APPENDIX B. CALCULATION OF THE RATE OF PARTICLES INERTIAL TRANSPORT ON A SINGLE HEMISPHERICAL PROTRUSION

The number of particles travelling with the mean flow towards the frontal area of an obstacle protruding from a flat wall per unit of time (j) can be found as a product of the particle concentration (c_p), flow speed (U_0) far upstream from the obstacle and the frontal area of the obstacle (F):

$$j(y) = c_p \times U_0(y) \times F. \quad \text{(B1)}$$

Since the flow speed is a function of the wall distance the particle flux also depends on this distance. Therefore, to find the total particle flax towards the obstacle this equation must be integrated over the obstacle height L:

$$\mathrm{j} = \int_0^{\mathrm{L_0}} c_p \cdot \mathrm{U_0(y)} \cdot \mathrm{S'(y)\ dy}, \quad \text{(B2)}$$

here $S'(\mathrm{y})$ is the frontal width of the obstacle which for a hemispherical obstacle can be found with the help of the following illustration:

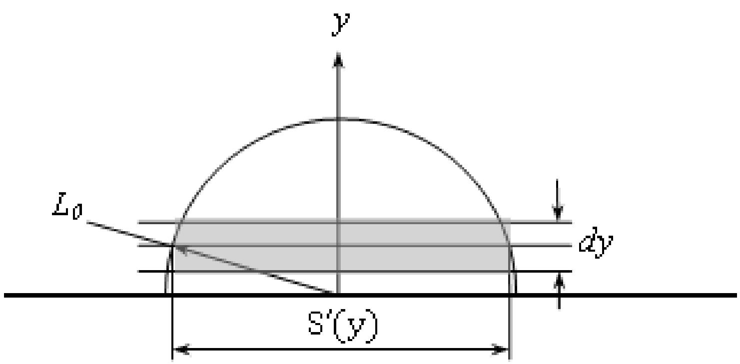

Figure B1: Frontal area of a hemispherical obstacle (flow direction is normal to the picture plane)

The area of the shaded region in Fig.B1 is equal to

$$\mathrm{F'(y)} = \mathrm{S'(y)dy} = 2\sqrt{\mathrm{L_0}^2 - (\mathrm{y} + \mathrm{dy}/2)^2}\ \mathrm{dy}. \quad \text{(B3)}$$

Therefore, assuming the uniformity of the particle concentration near the wall, the number of particles travelling towards the hemispherical obstacle equals:

$$j = 2c_p \int_0^{L_0} \cdot U_0(y) \cdot \sqrt{{L_0}^2 - (y + dy/2)^2}\, dy. \tag{B4}$$

Since particles tend to travel with the flow around the obstacle only a certain amount of them actually collide with it. The number of collisions can be found by multiplying the total number of particles travelling towards the obstacle by the collection efficiency $\epsilon\left(\mathrm{Stk}\left(U_0, d_p\right)\right)$. The collection efficiency is a known function of the dimensionless Stokes number which in turn is a function of the undisturbed flow speed and particle size d_p.

Therefore, collection efficiency also depends on the normal-to-wall distance and thus must be integrated together with other distance dependent parameters.

Finally, by including collection efficiency under the integral in Eq.B4 we arrive at a relationship for the total number of particles colliding with the hemispherical obstacle

$$j = 2c_p \int_0^{L_0} \epsilon\left(\mathrm{Stk}\left(y, d_p\right)\right) \cdot U_0(y) \cdot \sqrt{{L_0}^2 - (y + dy/2)^2}\, dy. \tag{B5}$$