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Effects of particle density and pore fluid on granular flow in a rotating drum

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Effects of particle density and pore fluid on granular flow in a rotating drum
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The understanding of granular flow is of importance in many practical applications. This study employs both experimental and numerical analyses of dry and submerged granular media in a rotating drum, with a range of particle density. A continuum approach based on the two-phase flow and \mu(I) rheology is adopted, with all material parameters identified from experimental measurements. The accuracy of our model is evidenced by its ability to closely replicate experimental observations, particularly in the rolling and cascading stages. We specifically examined the dynamic angle of repose, flow region depth, and pore pressure behaviour within the granular region. The roles of particle density and pore fluid are demonstrated in distinct granular flow characteristics. We examine the solid pressure and fluid pressure distribution across the different cases in the submerged conditions. A significant advancement of our study is the normalisation of fluid pressure, which is achieved through a function of the Reynolds number, the contrasts in particle and fluid density. The unified correlation aligns with the principles of the Kozeny-Carman model. This work offers an effective numerical approach for design and optimisation of industrial processes involving granular flow.
Key words: granular flow; rotating drum; granular rheology; dynamic angle of repose; pore fluids

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