Agglomeration of wet granular materials in rotating drum
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To cite this version:
Thanh-Trung Vo, Saeid Nezamabadi, Jean-Yves Delenne, Farhang Radjai. Agglomeration of wet granular materials in rotating drum. Powders & grains 2017, Jul 2017, Montpellier, France. hal-01772261

HAL Id: hal-01772261
https://hal.archives-ouvertes.fr/hal-01772261
Submitted on 20 Apr 2018

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Simulation of 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.

**OBJECTIVES & METHODOLOGY**

**MOLECULAR DYNAMICS METHOD**

$$ m_i \frac{d^2\mathbf{s}_i}{dt^2} = \sum_{j \neq i} (f_{ni} + f_{ti} + f_{visc}) \mathbf{n} + f_{visc} \mathbf{t} + m_i \mathbf{g} $$

- $\mathbf{s}_i$ position vector of particle $i$
- $\mathbf{g}$ vector gravity
- $\mathbf{n}$ normal unit vector
- $\mathbf{t}$ tangential unit vector
- $m_i$ mass of particle $i$ (kg)

**CAPILLARY COHESION & VISCOUS FORCE**

$$ f_c = \begin{cases} -\kappa R, & \delta_n < 0 \\ -\kappa R \varepsilon^n, & 0 \leq \delta_n \leq \varepsilon^n_{\text{max}} \\ 0, & \delta_n \geq \varepsilon^n_{\text{max}} \end{cases} $$

- $\kappa = 2\pi \gamma_s \cos \theta$
- $\varepsilon^n_{\text{max}} = 3 \pi R^2 \eta_0 \Delta \delta_n / \Delta t$
- $\alpha = R_{\text{max}} / R_{\text{min}}$
- $\lambda = c b(\alpha) (V_{\text{rel}}^1 / R)^{1/3}$

**AGGLOMERATION RESULTS**

- Exponential increase of wet & contact coordination numbers (a) and decrease of kinetic energy normalized by potential energy of granule (b), as functions of size ratio $\alpha$.

**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 agglomerates are proportional to size ratio.