

OP-056 [Section IV: Energy in Agriculture]

MODELING THE MOVEMENT OF HULLED MILLET IN AGITATED DRUM DRYER WITH DISCRETE ELEMENT METHOD

Tibor Poós¹, Dániel Horváth¹, Kornél Tamás²

¹Department of Building Services and Process Engineering, Budapest University of Technology and Economics, Budapest, Hungary

²Department of Machine and Product Design, Budapest University of Technology and Economics, Budapest, Hungary

There are several technologies in the agricultural, food, chemical and pharmaceutical industries for mixing granular materials. In these processes the homogenization of the particle fractions or the prevention of arch building process plays the very important roles. To select appropriate mixers' motors installed in certain devices, it is necessary to specify the rotational speed of the mixer and the power requirement of the propulsion engine. This selection is a difficult task nowadays for mechanical engineers without measurement or an appropriate method for the estimation of power requirement. In researches available in the literature, the determination of the mixing power requirement is solely analytical and only for devices of particular design and geometry, in the case of mixing of certain substances. The main purpose of this research is to improve a simulation model for determining the power requirement of an agitated drum dryer, which can be used commonly for modeling the mixing process of various moisture-containing granular materials. By mixing hulled millet, laboratory measurements were made and the results were approximated by the simulations based on discrete element method (DEM). In order to give an exact estimation of the power requirement of a given mixer, accurate geometry of the drum dryer and the appropriate micro-mechanical and physical parameters of the discrete particle assembly are required. With the results of the angle of repose and the direct shear box tests in laboratorial conditions and DEM simulations, certain material properties of the utilized particles have been determined. In laboratory tests, the mixing power requirements of the agitated drum dryer were determined at various rotational speeds ($0.32 \div 1.58$ rev/s) using hulled millet with different moisture contents on wet basis ($9.6 \div 29.5\%$) with different drum loading factors ($5 \div 25\%$). Based on results it can be stated that the mixing power requirement is greatly influenced by the moisture content of the material and the rotational speed of the agitator. Additionally, the demand of torque was decreased with increasing the rotational speed. The preliminary DEM simulations and parameter sensitivity tests revealed which micro-mechanical parameters of the contact model should be changed in order to simulate the power requirements with good approximation.

Keywords: hulled millet, agitated drum dryer, moisture content, mixing, discrete element method

