

# Potential Designated Chemicals: Diesel Exhaust and Vanadium

**Presentation to Scientific  
Guidance Panel**

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California Environmental  
Contaminant  
Biomonitoring Program

# Diesel Exhaust: A Complex Mixture

- Complex Mixture
  - Hundreds of organic and inorganic chemicals
  - Gas and particle phases
  - Over 40 cancer-causing compounds
    - Polycyclic aromatic hydrocarbons (PAHs) (biomonitored by CDC)
    - Nitro-PAHs (not biomonitored by CDC)
- Exposure or potential exposure
  - Widespread - all Californians exposed
  - High ambient exposure: Transportation corridors and ports

# Diesel Exhaust: Known or Suspected Health Effects

- California Toxic Air Contaminant
  - “Particulate emissions from diesel-fueled engines”
  - “...responsible for the majority of cancer risk attributable to air pollution” (California ARB 2005)
  - Major contributor to
    - Premature death from cardiovascular and lung disease
    - Asthma attacks and other respiratory effects
  - Accounts for thousands of hospital admissions annually in California

# Diesel Exhaust: Known or Suspected Health Effects

- Identified as known or probable carcinogen
  - International Agency for Research on Cancer (1989)
  - California Proposition 65 (1990)
  - National Institute for Occupation Safety and Health (1998)
  - Office of Environmental Health Hazard Assessment (1998)
  - National Toxicology Program (2000)
  - U.S. Environmental Protection Agency (2002)

# Potential to Biomonitor

## Three measurement approaches

### 1. Nitro-PAHs:

- Measure urinary metabolites of 1-nitropyrene (compound enriched in diesel particles)

### 2. Hydroxylated nitro aromatic compounds:

- Emissions from diesel are high: 100-1000x higher than gas engines
- Measure urinary metabolites of hydroxylated nitro derivatives of benzene, toluene & naphthalene

# Potential to Biomonitor

## 3. Measure PAHs in tandem with other markers:

- Urinary 1–hydroxypyrene
  - Marker for PAHs (common airborne contaminants from incomplete combustion)
  - Not diesel specific
- Urinary vanadium (V)
  - Metal in air from burning diesel & other fossil fuels
  - Not diesel specific (e.g., V present in food)
- Total serum Immunoglobulin E (IgE)
  - Traffic pollution simulates IgE
  - Not diesel specific

# Laboratory Considerations

- Nitro PAH (measure 1-nitropyrene metabolites in urine)
  - Method published
  - Levels correlate with 1- nitropyrene in air
  - But urinary levels very low and method is difficult and resource intensive.
- Hydroxylated nitro-aromatic metabolites in urine
  - Methods available
  - Studies needed to confirm presence of metabolites in urine
- Tandem marker approach:
  - Methods for 1- hydroxypyrene, vanadium & IgE available

# Vanadium (V)

- Exposure
  - Vanadium pentoxide ( $V_2O_5$ ) used in some diesel engine catalysts
    - Extent of future use as catalyst unclear
  - Diesel and other fossil fuels contain V
  - Petroleum processing releases V
  - V is in human diet but poorly absorbed gastrointestinally (1-2%)

# Vanadium (cont'd)

- Known or suspected health effects
  - $V_2O_5$  is a Proposition 65 carcinogen
  - $V_2O_5$  is teratogenic in rodents
- Efficacy of public health actions: V possible marker
  - Of diesel engine exhaust
  - Of ocean going vessel emissions in port communities
  - But sensitivity as exposure biomarker unclear
    - Indoor and outdoor levels in different Riverside locations did not vary
    - Air levels did vary in a South Coast Air Basin study

# Vanadium (cont'd)

- Availability of analytic methods:
  - Methods available.
  - Can be measured on CECBP's Agilent ICP-MS
- Adequate biospecimen
  - V detectable in human urine, whole blood, serum, hair
- Incremental cost of adding V to metals screen
  - Similar in cost to other metals (e.g., Cd, Hg)
  - Involves one time cost of method development and continuing QA/QC cost

# Summary: Diesel Exhaust & V

- Diesel is a major public health concern in CA.
- Approaches to biomonitoring for diesel:
  - 1- Nitropyrene metabolites - specific, but hard
  - Hydroxylated nitro aromatics - best bet, unproven
  - PAH in tandem with V and IgE –
    - Each marker nonspecific for diesel emission
    - Pattern recognition strategy could unravel diesel contributions
    - Further development needed for biomonitoring application