

The temperature gradient of cereals as an optimization parameter of the milling process in hammermills

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Abstract

The wear degree of knives in hammermills strongly influences electricity consumption, productivity, and total operating costs. Currently, the timely replacement of the knives set is decided based on visual inspections, a feedstock load or a lifespan defined, the electric demand of the mill as compared to the limit of the motor driving it, or the vibrations of the hammermill. These approaches present different shortcomings. This study proposes the temperature gradient of the feedstock during the milling process as an indicator to monitor the wear degree of knives. The temperature gradient was implemented in a hammermill milling maize to compare two operating modes. In the conventional operating mode, the knives set mills with one edge during its lifespan, replacing the set once the electricity demand approaches the limit capacity of the electric motor driving the mill, or until the vibrations increase over safety limits. Moreover, in the proposed operating mode the temperature gradient is used to define the timely replacement/rotation of the knives edge. In this case, the four edges of the knives are used. The electricity consumption, productivity, and temperature gradient of the process were measured during the milling of ten maize loads of 2500 tons each. These data were used to characterize the performance of the hammermill, and the influence of the temperature gradient on its operational performance. As a result, a temperature gradient of 6.5 °C was defined as the optimal value to change the rotational direction or replacing the knives set in the hammermill assessed. As compared to the traditional operation approach, the use of the temperature gradient resulted in a reduction of the electricity consumption of 32%, and the greenhouse gas emissions by 37%, while reducing the total costs by 33%, and increasing productivity by 20%. Therefore, this approach stands as a significant opportunity to upgrade the operation of hammermills.

Keywords

Hammermill, Knives wearing, Cereals milling, Energy efficiency

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