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Investigation of Air Flow Resistance for Maize Cobs Bulk Using an Automatic Test Rig

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Abstract

Maize production in Rwanda has increased in recent years, increasing the need for proper postharvest technologies. Drying is the main step in maize postharvest with maize planting seeds being preferably dried on cobs at low temperatures. The need to minimize the dryer energy consumption and increase the maize quality necessitates optimization of the drying efficiency through aeration to improve the airflow distribution. A pressure drop automatic test rig for a batch dryer was developed at the Institute of Agriculture Engineering in the Tropics and Subtropics with the aim to investigate the airflow resistance of products during drying. In this research, air flow resistance of maize cobs dried in a batch dryer was assessed and the moisture content was monitored. Three batches of 210 kg maize cobs were dried at a constant temperature of 35 °C. The dryer is equipped with pressure sensors at 0.1 to 1.15 m of the bulk height and the ventilation was regulated to vary from 0.1 to 1 m s^{-1} air velocity in the bulk. Moisture content of maize in different positions was monitored throughout the process. The results show that it took approximately 35 hours to dry maize cobs from 25 % to less than 14 % moisture content wet basis. Differences in pressure were recorded at different heights of the maize bulk for the velocity of 1 m s^{-1} with a maximum static pressure of 329 Pa recorded at the bottom of the bulk and a minimum of 55 Pa at the height of 1.115 m in the maize bulk at the beginning of the drying experiment. This pressure dropped significantly as drying continued and was 275 Pa and 32 Pa at 0.1 and 0.9 m height respectively. This difference could be explained by the significant reduction in bulk size due to the shrinkage of maize cobs as the bulk height reduced from 1.115 m at the beginning of the drying process to 0.9 m at the end of the drying experiments resulting in reduction of bulk density from 409.43 to 354.76 kg m^{-3}. Maize cobs drying takes longer than grains drying. Mechanical energy to run the fan can be supplied by photovoltaic system in order to reduce the energy cost of drying.

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Keywords: Air flow resistance, batch drying, bulk density, grain shrinkage, maize cobs, maize drying, pressure drop

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