

# **Thermophoretic deposition of aerosol particles in laminar tube flow with mixed convection**

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## **Abstract**

A model is developed to investigate the thermophoretic deposition of aerosol particles on the wall of a relatively cool cylindrical tube. A key aspect of the flow is the presence of mixed convection. Continuity, momentum, and energy equations are solved to determine the velocity and temperature profiles of the system. Additionally, an aerosol population balance that incorporates thermophoresis and Brownian diffusion is solved. The results indicate that more particles deposit at shorter axial distances in downward flow through a vertical pipe than in upward flow. This behavior is traced to the larger residence time associated with downward flow, despite the presence of a reduced radial temperature gradient relative to the upward configuration. Model predictions also indicate that a bulk Richardson number ( $Ri$ ) of at least unity is necessary, but not sufficient for free convection effects to be important. The additional evaluation of a local  $Ri$  provides a more reliable indicator.

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