Comments on paper: “Transport and deposition on ellipsoidal fibers in low reynolds number flows” from L. Tian, G. Ahmadi, Z. Wang, P.K. Hopke, Journal of Aerosol Science, 45, (2012…

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Comments on paper: “Transport and deposition on ellipsoidal fibers in low reynolds number flows” from L. Tian, G. Ahmadi, Z. Wang, P.K. Hopke, Journal of Aerosol Science, 45, (2012) 1–18

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Tian et al. (2012) established a computational model for ellipsoidal fiber transport, including rotation, and deposition in a circular pipe. The analysis provides physical insight to factors affecting the system-specific fluid-particle dynamics. Specifically, the effectiveness of using several different equivalent sphere diameters, including the *aerodynamic* diameter (see Stoeber, 1971 and http://en.wikipedia.org/wiki/Aerodynamic_diameter) to simplify the calculation of non-spherical particles, was investigated. Based on the simulation results provided by Tian et al. (2012), using the aerodynamic diameter of Eq. (42) they generated inaccurate predictions of ellipsoidal particle transport and deposition in the circular pipe. Comparisons with the correct simulation results in Fig. 1 below indicate that using the aerodynamic diameter will provide particle trajectories as accurate as using the Stokes sphere diameter Eq. (37). Possibly the authors did not change the particle density to 1000 kg/m^3, which may be the reason why their simulation results are incorrect.

To examine and compare the simulation results (Tian et al., 2012) which is also shown as the orange dash-dot-dot line in Fig. 1, we developed in-house user-defined function (UDF) codes, based on the same governing equations for particle translation and rotation. Also, the same circular pipe dimensions were used and the Poiseuille flow field with Reynolds number 169 was solved using ANSYS Fluent 13.0 (Ansys Inc., Canonsburg, PA). The same particle dimensions were employed, i.e., semi-minor axis $a_p = 0.5$ μm and $\beta = 14$.

To evaluate the effectiveness of different equivalent sphere diameters for ellipsoidal particle transport and deposition in a circular pipe, Eqs. (36–38, 42) were solved and the resulting particle trajectories are shown in Fig. 1. Specifically, for Eq. (42) which is the expression for the aerodynamic diameter d_{ae}, two different simulation cases were executed using $\rho_p = 2560$ kg/m^3 and $\rho_0 = 1000$ kg/m^3 as the particle densities. As shown in Fig. 1, using d_{ae} and setting $\rho_p = 2560$ kg/m^3 provided the most inaccurate prediction. However, using d_{ae} and setting $\rho_p = 1000$ kg/m^3 provided relatively accurate predictions, which is almost the same as using Eq. (37). Compared to the simulation result (see the orange dash-dot-dot line in Fig. 1) provided by Tian et al. (2012), the trajectory obtained using d_{ae} is incorrect i.e., it is assumed that the authors incorrectly set $\rho_p = 2560$ kg/m^3.

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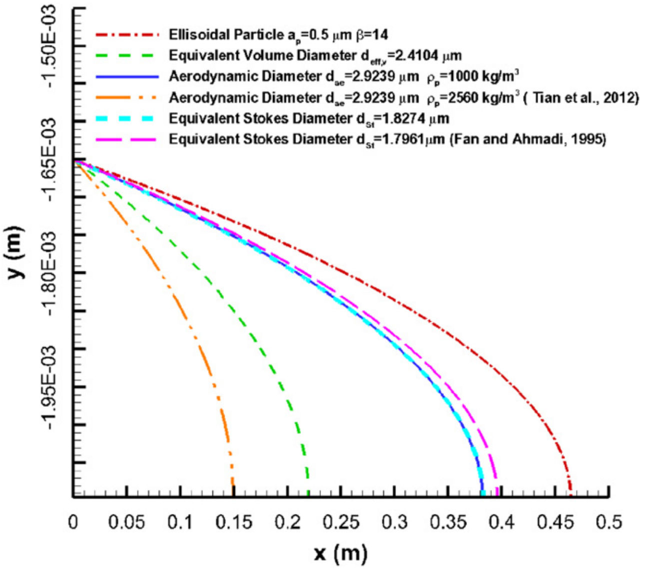

Fig. 1. Trajectory path comparisons using different equivalent spherical diameters for ellipsoidal particle with $a_p = 0.5$ μm and $\beta = 14$ in Poiseuille flow (Re = 169).

Therefore, the conclusions in the 3rd paragraph on page 12 and the 2nd paragraph on page 13 related to Fig. 11 also need to be revised. Based on the present simulation results (see Fig. 1), using the aerodynamic diameter d_{ae} can provide deposition results as accurate as using the Stokes diameter, which is given via Eq. (37).

Additionally, some typos were also found in the paper based on comparisons with Fan and Ahmadi (1995). For example, in Eq. (7), the element A_{22} of the matrix A should be $1-2(\varepsilon_3^2+\varepsilon_1^2)$. In the last equation of (32), a "$-$" should be used instead of a "$+$". In Eqs. (33) and (34), $\sqrt{\beta-1}$ should be substituted by $\sqrt{\beta^2-1}$.

References

Tian, L., Ahmadi, G., Wang, Z., & Hopke, P.K. (2012). Transport and deposition of ellipsoidal fibers in low reynolds number flows. *Journal of Aerosol Science*, *45*, 1–18.

Stoeber, W. (1971). A note on the aerodynamic diameter and the mobility of non-spherical aerosol particles. *Journal of Aerosol Science*, *2*, 453–456.

Fan, F.G., & Ahmadi, G. (1995). A sublayer model for wall deposition of ellipsoidal particles in turbulent streams. *Journal of Aerosol Science*, *26*, 831–840.