

CONTACT MODEL: SINTERING

During modeling of sintering process rotation of particles is not considered.

Velocities:

$$\bar{v}_{rel} = \bar{v}_2 - \bar{v}_1$$

$$\bar{v}_{rel,n} = \bar{r}_n \cdot (\bar{r}_n \cdot \bar{v}_{rel})$$

$$\bar{v}_{rel,t} = \bar{v}_{rel} - \bar{v}_{rel,n}$$

Additional parameters:

$$\xi_n = r_1 + r_2 - |O_2 - O_1|$$

$$R^* = \frac{r_1 \cdot r_2}{r_1 + r_2}$$

$$a_s = (4 \cdot R^* \cdot \xi_n)^{0.5}$$

Normal force:

$$F_n = 1.125 \cdot \pi \cdot 2 \cdot R^* \cdot \gamma - v_{rel,n} \cdot \pi \cdot \frac{a_s^4}{8 \cdot D}$$

Tangential force:

$$F_t = v_{rel,t} \cdot (-0.01) \cdot \pi \cdot a_s^2 \cdot \frac{(2R^*)^2}{8D}$$

Summarized forces and moments acting on particle (wall):

$$\bar{F}_{tot} = \bar{F}_n + \bar{F}_t$$

$$\bar{F}_1 = \bar{F}_n + \bar{F}_t$$

$$\bar{F}_2 = -\bar{F}_n - \bar{F}_t$$

Literature

Bessler R., da Silva M.R., do Rosario J.J., Dosta M., Heinrich S., Janssen R. (2015). Sintering Simulation of Periodic Macro Porous Alumina, *Journal of Americ. Ceramic Society* 98, 3496-3502.

Parhami F., McMeeking R. (1998). A network model for initial stage sintering, *Mech. Mat.* 2, 111–124.

Martin C., Bordia R. (2009). The effect of a substrate on the sintering of constrained films, *Acta Mater.* 2, 549–558.

Symbol	Description
$\Delta \bar{\xi}_t$	Tangential displacement in the current step [m]
\bar{F}_n, \bar{F}_t	Force in normal and tangential directions [N]
γ	Surface energy []
O_1, O_2	Centers of contact partners [m]
\bar{v}_{rel}	Relative velocity [m/s]
\bar{v}_1, \bar{v}_2	Translational velocities of contact partners [m/s]
r_1, r_2	Particle radii [m]
R^*	Equivalent radius [m]
\bar{r}_c	Contact vector [m]
\bar{r}_n	Normalized contact vector [-]
$\bar{\omega}_1, \bar{\omega}_2$	Rotation velocities of particles [rad/s]
ξ_n	Normal overlap [m]