The Gateway Cities
Air Quality Action Plan

DRAFT

State-of-Science on Ultrafine Particles Near Roadways

Environmental Committee

September 28, 2011

This AQAP study is not part of the I-710 Corridor Project studies, but upon completion, it will be submitted to Caltrans for review and consideration for use in preparing the I-710 Corridor Project EIR/EIS.

GATEWAY CITIES
COUNCIL OF GOVERNMENTS

Made possible with support from
Metro

Outline

Objectives of the study

Literature review

Synthesis of the findings

Conclusions

Objectives

Perform a literature review on ultrafine particles with emphasis on latest understanding and findings on:

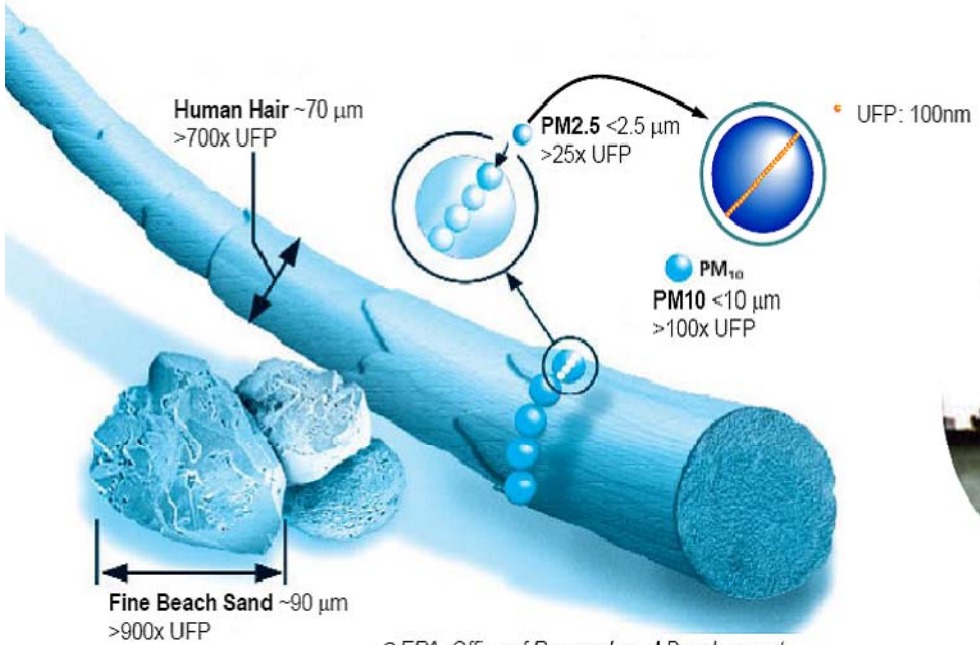
- Characteristics
- Measurements techniques
- Emissions and atmospheric processing
- Monitoring studies in LA basin
- Current and future regulation

100+ articles reviewed; interviews with EPA, CARB, SCAQMD

Ultrafine Particles

General accepted definition: Particles less than 100 nm (0.1µm) in size

- Particles are not always spherical
- Diameter of a sphere with “equivalent” mobility



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Ultrafine Particles

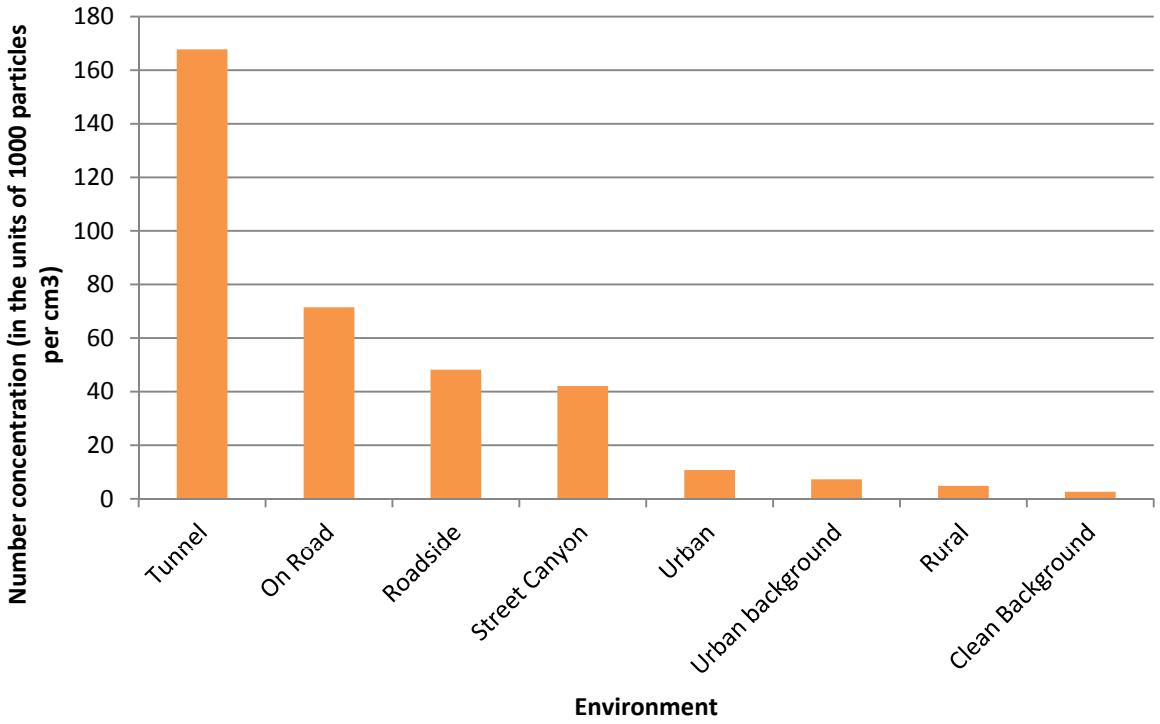
Smaller particles have higher probability of depositing in lower parts of the lung and entering bloodstream – linked to respiratory and cardiovascular diseases

Particles are so small have little mass compared to larger particles – measure as number of particles per unit volume

Characterized by shape, structure, chemical composition, toxicity

Ultrafine Particles: Ambient Concentrations

Urban environments contain elevated levels of ultrafine particles. Typical concentrations in various environments are as below in 10^3 Particles/cm ^{3}:



Ultrafine Particles: Emissions

Emissions depend upon vehicle type, vehicle age, fuel type and composition, control technologies, vehicle speed, engine load, and road conditions

On a per mile basis heavy-duty diesel trucks emit significantly higher levels of ultrafine particles than light-duty gasoline vehicles

Ultrafine emission factors are not well characterized for vehicles.

Ultrafine Particles: Near-Roadway Environment

Tailpipe - major sources of ultrafine particles in urban environment.

Particle number concentration are significantly elevated in near-roadway environments

Concentration drops exponentially in the downwind distance from the roadway

- Reaches background levels within 500m in clean environment
- Sooner in urban environment – typically 200-300 m

Ultrafine Particles: LA Region

Numerous studies have shown significantly elevated levels of UFP near LA freeways

Sites near I-710 showed higher concentrations than I-405

Most communities have at least typical urban “background” concentrations

Winter concentrations are generally higher than those in summer (Huda, et al. 2010)

Ultrafine Particles: Exposure in LA region

Two major populations exposed to ultrafine particles in near-roadway environment:

Residents in the vicinity of freeways:

- Particles can penetrate efficiently into residences downwind near freeways – natural ventilation

Commuters/drivers on the freeways:

- UFP penetrate efficiently into vehicles Zhu et al. (2008) found
    - High (nearly full) penetration of UFP unless recirculation then about half.

Ultrafine Particles: Regulations

Currently no ambient standards for number concentration anywhere in the world.

- EU recently adopted a tailpipe emissions standard for light duty diesel
- EPA reviewed testing protocol, but found not satisfactory for US due to the exclusion of volatile (gas-phase) material

Ultrafine Particles: Regulations

EPA - no immediate plans of regulation– continue with mass based std to reduce UFP, but continued priority research

CARB had planned regulations similar to that of EU for SULEV gasoline vehicles under upcoming LEV III standards

- standardized testing procedures need to be developed
- no plans heavy-duty diesel (DPF deemed best avail)

Ultrafine Particles: Regulations

SCAQMD taking steps to characterize the level of ultrafine particles in LA region

- MATES-IV study currently planning stage is underway with emphasis on UFP

Local agencies lack the authority to set either tailpipe or ambient standards

- Incentives for clean vehicles (zero emissions vehicles do not emit UFP