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'MIXED MOMENTS' FOR THE CALCULATION OF DEPOSITION SCAVENGING AND OPTICAL PROPERTIES OF POPULATIONS OF NONSPHERICAL PARTICLES

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For many purposes a description of the state of an individual particle based on its *volume* and *surface area* is sufficient to estimate certain statistical properties of a dilute suspension of such nonuniform nonspherical particles, especially if the intrinsic mass density and particle morphology (class) are specified. We show that this *is* the case for quantities dependent on the orientation-averaged *Brownian diffusivity* of such particles (as in the case of mass deposition across isothermal gaseous boundary layers near solid target surfaces) or for their ability to 'scavenge' (condensable or reactive) vapors locally present in the carrier gas. Ongoing research is providing valuable information on the joint *pdf* of particle size and surface area for particles subject to simple uncoupled rate laws governing *coagulation* and *coalescence* (Koch and Friedlander, 1990; Xiong and Pratsinis, 1993; Tandon and Rosner, 1999; Rosner and Yu, 2000, Wright et al., 2000), including selected 'mixed moments' of the joint *pdf*s. Moreover, it has been shown that the notion of *self-preserving* distribution shape also applies asymptotically to these *bivariate* distribution functions (Tandon and Rosner, 1999; Rosner and Yu, 2000, Wright et al., 2000). Here we show how certain physically relevant dimensionless mixed moments of these distributions can be used to simplify the prediction of mass transfer rates to/from such aerosol populations, and numerical values of these particular moments are provided. We explicitly focus on: a) diffusion-controlled aerosol mass deposition (Sc>>1) across laminar forced-convection boundary layers, and b) the scavenging power of such suspended aerosols for vapors present in the carrier gas. Both extremes of Knudsen number are considered (free-molecule, Kn>>1, and continuum, Kn<<1), for arbitrary ratios of the characteristic time for *sintering* to the characteristic time for Brownian *coagulation*. We illustrate that this general approach, which, for any $Dam_{coalesc}=t_{coalesc}/t_{coag}$, provides rational correction factors to preliminary engineering estimates based only on population-*mean* 'state' variables, can be extended to other aerosol population properties of engineering- or environmental-interest, including those associated with the interaction of such aerosols with electromagnetic *radiation*.

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