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Interaction of Metrology and the Assessment of Health Effects

Particle metrology and the assessment of health effects

3. Nanoparticle Workshop - Zurich, August 1999

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AEA TECHNOLOGY
ENVIRONMENT

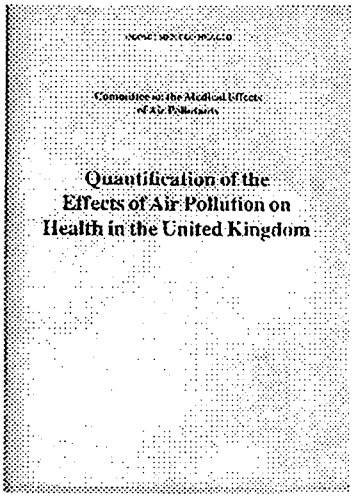
Structure

- Particles and Health
  - causality of PM_{10} exposure
  - causality of VPE exposure
  - economics
- Measurement Programmes
  - emissions data
  - ambient data
  - alternative metrics
- Legislation
  - timeline
  - metrology community input

Studies of Health Effects

Method	Strengths	Limitations
Epidemiology	Populations in normal environments	Association v Causation Exposure estimates Potential confounders
Controlled human exposures	Relevant species	Small numbers Limited exposures Healthy subjects
Toxicology Studies (Animals / cells)	Addresses mechanisms Rapid results Controlled conditions	Relevance to humans 'Artificial'

Causality of PM_{10} Exposure



- Strong case for causality on public health grounds versus Bradford Hill criteria
- 8 500 early deaths per year in UK from 430 000 deaths (epidemiology calculation)
- Similar magnitude of response in WHO study in Austria, Switzerland and France
- Health costs 1.7% of GDP

Causality of VPE exposure

Current

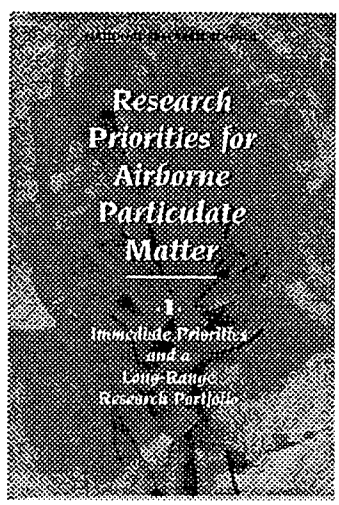
- Currently calculated on $\%PM_{10}$ attributed to vehicle emissions
- 30% vehicle contribution typical measured or calculated (UK, WHO)
- no discrimination of particle size and composition differences

New studies

- new epidemiology studies accounting for direct VPE exposure in progress
- Wichmann studies in Erfurt and other European centres
- Pershagen, Sweden
- associations observed with VPE components

US National Research Council (1998)

- Priorities for research programme on PM health effects
- 10 year plan
- $450M budget
- Announcement of 5 US 'Centres of Excellence' this year



Legislation

Emissions timeline

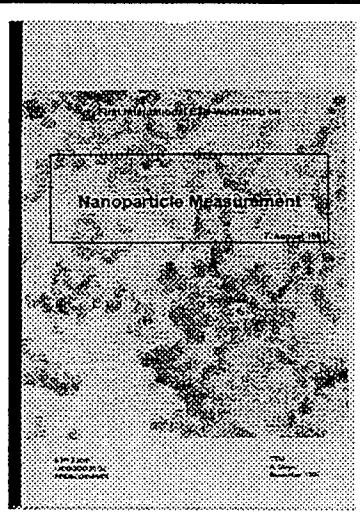
- Euro III, IV, V and equivalent legislation world-wide projected forward to 2008
- Reviews in 2002/2003
- Role of after-treatment
- Is particle number legislation ? :
  - relevant
  - necessary - if so, when ?
  - practical - if so, how?

Ambient timeline

- 'New' PM_{10} and $PM_{2.5}$ legislation under review
- Review process in 2002 / 2003
- Forward projections to 2010 imply cleaner air but from emissions reductions
- Need for discriminated epidemiology and toxicology mechanisms

Measurement comparison

- 'Informal' to date
- 2 x annual meetings of 'users' in Zurich to exchange data (1997/98)
  - multiple presentations
- Workshops for US industry and Government hosted by EPA, Ann Arbor (1998) and USDoE (1999)
- EC DG3 programme to establish e-network of metrology experts
- Questionnaire



Key uncertainty factors

Emissions

- Dilution & Ageing
- Size Range
- Sample Residence Time, T, RH & system build
- Sampling
- Instrument Choice
- Data Processing
- Pre- and post tailpipe factors
- Composition

Ambient

- Dilution effects
- Ageing effects
- Loss of Volatiles
- Dispersion effects
- Environment Factors (T, RH, wind speed)
- Attribution of VPEs to particle mix

Conclusions

- PM_{10} exposure is effectively causal wrt reported health effects; evidence for VPEs is indirect only; but new studies underway
- improved metrology knowledge of particle sizing and composition
- plausible mechanistic hypotheses under active investigation
- particle metrology skills (size and composition) important across research areas
- scope for e-network of metrology experts via questionnaire, then WWW site