Agglomeration Process of Wet Granular Material: Effects of Size Distribution and Froude Number
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Granular material flow & granule growth in the steel making.

Commonly refers to the upgrading of material fines into larger particles, Agglomeration is the process of particles size enlargement and most granulation in a horizontal rotating drum. In this work, we use Molecular Dynamics (MD) method to simulate the agglomeration process during the dense granular flows in the rotary drum. In which particles are distributed by an uniform distribution of particle volume fractions.

OBJECTIVES & METHODOLOGY

We investigate the agglomeration process of solid particles in the presence of a viscous liquid. We are mostly interested in application to iron ore granulation in a horizontal rotating drum. In this work, we use Molecular Dynamics (MD) method to simulate the agglomeration process during the dense granular flows in the rotary drum. In which particles are distributed by an uniform distribution of particle volume fractions.

MOLECULAR DYNAMICS METHOD

\[ m \frac{d^2 \mathbf{r}_i}{dt^2} = \sum_{j \neq i} \left( \mathbf{f}_{ij} + \mathbf{f}_{visc,j} \right) \mathbf{n} + \mathbf{f}_{ext} + m \mathbf{g} \]

Where:
- \( \mathbf{r}_i \) is the position vector of particle \( i \)
- \( \mathbf{g} \) is the gravity vector
- \( \mathbf{n} \) is the normal unit vector
- \( \mathbf{t} \) is the tangential unit vector
- \( m \) is the mass of particle \( i \)

Mechanism of granule formation

Exponential increase of granule for different size ratios

Exponential increase of kinetic energy normalized by potential energy of granule as function of \( \alpha \).

Conclusions

1. The effect of size ratio on the granule growth is more crucial than that of rotational speed.
2. Granule growth is an exponential function of size ratio and rotational speed of drum.
3. Kinetic energy normalized by potential energy increases proportional to the rotational speed, but inversely proportional to the size ratio.
4. The wet and contact coordination numbers of agglomerate grains are proportional to size ratio.

Further Researches

- Investigation the agglomeration process of a huge number of particles.
- Comparison between experiment and simulation of agglomeration processes in rotating drum.