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Aghaei, E.[a] , Rostampour, V.[a] , Rezvanivand Fanaei, A.[a] , Nikbakht, A.M.[a] , Gimbun, J.[b]

A novel idea to increase the performance of a wheat flour cyclone separator: Controlling the reverse flow
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[a] Department of Mechanic of Biosystem Engineering, Urmia University, Urmia, Iran
[b] Department of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, Kuantan, Malaysia

Abstract
In this study, as a novelty, the reverse flow effect on a wheat flour cyclone performance was evaluated. A computational fluid dynamics (CFD) simulation was realized using a Reynolds stress turbulence model. Also, particle–air interactions were modeled applying a discrete phase model. Besides the experimental measurement, the numerical simulation was conducted in a main (without reverse flow) and six various reverse flow levels (I = 0.0385 m3 s−1, II = 0.0396 m3 s−1, III = 0.0484 m3 s−1, IV = 0.0583 m3 s−1, V = 0.0704 m3 s−1, and VI = 0.0836 m3 s−1) by CFD. The validation between pressure drop in experimental data and numerical results revealed a good agreement with a maximum deviation of 8.2%. Cyclone performance including pressure drop and separation efficiency was assessed in the mentioned reverse flow levels. Moreover, velocity field, centrifugal force, and turbulence parameter were evaluated, comprehensively. It was found that the flour separation efficiency increased with enhancing the reverse flow level to IV = 0.0583 m3 s−1, but decreased with a sharp slope in the reverse levels of V = 0.0704 m3 s−1 and VI = 0.0836 m3 s−1. Practical Applications: Cyclone separators are widely used in various industries such as flour and cement. The various parameters of cyclones in a food processing unit effectively affect cyclone efficiency. Therefore, an innovative method for increasing cyclone performance is presented in this study. Computational fluid dynamics (CFD) is a powerful tool for simulation of the food processing phenomenon. Validation could be guaranteed by the usage of numerical results that are obtained from CFD simulations. The innovative methods can play a key role in decreasing energy usage by reducing the pressure drop and enhancing separation efficiency. © 2022 Wiley Periodicals LLC.

Author Keywords
pressure drop; separation efficiency; tangential velocity; wheat flour conveying

Index Keywords
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Correspondence Address
Rostampour V.; Department of Mechanic of Biosystem Engineering, P.O. Box 165, Iran; email: v.rostampour@urmia.ac.ir

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