

Title *

Significance of Agglomerate Aerosol and Particle Densities for Effects and

Mechanisms of Inhaled Particles

Abstract *

We designed *in vivo* and abiotic *in vitro* studies to determine (i) effective aerosol density (ρ_{eff}) using rat inhalation combined with estimating *in vivo* dissolution, and (ii) agglomerate density in phagolysosomal fluid simulant (PFS). The deposition fraction (DF) was calculated from aerosol characteristics including concentration, rat minute ventilation, and lung burden measured immediately at 4-hr. exposure. Using the MPPD model by iteratively changing input density until it fits the calculated DF gives the ρ_{eff} . Applying this concept to inhaled nano-SiO₂ resulted in ρ_{eff} of 0.165 g/cm³, very different from the SiO₂ material density of 2.65 g/cm³. *In vivo* dissolution was estimated by comparing retained lung burden in a 28-day nano-SiO₂ inhalation study with the retention of insoluble particle. We confirmed biosolubility and extensive bioprocessing in ultra-high resolution imaging studies. Agglomerate “packing” density of phagocytized particles was determined in air and in PFS by centrifugation ($\leq 5000g$) and “settling density” in PFS at 1g over several days. Densities for micro- and nano-TiO₂ in PFS ranged from a high of 1.43 and 0.43 g/cm³ (5000g, micro- vs. nano-TiO₂) to a low of 0.4 and 0.1 g/cm³ (settling, micro- vs. nano-TiO₂). Using these results to express retained particle mass as volume metric in a subchronic rat TiO₂ inhalation study showed that neither measured low nor high agglomerated density for micro- and nano-TiO₂ support the volumetric lung particle overload hypothesis. Rather, particle surface area is a more appropriate metric. Knowledge of agglomerate particle densities is essential for interpreting biokinetics and dosimetrics of inhaled particles.

Permission to publish *



Check this box to give us permission to publish your abstract on a flash drive/USB Stick for distribution to all delegates if it is accepted for presentation

Affiliations and Authors *

Author Information

Günter Oberdörster (Presenting)

Affiliations

University of Rochester, Rochester, NY, USA

Author Information

Andrea Kennell

Affiliations

University of Rochester, Rochester, NY, USA

Author Information

Robert Gelein

Affiliations

University of Rochester, Rochester, NY, USA

Author Information

Candace Wong

Affiliations

University of Rochester, Rochester, NY, USA

Author Information

Uschi Graham

Affiliations

University of Kentucky, Lexington, KY, USA

Author Information

Alison Elder

Affiliations

University of Rochester, Rochester, NY, USA