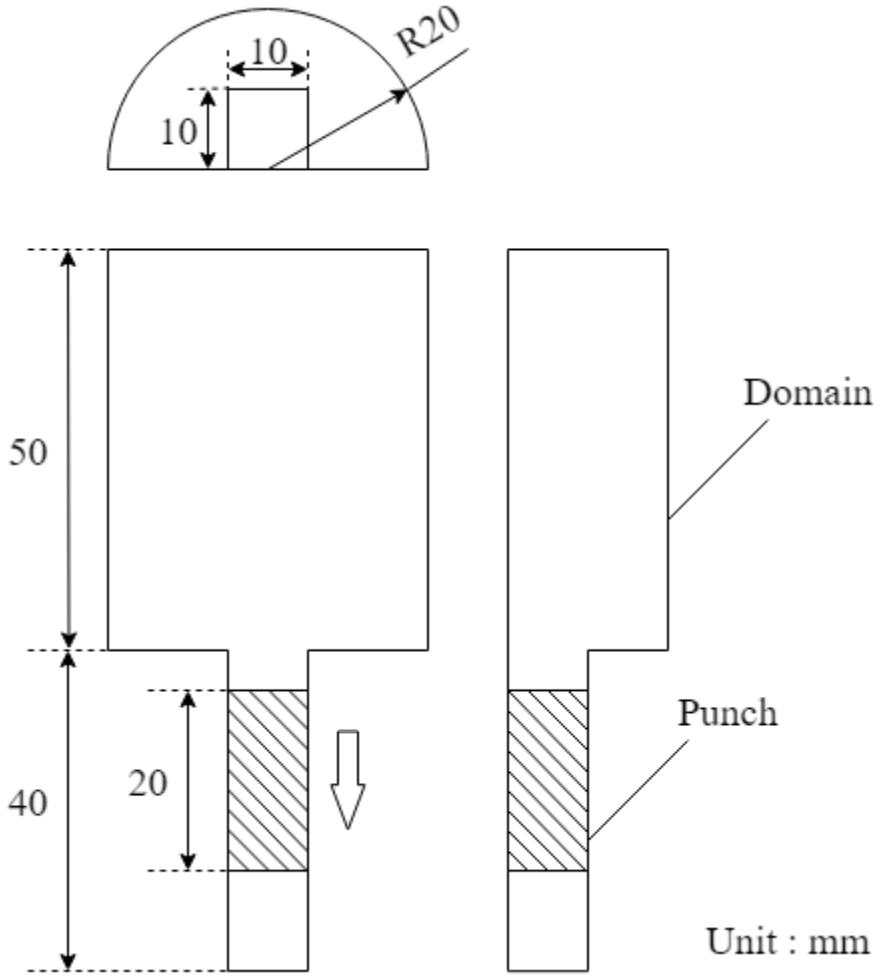

Figure 1. Schematic diagram

Table 1. Physical properties

Gas phase	
Viscosity	1.8×10^{-5} Pa・s
Density	1 kg/m^3
Solid phase	
Density	1500 kg/m^3
Spring constant	50 N/m
Coefficient of restitution	0.9
Coefficient of friction	0.3

Table 2. Calculation conditions

Particle diameter	250 μm
Number of particles	500,000
Grid size	0.5 mm
Calculation time	0.24 s

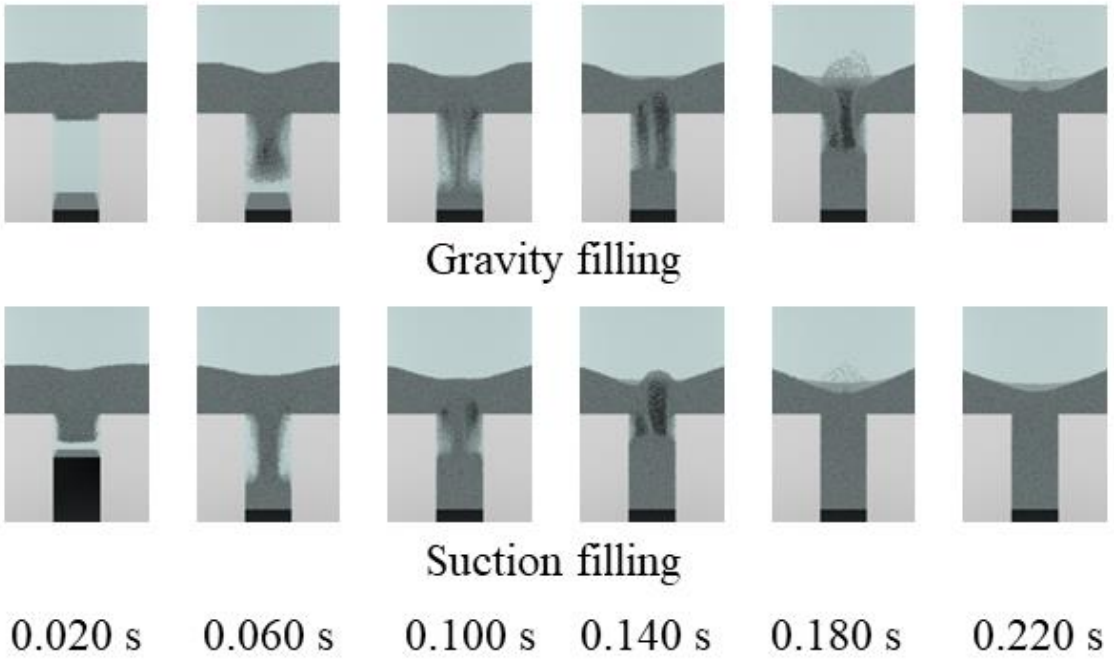

Figure 2. Powder distribution
In case suction filling, the punch speed was 500 mm/s.

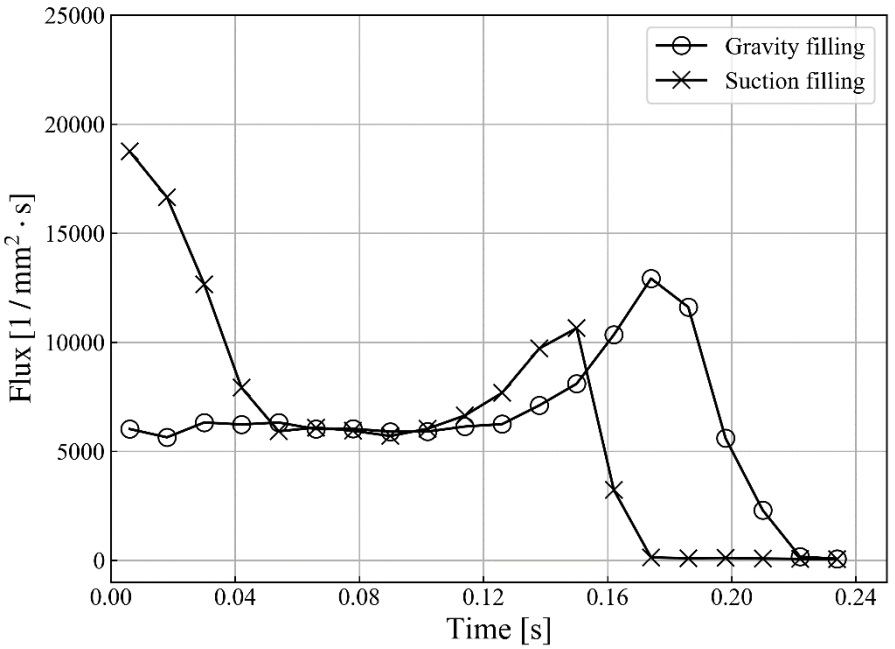

Figure 3. Flux of powder to die region

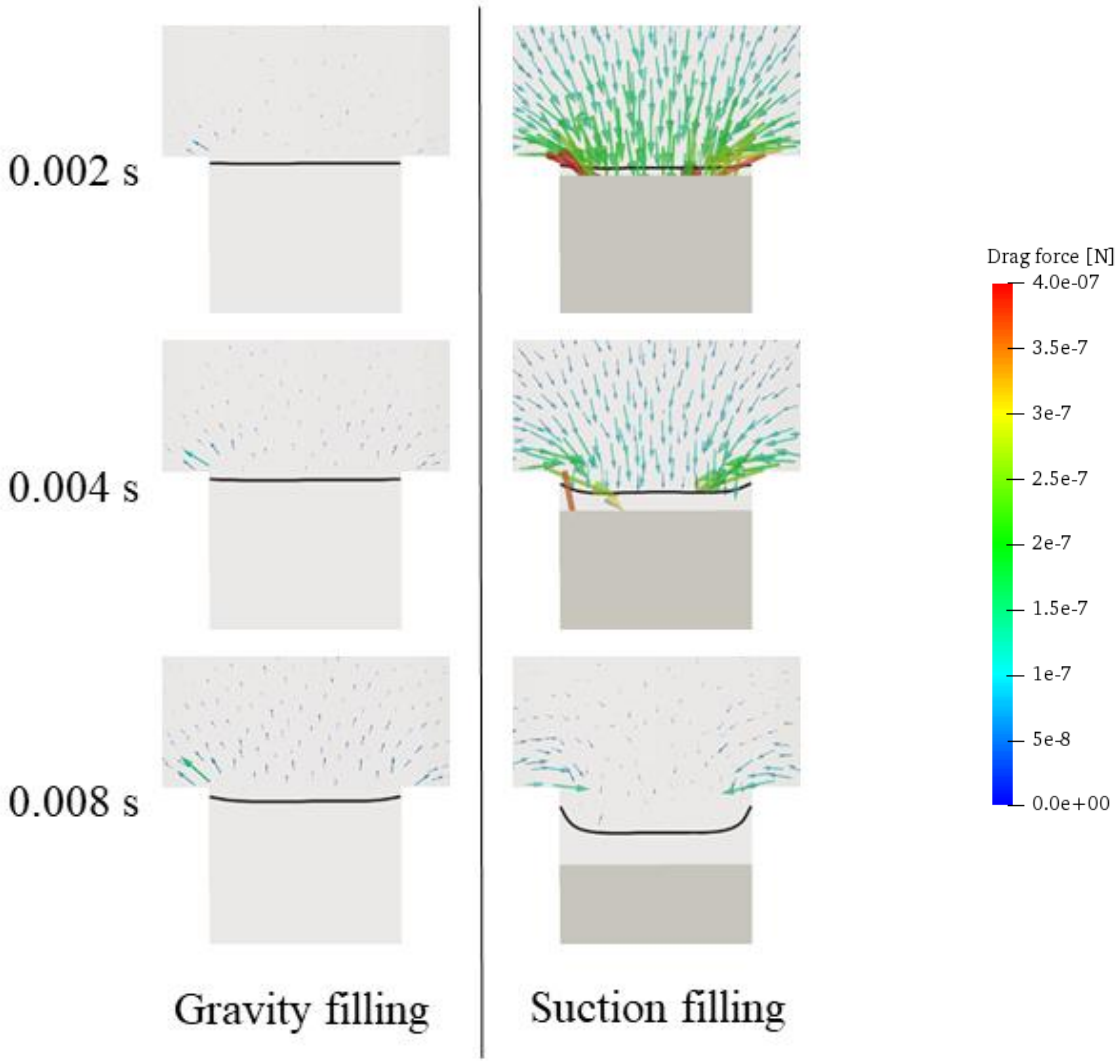

Figure 4. Drag force

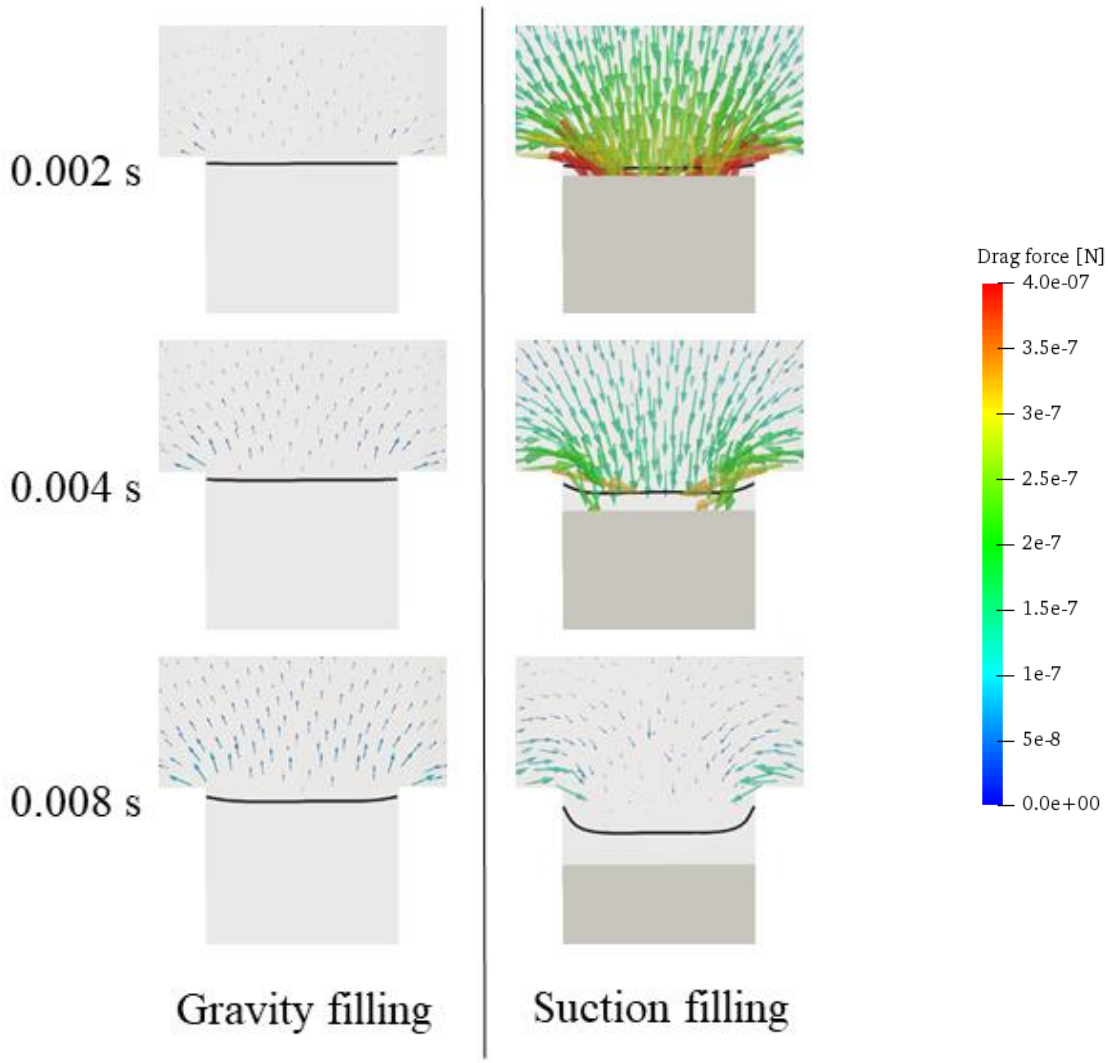

Figure 5. Pressure force

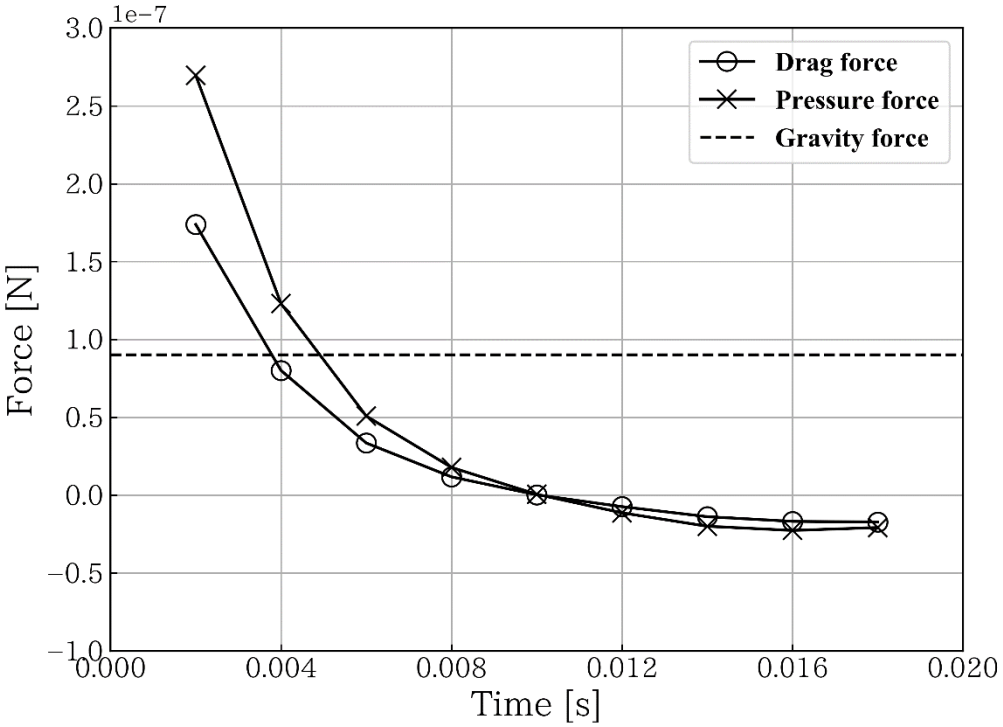

Figure 6. Forces applied on particles

Use vertical component of force vector
Average force applied on particles above the punch (in 10mm ×10mm region)

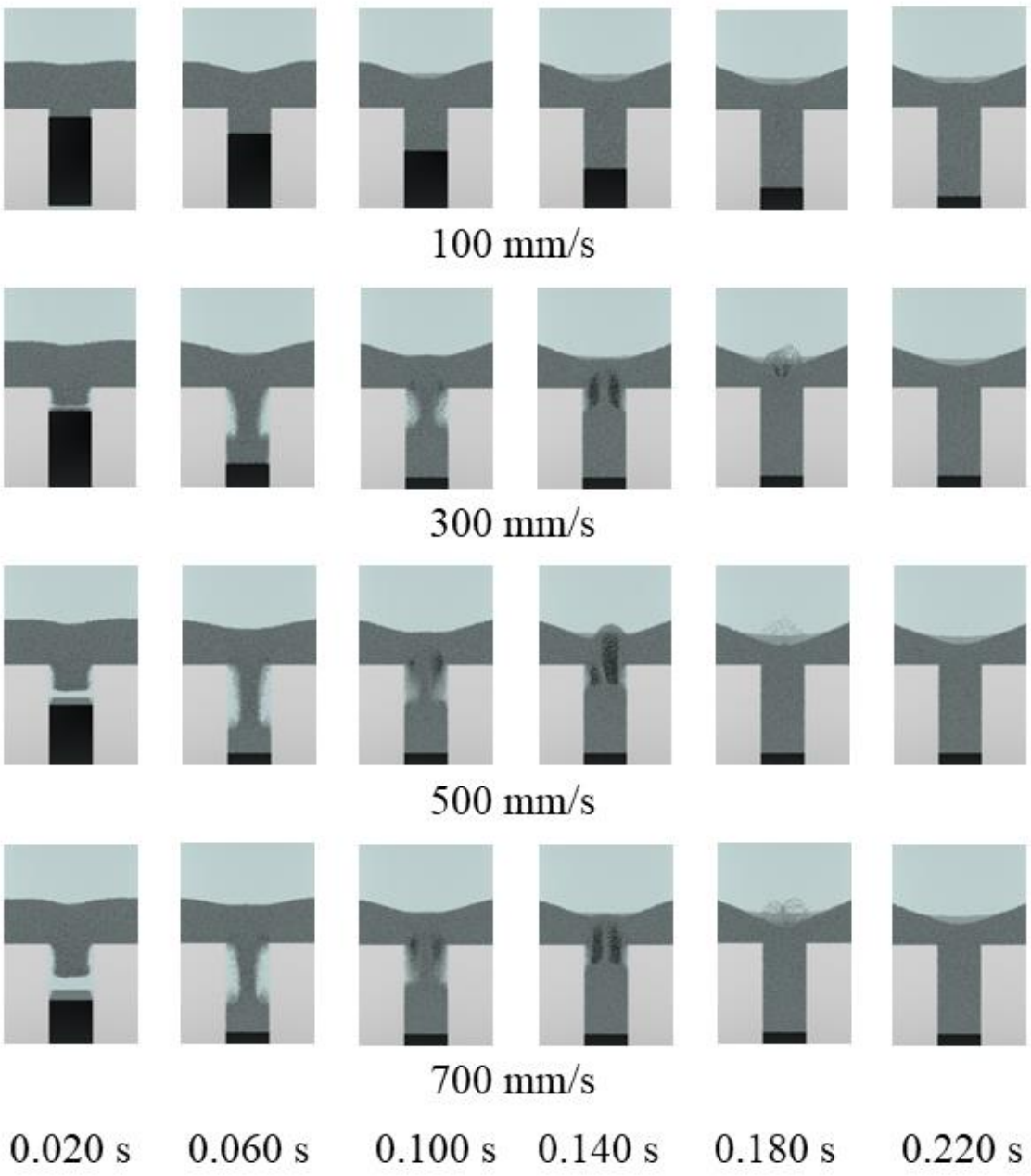

Figure 7. Powder distribution

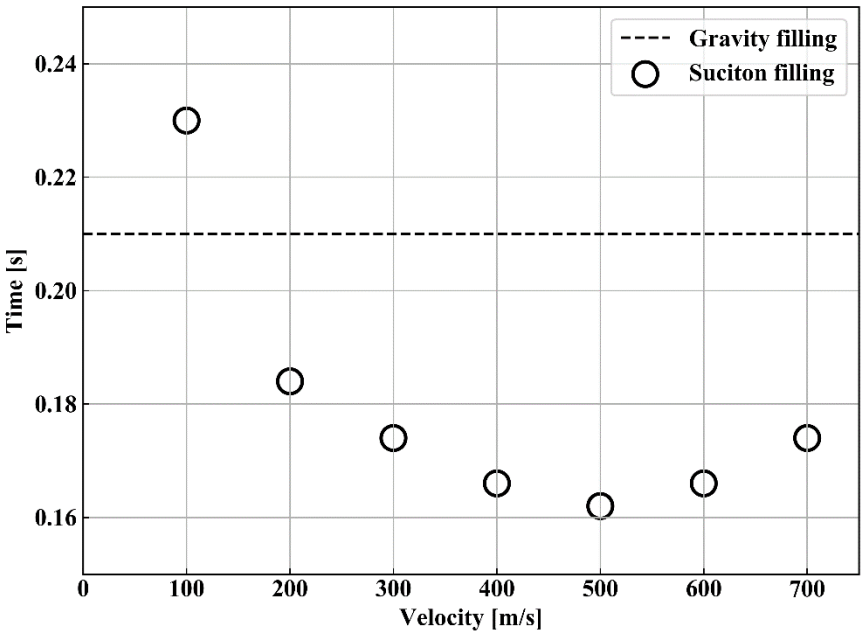

Figure 8. Filling time

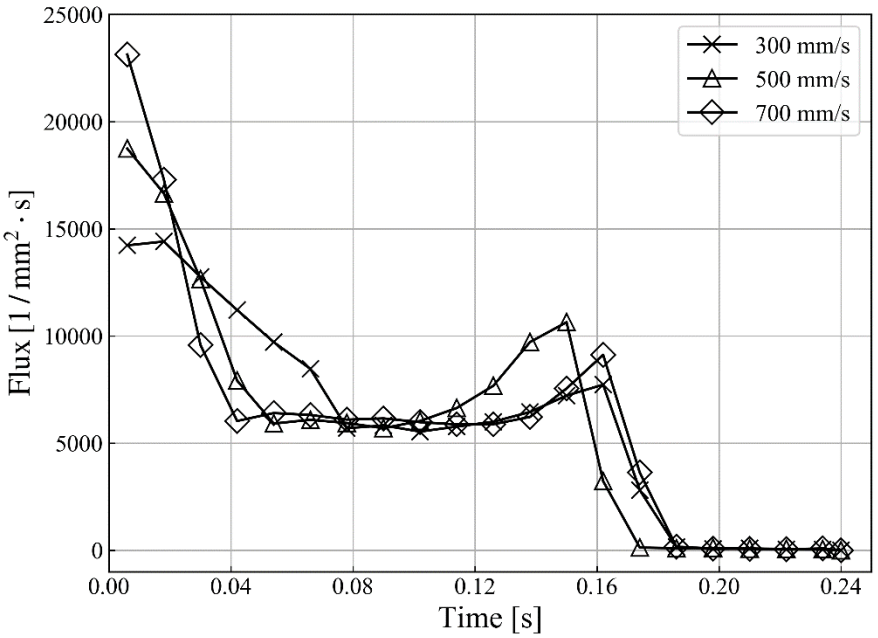

Figure 9. Flux of powder to die region

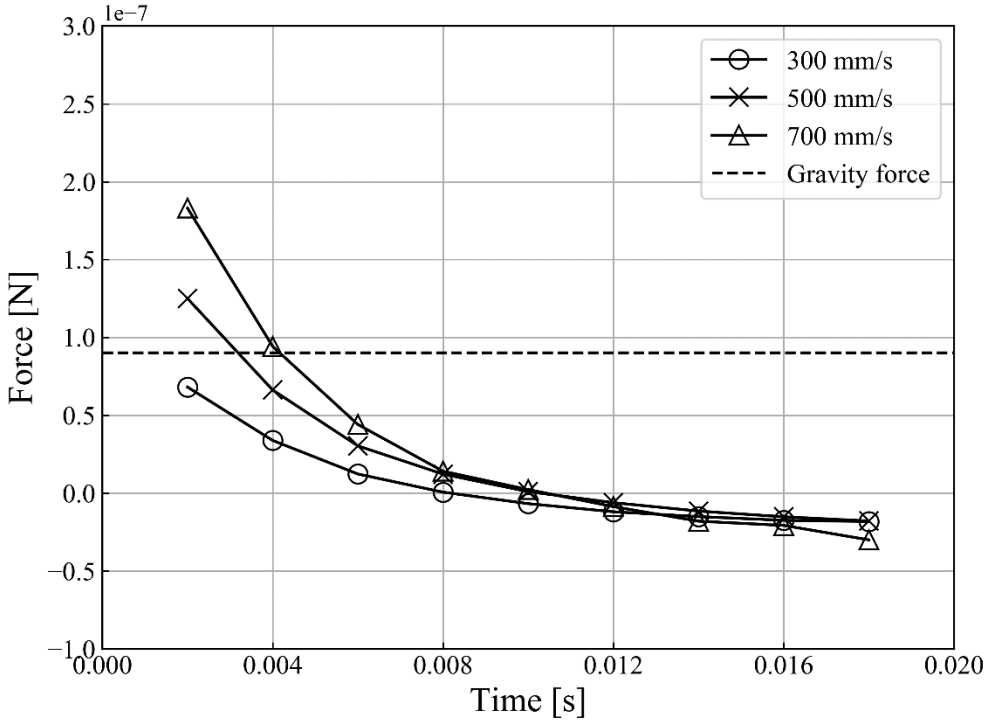

Figure 10. Drag force

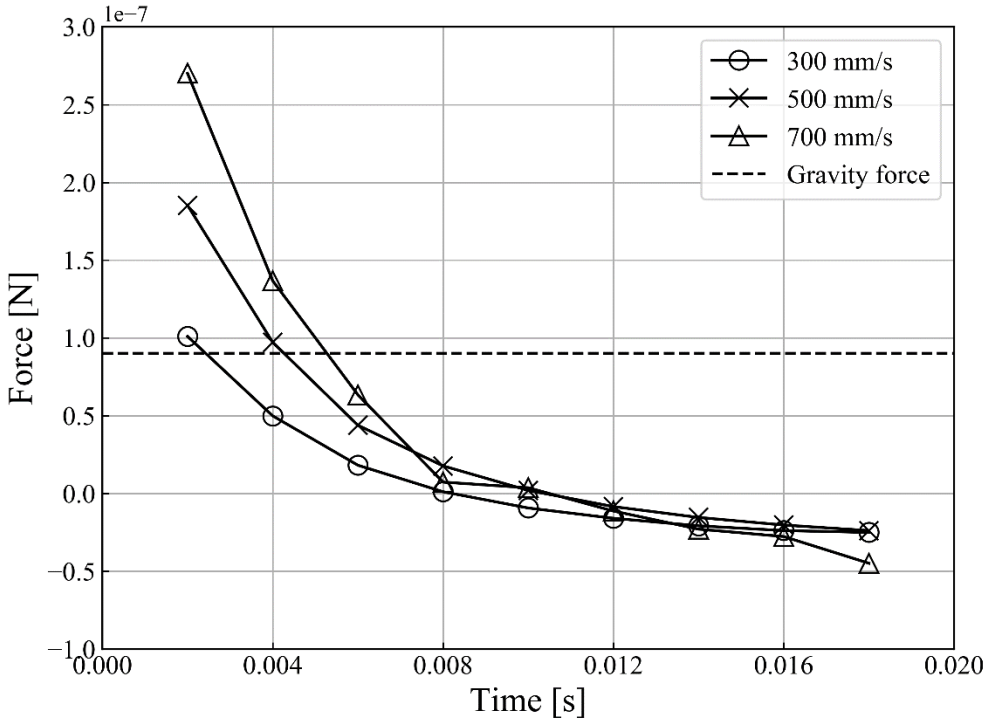

Figure 11. Pressure force

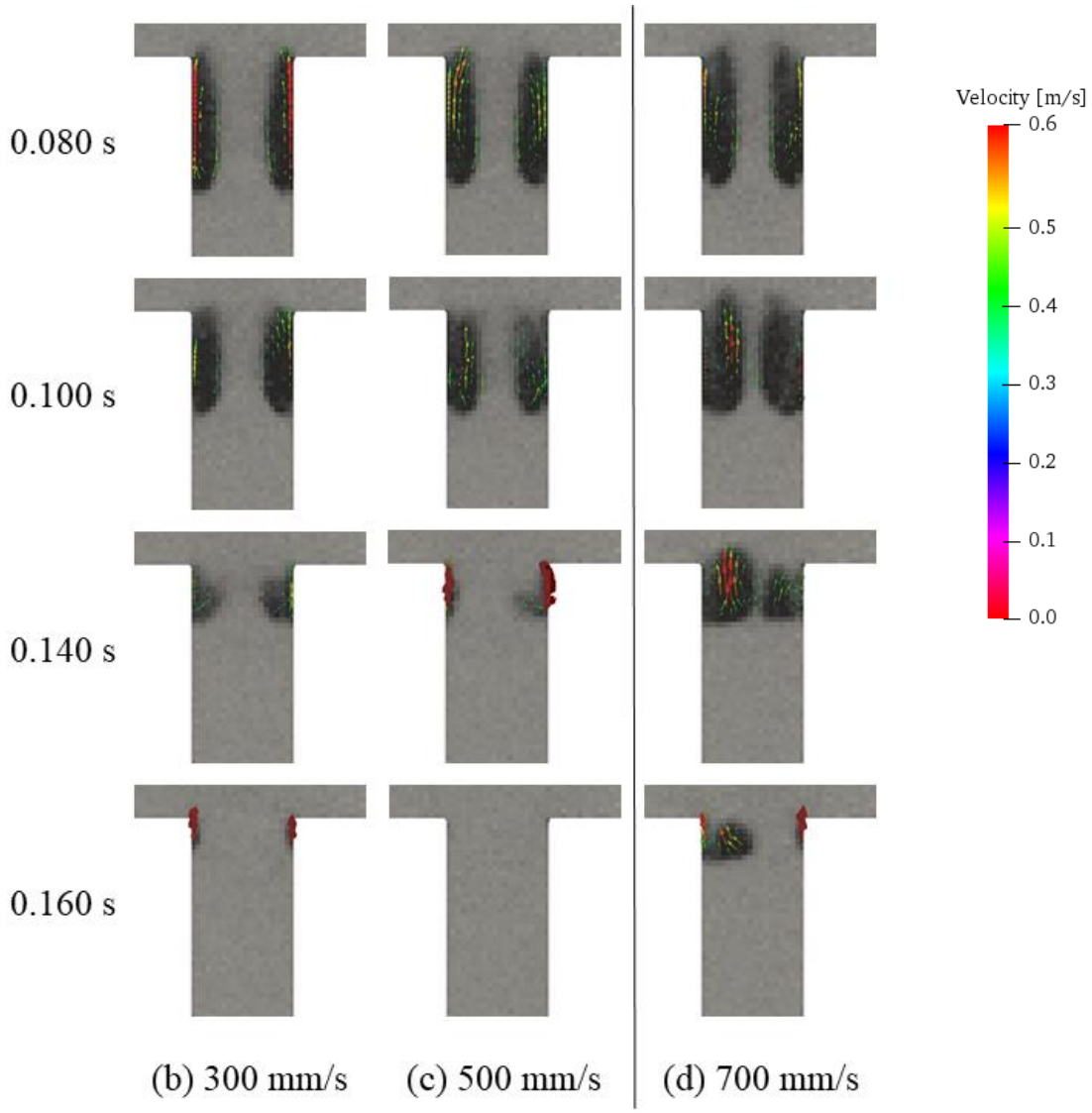

Figure 12. Bubble velocity