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Segregation in horizontal rotating cylinders: radial and axial band formation, band traveling and merging studied by Magnetic Resonance Imaging. THOA NGUYEN, ANDREW SEDERMAN, LYNN GLADDEN, Department of Chemical Engineering, University of Cambridge — Radial and axial segregations are investigated by Magnetic Resonance Imaging (MRI). For the first time, full 3D structures and real-time 2D MRI movies showing the progress of segregation over many hours are reported. Data were acquired with high temporal (74 ms) and in-plane spatial resolutions (1 mm $\times$ 1 mm), giving new insights into the underlying mechanisms. The mixture composition can be quantified throughout segregation. The cylinder to be considered is 48 mm in diameter, up to 50 cm long and filled to 50 – 82% by volume with millet and poppy seeds at a 3:1 ratio. In particular, the effects of filling fraction, cylinder length and rotational speed on segregation are addressed. Radial segregation is found to be driven by both core diffusion and the free surface. The former is dominant in the cylindrical core buried under the avalanche layer in systems over 75% full while the latter is significant at lower filling levels. Axial segregation is characterized by band formation, traveling, and merging. In all cases studied, the formation of poppy-rich bands is observed, after which individual bands start to travel at $\sim$3 μm s^{-1} until they are within $\sim$3 cm of a stationary band. Adjacent bands then merge into a single, enlarged poppy band as millet seeds move out of the merging region.

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