

ABSTRACT

Energy intensive commercial abrasive-friction rice polishing system with heavy moving parts induce considerable breakage of rice (20-50 %). Jet polishing technique, used for metals with high speed air-abrasive particles, is adopted for developing simple pneumatic rice polishing system without any moving parts. The system consisted of a gas cyclone. The inner surface of the cyclone was covered with an abrasive surface. The rice was allowed to move over the static abrasive surface to receive scouring action. CFD simulations were carried out to study the velocity and pressure distribution for single and multiple phase flow in the pneumatic rice polishers with different constructional features and operating conditions. Performance evaluation of pneumatic rice polishing systems with different machine, material and operational factors was carried out followed by optimization. Particle-trajectory, particle-abrasive surface interaction, particle flow path and movement pattern were also studied. Kinetics in polishing performance of an abrasive surface with its uninterrupted use was evaluated. Finally, quality of polished rice was assessed using image analysis technique.

The magnitudes of air velocity and pressure distributions in the parallel-inlets and opposite-inlets systems were higher in comparison to those in the single-inlet system. Spinning action of rice kernels on its own axes during its travelling inside the polisher ensured uniform polishing. Average D_p and B_r values after 60 passes were estimated to be $8.31 \pm 0.38\%$, $24.12 \pm 0.51\%$ and $11.39 \pm 0.16\%$, $31.39 \pm 1.65\%$ with single-inlet and parallel-inlets polishers containing very fine abrasive particle surface, respectively. Cascade system (two single units in series) gave higher degree of polishing and broken content than the single unit for equivalent number of passes. There was no significant decrease in polishing and increase in broken content with the continuous (uninterrupted) use of very fine particle abrasive surface up to 2160 passes. Successive reduction in grain dimensions on both axes (length-wise and width-wise) occurred during the polishing action. Parallel-inlets polisher yielded slightly more whitish rice compared to single-inlet polisher due to more uniform polishing action on the kernel, but breakage was more in it.

Keywords: Rice, Rice milling, Rice polishing, Pneumatic system, CFD simulation, Image analysis.