on the compaction process in a closed die. The specific energy of compaction was separated into inertia and elastic components, and the proportion expended on overcoming frictional resistance quantified. The inertia stage is shown to account for 14 to 38% of the total specific energy. The recovery of the compacted material in a die was evaluated, leading to the definition of a true compression energy, which reflects the "hidden" additional energy associated with the postcompression recovery of a material. The control of in-die recovery, which accounts for 42 to 73% of the total relaxation, is identified as a necessary condition for effective wafering.

Although less specific energy was required for compressing ground straw, long straw produced the most stable wafers. Chopping the material was found undesirable both in terms of energy requirement and the stability of the wafer produced.

Optimum hold times of 5 and 2·5 s, respectively, were identified for long and ground straw. The optimum initial charge density for ground straw in a 53 mm die is 104 kg/m^3. Based on the findings of the study, a four-stage compaction process, which reflects the inertia and elastic phases of compression, is proposed.

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