Practical Applications of Diffusive Monitoring with Other Complimentary Techniques in the Workplace Environment

Practical Applications of Diffusive Monitoring with Other Complimentary Techniques in the Workplace Environment

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An industry perspective on the use of diffusive monitoring techniques with other complimentary techniques in the workplace environment

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- Examples of Uses with Complimentary Techniques
  - solvent production, road tanker loading, community/environmental impact assessment.
- Novel Data Uses
- A Summary of Requirements, Challenges and Implications

➢ any questions & discussion ?

Background & Introduction

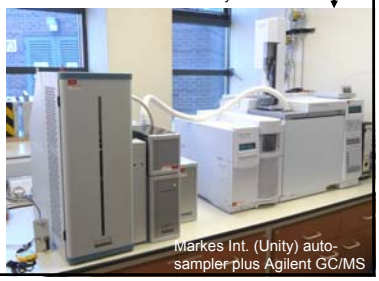
- What do I mean by:
  - diffusive monitors
  - complimentary techniques
- Why are they a useful combination?
  - potential for quick/immediate results
  - potential for quick intervention/action
  - task profiling/mapping
  - targeting of controls on greatest exposure risk
  - reduce ambiguity in assessment against control limits

Diffusive monitors – a few examples

A typical Perkin Elmer type diffusive tube and the equipment needed to analyse these

Drager diffusive tubes

Knudsen diffusive sampler



Markes Int. (Unity) auto-sampler plus Agilent GC/MS

Complementary techniques - a few examples

BW Technologies Micro5pid

RaeSystems new UltraRae 3000

Gastec tubes

RaeSystems ToxiRae PID

FLIR IR Emission imaging camera

Drager CMS & cartridges

A Brief History of Development & Uses

- Used extensively in BP from 1980s onwards
  - for workplace applications (industrial/occupational hygiene)
    - benzene, butadiene, solvents etc
  - for environmental impact assessments e.g.
    - perimeter monitoring,
    - contaminated land surveys
- Baglan Bay Example
  - external study results shown to be due to contamination
  - major sources shown to include road traffic

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Examples of uses with complimentary techniques - solvent production

BP Hull Site, UK c1998

Ethyl acetate process c1998

Diffusive uptake rate: 1.91 ± 0.21 ethyl acetate on TXGR

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Examples of uses with complimentary techniques - solvent production

- Process are: Ethyl Acetate Production
- Activity: operator taking production samples and general plant inspection activities.
- Diffusive method:
  - personal sampling using an axial (Perkin Elmer type) tube
  - analysis by ATD400/GC/Mass Spec-FID
- Complementary method:
  - personal photo-ionisation detector (10.6eV lamp) using a RaeSystems ToxiRae.
- Results: TWA & STEL plus real-time profiles with peak exposures
- Outcome:
  - improved control and reduced personal exposures.

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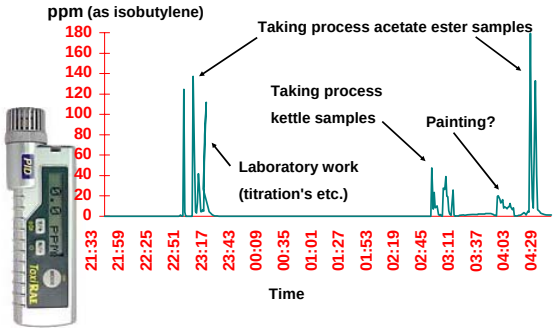
Examples of uses with complimentary techniques - solvent production



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Examples of uses with complimentary techniques - solvent production

- Diffusive Results – example from ethyl acetate personal monitoring

Date	Tube No	Employee Name & No.	Shift	Time & Minutes	Substance	ug on tube	ppm v/v as TWA	ppm v/v as 8 hour TWA
08/03/2009	TXGR45	A & 1	C (afternoon)	1400 to 2115; 435	Ethyl Acetate	0.2	0.24	0.22
09/03/2009	TXGR 06	B & 2	A (morning)	0630 to 1245; 375	Ethyl Acetate	0.9	1.26	0.98

- 10 Full shift diffusive results: 0.1 to 1.0 ppm as 8 hour TWA
- cf control limit (UK EH40, 1999):
  - 400ppm (8 Hour TWA)
  - no STEL, therefore EH40 guidance applies)
- Also 19 Short-term tasks specific measurements (but axial P/E tubes used in pumped sampling mode), 0 to 33 ppm (0 to 11 ppm as 15 min STEL)

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Examples of uses with complimentary techniques - road tanker loading

- Road Tanker loading of acetic acid (& acetic anhydride)

Loading Gantry

Loading arm

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Examples of uses with complimentary techniques - road tanker loading

- Process area: Acetic Acid Road Tanker Loading
- Activity: operator taking samples for quality assurance.
- Diffusive method:
  - personal sampling using a direct reading colorimetric indicator tube (Drager & Kitigawa)
- Complementary method:
  - image visualisation method using latest infrared camera technology.
- Results: TWA information plus visualisation of real exposure variation
- Outcome:
  - improved control and reduced personal exposure through greater awareness of variables and additional measures (rpe – respiratory protective equipment).

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Examples of uses with complimentary techniques - road tanker loading

- Diffusive Results – example from acetic acid personal monitoring
- 18 Full shift diffusive results: 0 to 2.5 ppm as 8 hour TWA (median c0.6 ppm)
- cf control limits (In-house limit):
  - 10ppm; 8 Hour TWA
  - 15 ppm; STEL
- Also 70+ Short-term tasks specific measurements (but standard pumped indicator tubes, Drager acetic acid 5/a); 0 to 80 ppm.

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Examples of uses with complimentary techniques - road tanker loading

- **Infrared imaging technology – FLIR camera**

http://www.flir.com

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Examples of uses with complimentary techniques - community impact assessment

- Process area: Chemical Site Perimeter
- Activity: environmental impact assessment of VOC contributions.
- Diffusive method:
  - static sampling using an axial (Perkin Elmer type) tube
- Complementary method:
  - active sampling (pumped) using an axial (Perkin Elmer type) tube in a sequential tube sampler.
- Results: TWA (days) information plus short-term variation (hours)
- Outcome:
  - improved awareness of environmental impact and extent of shorter term variation.

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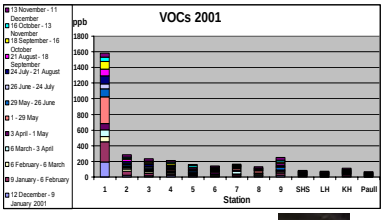
Examples of uses with complimentary techniques - community impact assessment

VOC profile example from long term diffusive monitoring



1 to 9 - Perimeter Monitoring Stations

SHS, LH, KH & Paull - External Community Stations

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Novel Uses of Data

- EEL (Exposure Equivalent Level) concept:
  - Exposure example based on a diffusive result of 1 ppm 8hr TWA
  - 1ppm as 8 hour TWA equivalent to:
    - 32 ppm as 15 minute average (e.g. STEL)
    - 480 ppm as 1 minute average
    - 4800 ppm as 6 second average (time enough for 1 good lung full)
  - Concept can be supported by:
    - diffusive monitoring & complimentary techniques
    - diffusive monitoring & good task observation

    and provide an estimation of potential shorter term variation

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Requirements, Challenges and Implications

- Requirements
  - more good, low cost, validated diffusive methods (including direct reading colour indicator diffusive techniques and gas permeable membrane methods into liquid media).
  - more good low cost, direct and indirect reading complimentary techniques.
  - occasional and targeted use of good task observation – none of these are a complete replacement for personal observation by a competent assessor i.e. still an important role for the occupational/industrial hygienist.

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Requirements, Challenges and Implications

- Challenges
  - greater acceptance of diffusive methods
  - realisation that other techniques can work well with diffusive methods
  - competency and awareness of users
  - demonstrating equivalence of diffusive and complementary methods

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Requirements, Challenges and Implications

- Implications:
  - any good methods (diffusive and complimentary techniques) allow time to be used more effectively and less on the mechanics of measurement.
  - allow more time and effort to be spent on data interpretation and context.
  - provide a more targeted and confident approach on controls/actions to improve the workplace environment.
  - combining diffusive methods with complimentary techniques helps in the production of a more convincing management report.

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Thank you

- any questions?
- & discussion

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