Aerodynamic Properties of Popcorn Ash Particles

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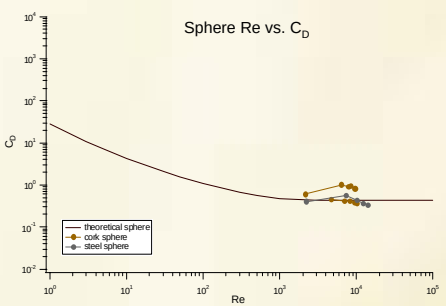
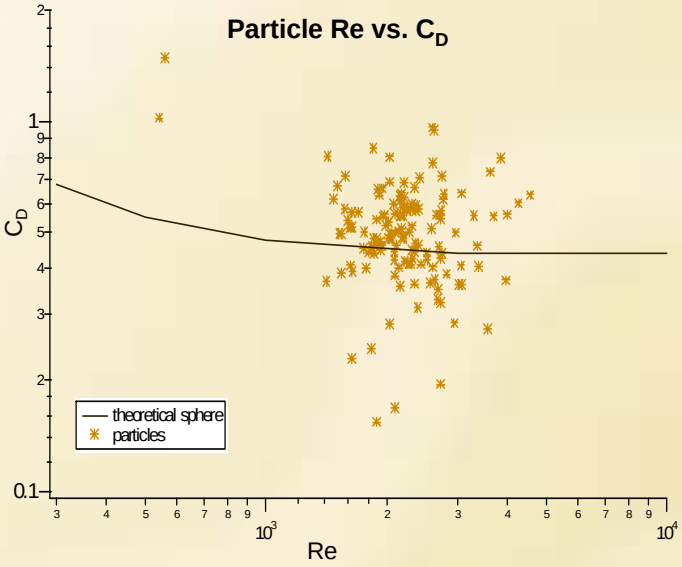
Background

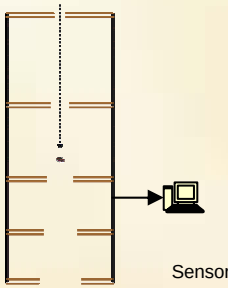
- Coal-fired power plant byproduct
- Formed from fly ash deposits on furnace wall
- Deposits break off and fall back down or flow downstream
- Particles interfere with heat exchangers and SCR surfaces





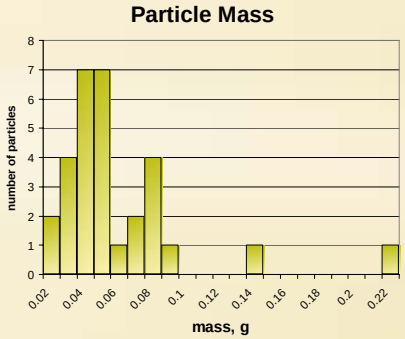
Purpose

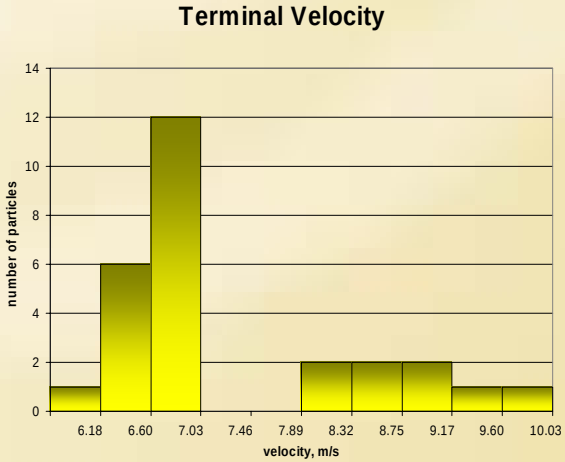
- Determine drag coefficient C_D of particles for use in computational fluid dynamics
- Determine terminal velocity of particles



Method

- Used digital photographic analysis to determine projected surface area, outside surface area, and total volume
- Used array of photosensors to directly measure velocity in freefall
- Directly calculate C_D from data, and calculate terminal velocity for particles that did not reach terminal in freefall





Conclusions

- Particles in freefall quickly reach Re of 1500 to 4000, with C_D between 0.4 and 1.0
- Average C_D of 0.5 is in range of C_D for spheres at similar Re
- Terminal velocity is average of 7.2 m/s, with mode in the 6.6 m/s to 7.0 m/s range.

Future Work

- Determine C_D at lower Re, before entering Newton regime
- Find cause of discrepancy between experimental C_D and literature C_D
- Estimate or conduct experiments to determine change in C_D for lower density gas. (i.e. higher temperature gas in boiler)

Acknowledgements

Dr. Larry Baxter, Brigham Young University, Provo, UT

Dr. Larry Monroe. Southern Company Services, Inc. Birmingham, AL