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Measuring the Mixing Rate in Bladed Mixers

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Granular flows are of paramount importance in industry and nature. To understand, e.g., the effect of various process parameters on the final product performance is critical. In industry, the flow in agitated mixing equipment basically consists of granular flow over a blade. While previous experimental and numerical work [1, 2] could reveal some features of this flow situation, information like single-blade mixing efficiency or the principal parameters that influence this flow are still scarce.

We performed excessive high-speed video imaging of dry and wet granular flow under a controlled atmosphere in a 3D mixer as well as in a novel 2D flow setup. We use particle image velocimetry (PIV) to measure the velocity of the granular bed from the top (3D system) as well as in a cross section of the blade. Discrete-Element-Method (DEM) simulations are used to help interpreting our experimental results. The ultimate goal was to quantify the mixing in bladed mixers (e. g., high-shear granulators).

We show results for the instantaneous, time-averaged as well as fluctuating velocity fields for the flow over a single blade. Our results indicate that the bed height in front of the blade has a significant effect on the flow pattern. Also, the flow situation changes when multiple blades are used and the blade-to-blade distance is changed. Finally, we quantify the mixing efficiency of a single-blade passage using image analysis.

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