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IMPACT OF ROTATION AXIS POSITIONING ON INDUSTRIAL-SCALE POWDER MIXERS: A DEM STUDY

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Powder mixing is ubiquitous in process engineering [1], and adequate mixing of solid materials is of paramount importance for processes and manufacturing in pharmaceutical, food and construction industries, among many others. In the pharmaceutical industry mixing is key to ensure the proper Active Pharmaceutical Ingredient (API) concentration in every dosage form to achieve the proper therapeutical effects and avoid side effects [2].

Pharmaceutical industrial-scale mixing involves devices of many different shapes and sizes, and a broad range of operational parameters depending on the desired level of shear. Mixing can involve many different materials, with a wide range of size distributions, shapes, aspect ratios and flow properties. Such variety makes the prediction of mixing efficiency and optimal mixing time a very challenging endeavour.

In our study we investigate the effect of different rotational axes positioning on mixing trends and qualities. Mixing in Intermediate Bulk Containers (IBCs) of square and cylindrical section was modelled via DEM [3] for different binary powder blends. The latter span a linear combination of binary size distributions (mono-modal or bi-modal) and flow properties (free-flowing or cohesive). The simulations are initialised either in a stratified completely segregated configuration or in a perfectly mixed state, to model respectively mixing and de-mixing. According to the IBC shape different rotational axis configurations are tested, and their impact on mixing quality, de-mixing tendency and their characteristic times was evaluated as a function of powder blend properties. Eventual areas of uneven material concentrations are highlighted, and the dependence on the rotational axes are elucidated.

This work is aimed to improve the basic understanding of operational process parameters impact on mixing as a function of material properties of blended powders. It will also help to identify the optimal mixing time, a crucial parameter that determines the threshold between the mixing and de-mixing regimes. The final goal is a step towards improving mixing quality and optimising manufacturing processes.

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