Objectives

of the 2nd ICdA H&S Ctee Meeting

Main objectives of the second ICdA H&S Ctee meeting

- Cd in air:
  - Review how Cd dust in air is monitored across our industries
  - Agree on a set of recommended pratices
- Others:
  - Make a recommandation to the Board regarding the Cd Exposure Observatory
  - Update on SCOEL situation and proposed actions

Of DUST and HEALTH

Some definitions

ICDA H&S Committee 10 March 2009 Bernard Pitié

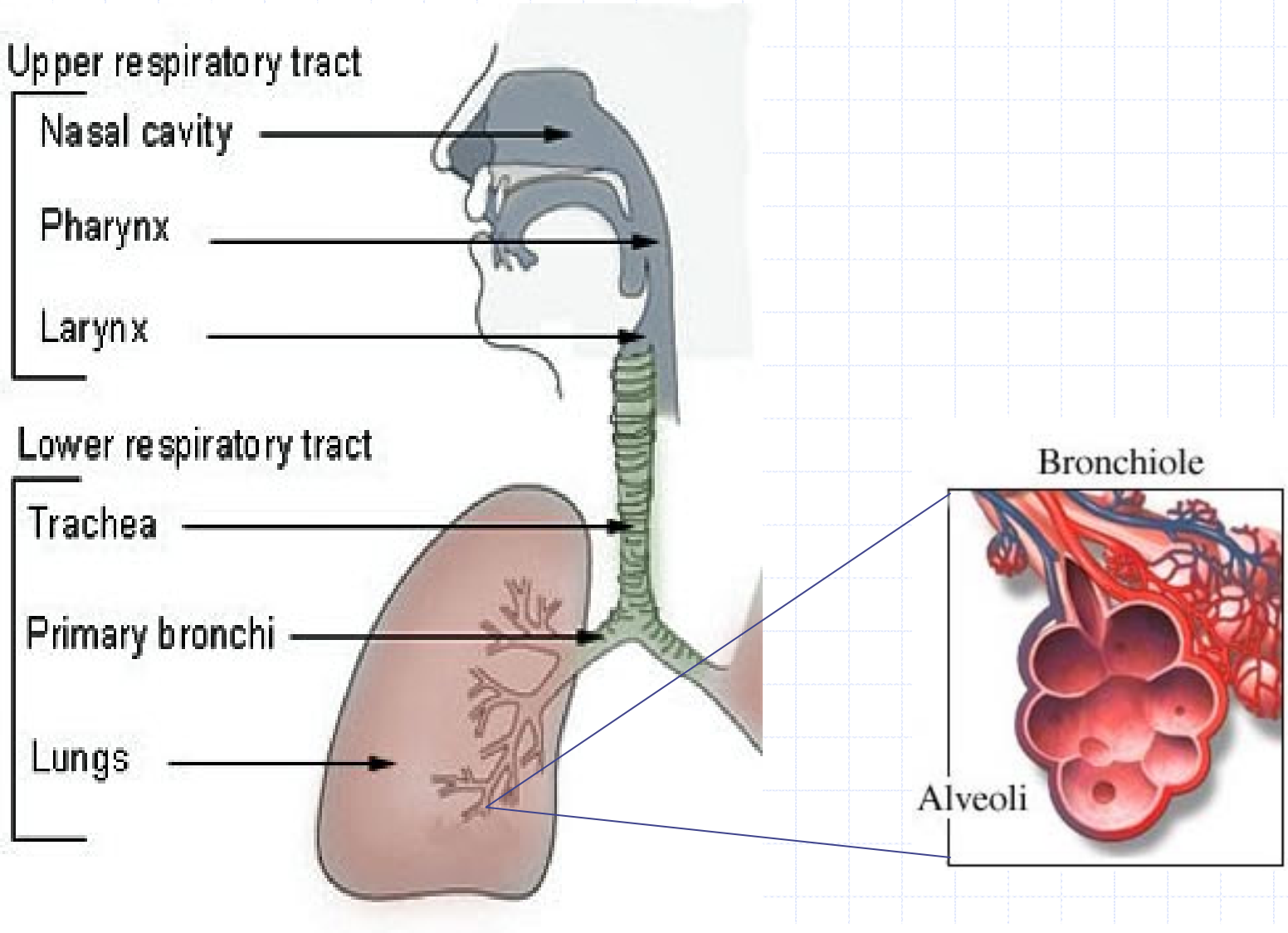
Contents

- Respiratory tract & air route of exposure
- How to define and to use occupational exposure limit (OEL)?
- Particles, dust and aerosol
- Aerodynamic diameter
- Types of particles : inhalable, thoracic and respirable
- Exposure : duration of measurement (8 hours or 15 minutes)
- Legal nature of the OEL
- Mass equivalence of inhaled cadmium and ingested cadmium
- Static and personal sampling
- EU SCOEL procedure : guidance or binding

Respiratory tract

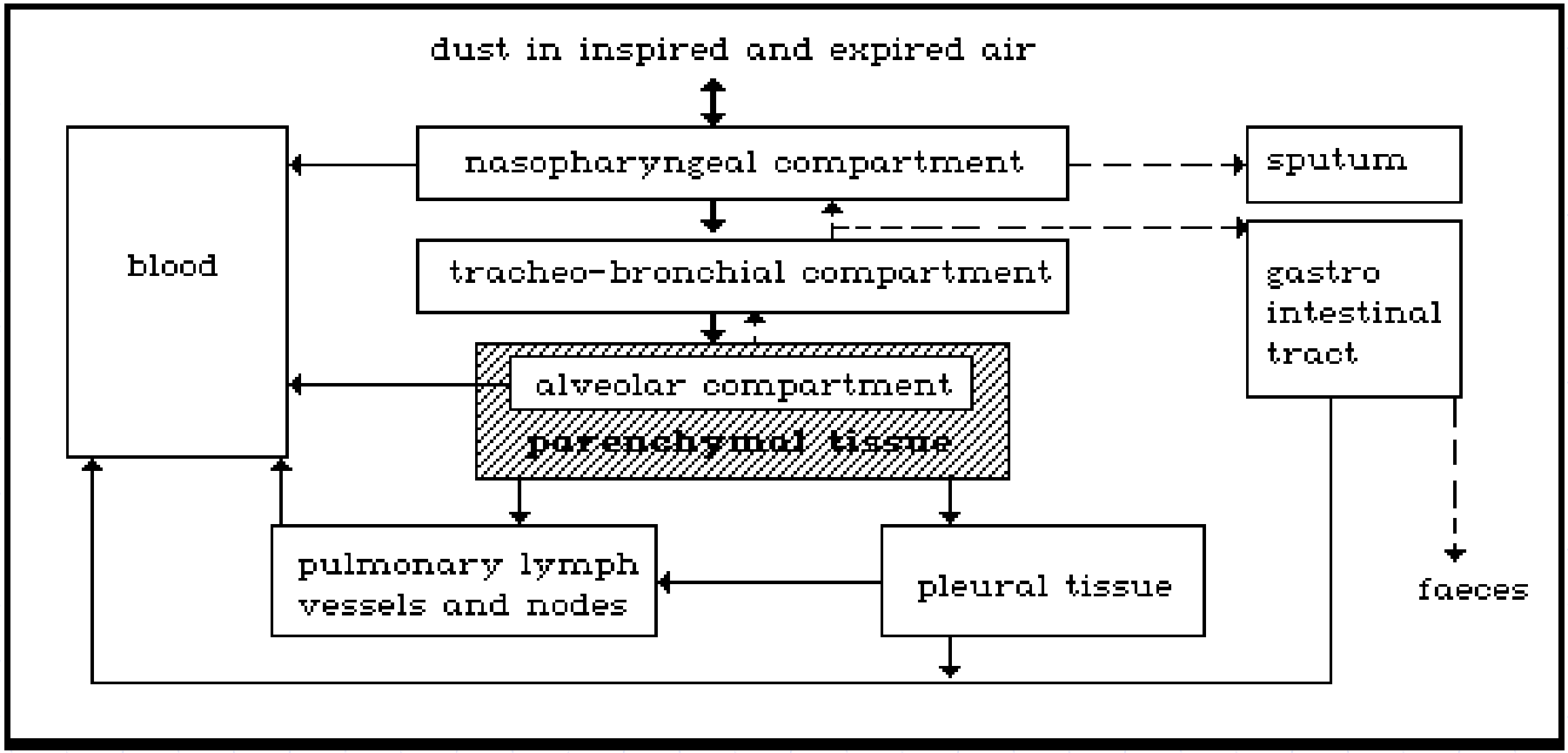
- Respiratory Tract
  - The respiratory tract begins at the nasal entrance, where particles are inhalable and continues through the thoracic cavity and down into the respirable gas exchange regions of the lungs (alveoli)
- For chemical substances present in inhaled air as suspensions of solid particles or droplets, the potential hazard depends on particle size as well as mass concentration because of:
  - The effects of particle size on the deposition site in the respiratory tract
  - The tendency for many occupational diseases to be associated with material deposited in particular regions of the respiratory tract

Respiratory tract



Air route

General scheme for the deposition, clearance, translocation and retention of particles (Diagram from Bignon & al)



Heavy arrows : deposition
Light dotted arrows : clearance pathways
Light arrow : translocation pathway

How to define and to use occupational exposure limits (OEL) ?

- Defining and using OEL implies to know :
  - Which types of particles are measured (inhalable, thoracic or respirable)
  - What is the length of the exposure (8 hours, 15 minutes...)
  - If the measurement is static or personal
  - If the limits defined by the regulation(s) are indicative values or binding values.

Particles, dust and aerosols

- Particle
  - A very small portion of matter
- Dust (OSHA : Occupational Safety and Health administration)
  - Dust consists of tiny solid particles carried by air currents.
  - A wide range of particle size is produced during a dust generating process. Particles that are too large to remain airborne settle while others remain in the air indefinitely.
  - Dust is generally measured in micrometers (commonly known as microns).
- Aerosol (ACGIH : American Conference of Governmental Industrial Hygienists)
  - An aerosol is a suspension of solid particles or liquid droplets in a gaseous medium.
  - Other terms used to describe an aerosol include dust, mist, fume, fog, fiber, smoke, and smog.

Aerodynamic diameter

- **Aerodynamic diameter** (AD), (US EPA, EN 481)
  - The term **"aerodynamic diameter"** has been developed by aerosol physicists in order to provide a simple means of categorizing the sizes of particles having different shapes and densities with a single dimension.
  - Aerodynamic diameter is commonly applied to particulate pollutants to predict where in the respiratory tract such particles will deposit.
  - The **aerodynamic diameter** is the diameter of a spherical particle, having a density of 1 g/cm^3, that has the same inertial properties [i.e. terminal settling velocity)] in the gas as the particle of interest.
    - ✓ Any particle with aerodynamic diameter of X falls at the same speed as a unit density sphere with X diameter
  - Note:
    - ✓ For particles of aerodynamic diameter less than 0.5 µm, the particle diffusion diameter should be used instead of the particle aerodynamic diameter.

Types of particles (EN 481, ACGIH)

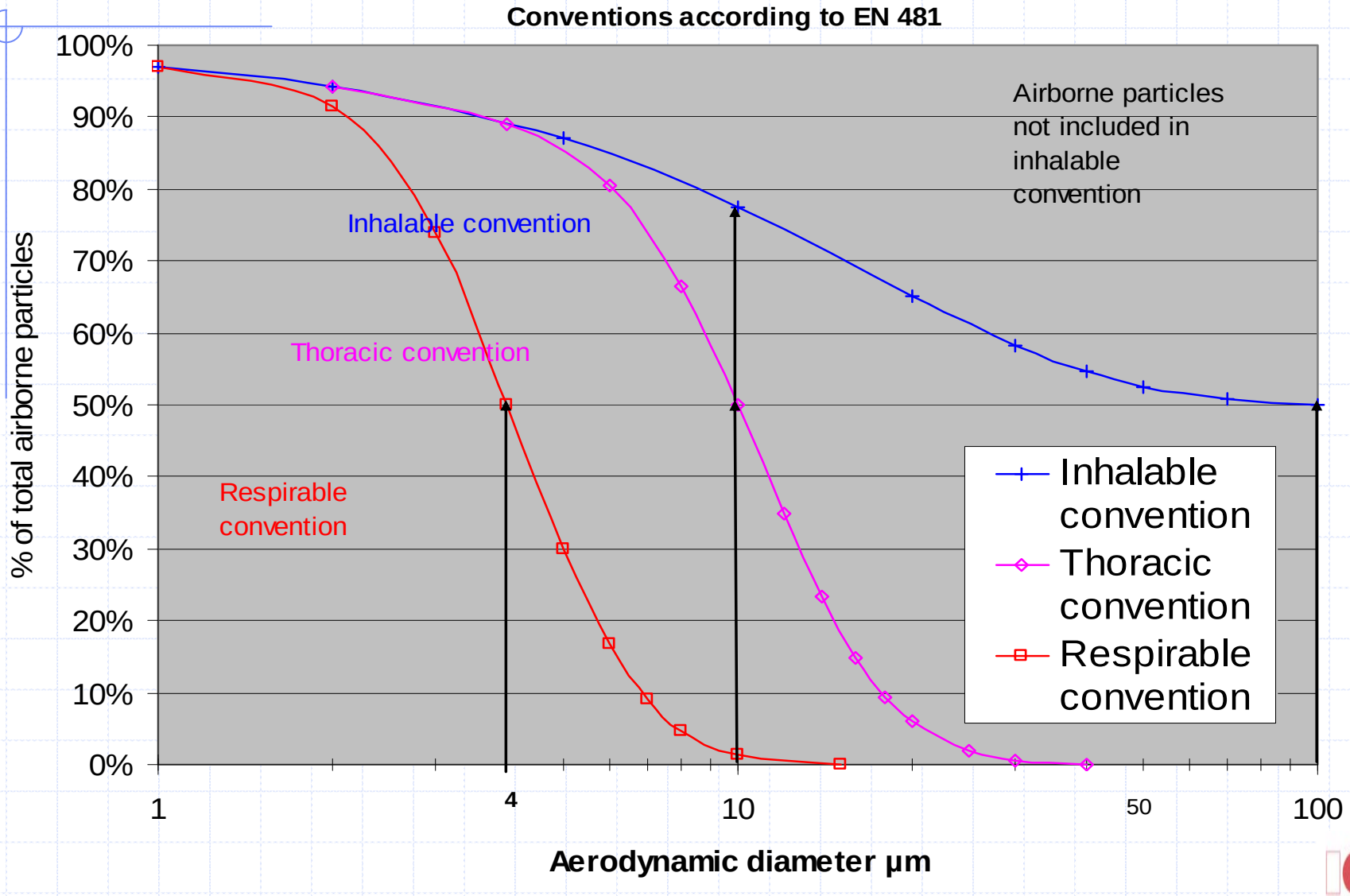
- **Total airborne particles**
  - All particles surrounded by air in a given volume of air
  - By definition: 100% of all particles are in the total aerosol

- **Inhalable fraction** (EN 481)
  - The mass fraction of total airborne particles which is inhaled through the nose and mouth.
    - ✓ The inhalable fraction depends on the speed and direction of the air movement, on breathing rate and other factors.
  - "Inhalability" decreases gradually as particle diameter increases, reaching a level of about 50 percent at 100 microns (µm).

Types of particles

- **Thoracic fraction** (EN 481)
  - The mass fraction of inhaled particles penetrating beyond the larynx and which can penetrate the lung pathways and gas exchange region of the lungs.
  - Almost 0% of total particles with an AD >= 30 µm reach this area
  - 50% of total particles with an AD of 10 µm reach this area
  - Almost 100% of total particles with an aerodynamic diameter (AD) of 1 µm reach this part of the respiratory system
- **Respirable fraction** (EN 481)
  - The mass fraction of particles which are deposited in the gas exchange region of the lungs (alveoli of the lungs)
  - Almost 0% of total particles with an AD >= 10 µm reach this area
  - 50% of total particles with an AD of 4 µm reach this area
  - Almost 100% of total particles with an aerodynamic diameter (AD) of 1 µm reach this part of the respiratory system

Air conventions (EN 481 – 1993)



Nomenclature of inhalable, thoracic and respirable fractions (Norm EN 481 1993)

German	French	English
einatembar	inhalable	inhalable (= inspirable)
thorakal	thoracique	thoracic
alveolengängig	alvéolaire	respirable

Exposure : duration of measurement

- The setting of Occupational Exposure Limits may include :
  - the eight-hour time weighted average (TWA)
    - ✓ recommendations for 8h TWA OELs will use, as preferred values, decimals of the integers 1,2 or 5 ppm or mg/m3
  - short-term limits/ excursion limits (STEL)
  - These values can be defined for inhalable air, thoracic or respirable air

OEL-TWA

- OEL – TWA (Time-Weighted Average)
  - Definition from ACGIH (American Conference of Governmental Industrial Hygienists)
  - The TWA concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, for a working lifetime without adverse effect.
  - This threshold is designed to protect workers against chronic effects
  - *In French : VME (valeur moyenne d'exposition)*

OEL – STEL

- STEL (Short Term Exposure Limit)
  - A 15-minute TWA exposure that should not be exceeded at any time during a work-day, even if the 8-hour TWA is within the OEL - TWA.
  - The STEL is the concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, 3) dose-rate-dependent toxic effects, or 4) narcosis.
  - The STEL will not necessarily protect against these effects if the daily OEL–TWA is exceeded.
  - This threshold is designed to protect workers against acute effects
  - *In French VLE, replaced by VLCT*

Excursion limit and TLV-C

(caution : used in the US)

- Definition : TLV = Threshold limit value
- Excursion limit
  - Excursion limits apply to those TLV –TWA's that do not have TLV–STEL's.
  - Excursions in worker exposure levels may exceed 3 times the TLV–TWA for no more than a total of 30 minutes during a work-day, and under no circumstances should they exceed 5 times the TLV–TWA, provided that the TLV–TWA is not exceeded.
- TLV–C (Threshold Limit Value – Ceiling)
  - The concentration that should not be exceeded during any part of the working exposure.

Legal nature of the OEL

- National (and international) OELs can be:
- Legally binding:
  - You have to match them or you can be filed
  - You have to match them or you can be sued by employees
- Indicative:
  - In many countries, if you do not follow indicative OELs, you open yourself to civil (and/or penal) liability
- In reality, is the difference so great between binding and indicative?

Mass equivalence of inhaled cadmium and ingested cadmium

Cadmium in air - Total concentration (µg/m3)	µg/m^3	10	20	50
Inhalation of occupational air (20l/min during 8 h = 9,6 m3/d)	m^3/d	9,60	9,60	9,60
Cadmium intake by inhalation	**µg/d**	**96,00**	**192,00**	**480,00**
Inhalation Uptake ratio (Cd blood/Cd inhaled)		0,25	0,25	0,25
Cadmium uptake into blood	**µg/d**	**24,00**	**48,00**	**120,00**
Ingestion Uptake ratio (Cadmium in blood/Cd in diet)		0,03	0,03	0,03
Cadmium ingested (equivalent)	µg/d	800,00	1600,00	4000,00
Cadmium ingested (equivalent)	**mg/d**	**0,80**	**1,60**	**4,00**
Cd density	mg/mm^3	8,65	8,65	8,65
Diameter of 1 sphere containing ingested Cd	mm	0,56	0,71	0,96
Diameter of 100 spheres containing ingested Cd	**mm**	**0,12**	**0,15**	**0,21**

Static and personal air sampling

- Static (also called: stationary sampling)
  - Sampling on one site
  - Fixed air inlet near source
  - Sampling in a room near where workers work
  - Results for an area
- Personal sampling
  - Sampling for a worker
  - Sampling tube and pump carried by worker

Static and personal sampling

- Are personal and static samples related ?
  - "Key factors in determining the relation between personal and static measurements in any situation will include :
    - ✓ the volume of the room
    - ✓ the quantity of general ventilation
    - ✓ the time the person spends in the proximity of sources of hazardous substances (that is, with a source in their breathing zone)
    - ✓ the presence of other internal or environmental sources of the contaminant, and others.
  - In most circumstances, without knowing something, about each of these factors, it is impossible to predict what the relation between personal and static concentrations might be." Cherrie, JW, 2004

EU SCOEL procedure
Indicative or binding ?

- The European Commission uses the scientific advice from SCOEL (Scientific Committee on Occupational Exposure Limits) to make proposals for OELs (occupational exposure limits).
- Limits based solely on scientific considerations are considered as adaptations to technical progress, and are incorporated in proposals for Commission directives within the framework of the chemical agents directive and are indicative.
- Limits that take account also of socio-economic and technical feasibility factors are included in proposals for Council directives under either the chemical agents directive or the carcinogens at work directive and are binding.

- NB : EU Member States can only lower these limits and transform indicative values into binding values

Thank you
for your attention

Analysis of dust monitoring questionnaire responses

Phil Rowley

ICdA health & safety committee meeting
Brussels, Tuesday 10th March 2009

Plants and activities

	PLANT ACTIVITY					
COUNTRY	Batteries (B)	Chemicals (C)	Metal refining (M)	Pigments (P)	Recycling (R)	Σ
Belgium		1	2			3
Czech Republic	1					1
France	2				2	4
Germany	1		1		1	3
Italy			1			1
Netherlands			1			1
Norway			1			1
Sweden	1					1
United Kingdom				2		2
Σ	5	1	6	2	3	17

Persons exposed to cadmium

Activity	Plant	Personal dust sampling frequency	Workers exposed to cadmium
Batteries	1	12 months	679
	2	12 months	
	3	6 or 12 months	
	4	12 months	
	5	3 months	
Metal refining	1	12 months	583
	2	6 months	
	3	12 months	
	4	*	
	5	12 months	
Chemicals + Pigments + Recycling	1	6 months	127
	2	6 months	
	3	6 months	
	4	24 months *	
	5	6 months	
	6	6 months	

* these plants use mainly static sampling

Basic standards

EN 481 “Workplace atmospheres. Size fraction definitions for measurement of airborne particles”

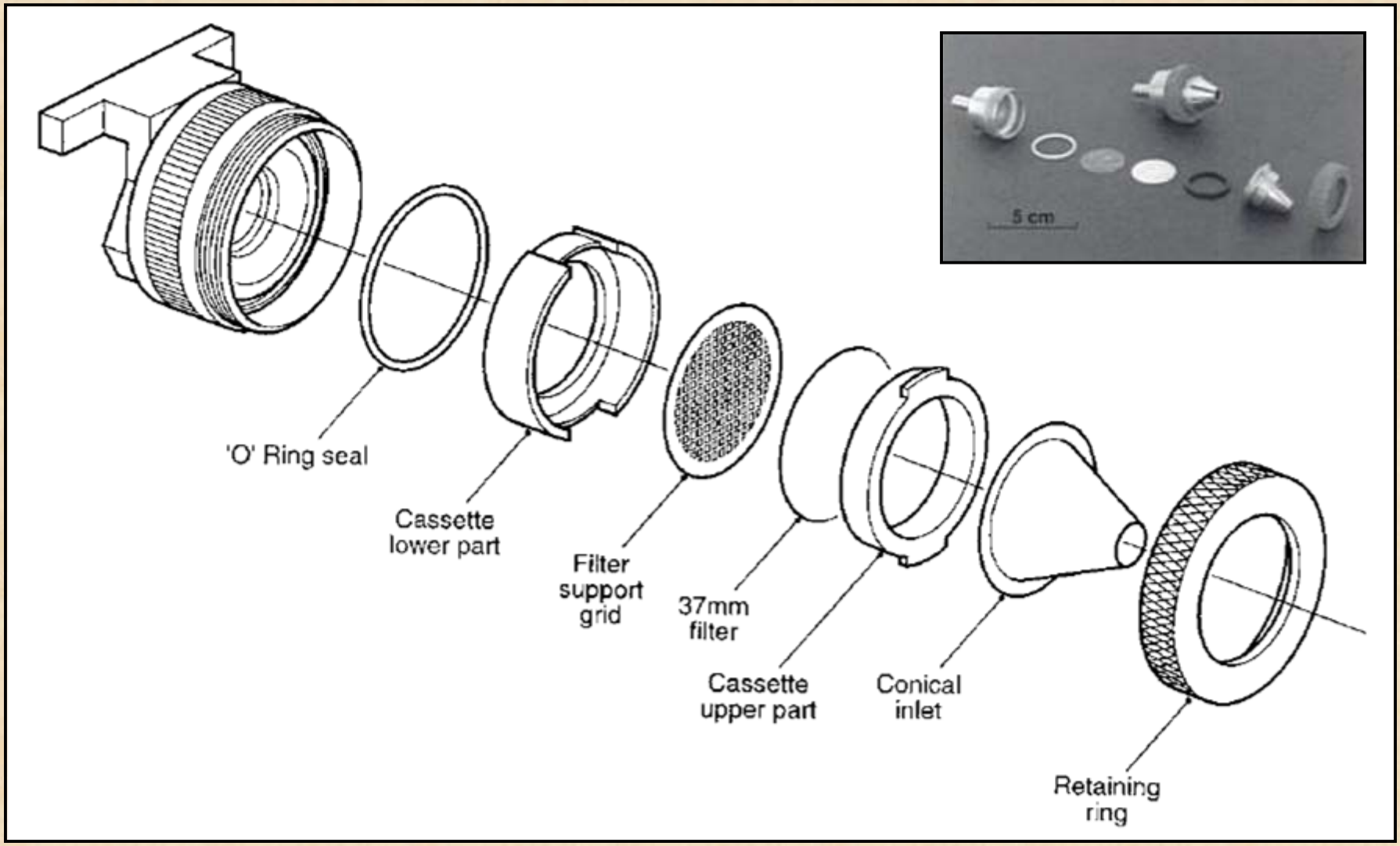
EN 482 “Workplace atmospheres. General requirements for the performance of procedures for the measurement of chemical agents”

Site	Country	Pumps	Flow (l/min)	Filters	Comments
B1	CZ	SKC 224 PCX	3.0	Pragopur, MCE	
B2	FR	SKC		37 mm quartz fibre FQ	
B3	FR	SKC 224 X ATEX 2	2.0	37 mm quartz fibre	
B4	DE				
B5	SE	SKC Airchek XR5000	2.0	SKC respirable cyclone, 37 mm MCE 0.8 µm	
C1	BE	Casella Vortex Timer 2	2.0	SKC IOM Multidust sampler, Millipore membrane 0.8 µm	
M1	NO	SKC Sidekick	2.0	CAC filter 37 mm, PVC filter cassette with 0.8 µm pores	
M2	BE	Gilian Gilair 5	2.0	American cassette 37 mm	
M3	NL	Gilian Gilair	2.1	PAS-6 inhalable sampler	
M4	DE				
M5	IT	Zambelli Ego TT	2.0	SKC IOM / 25 mm 5µm	+ annual static
P1	UK	Casella Vortex Timer 2	2.2	Casella hole + SKC cyclone, Whatman 25 mm GF/A	
P2	UK	SKC 224-PCTX4	2.0	Inhalable: SKC Multidust 225-70A, 25 mm Whatman 0.8 µm membrane	
			2.2	Respirable: SKC plastic cyclone with 37 mm plastic cassette, 37 mm 0.8 µm Whatman membrane	
R1	DE	Ströhlein Gravikon VC25G	22.5 m^3/hr	Sartorius SM 11301 150mm diameter membrane filter 8µm	**STATIC**
R2	FR	MSA Escort ELF	1.0	Quartz fibre filter 37 mm	+ monthly static tests
R3					

Standards: EN 1232 “Workplace atmospheres – pumps for personal sampling of chemical agents”. All current sampling pumps claim compliance to this standard.

Netherlands PAS-6 sample head

(similar to IOM and German GSP inhalable heads)



Static dust sampling

- Virtually all respondents use static sampling to some extent – perhaps for troubleshooting or to monitor the effect of process / plant modifications
- One respondent with a small number of employees uses mainly static dust monitoring with this sampling equipment
- Used with a total dust head, this unit is stated to comply with VDI 2265 - “Determination of the dust concentration in the workplace for industrial hygiene purposes.”
- Standard: EN 12919 “Workplace atmospheres – pumps for the sampling of chemical agents with a volume flow rate of over 5 litres / minute. Requirements and test methods.”

Ströhlein
GRAVIKON VC25G
dust sampling
at 22.5 m^3 / hour

Limit values for cadmium & compounds

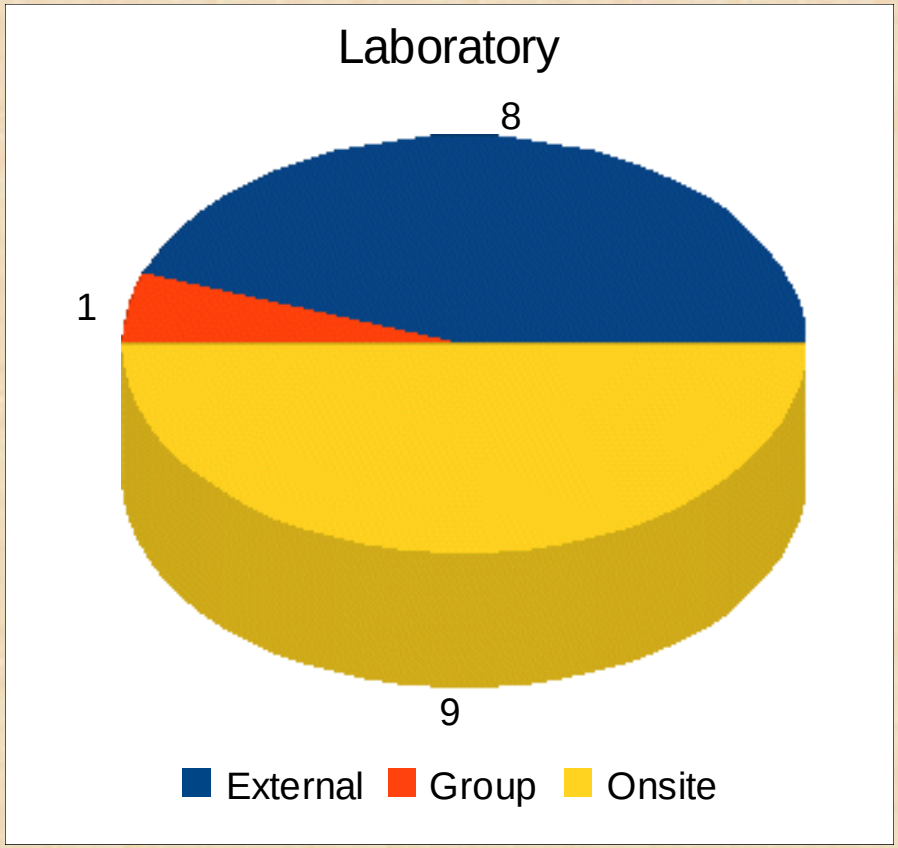
Country	Material(s)	Limit mg / m3	Type *	Period	Source / comments
CZ	CdO, $Cd(OH)_2$	**0.05**	I	8-hr	Czech decree 361/2007
		0.1	I	15-min	
BE	Cd & compounds	**0.01**	I	8-hr ?	Arrêté royal 11 mars 2002
		0.002	R		
DE	Cd, CdO				TRGS 905
		0.03	T	8-hr ?	Battery / Zn / Cu / Pb production
		0.015	T	8-hr ?	Elsewhere
FR	Cd & compounds	0.05	I	8-hr	INRS ED984 – guidance only
	CdO	0.05	I	15-min	
IT	Cd & compounds	0.01	I	8-hr	ACGIH 2008
NL	CdO	**0.005**	I	8-hr ?	Limit values 28/12/2006
NO	Cd & compounds except CdO	0.05	T	8-hr	
	CdO	0.02	T		
SE	Cd & compounds	**0.02**	T	8-hr	
		0.005	R		
UK	CdO fume	**0.025**	I	8-hr	UK HSE
		0.05	I	15-min	
	CdS & Cd pigments	**0.03**	R	8-hr	
	Cd and all other Cd materials	**0.025**	I	8-hr	

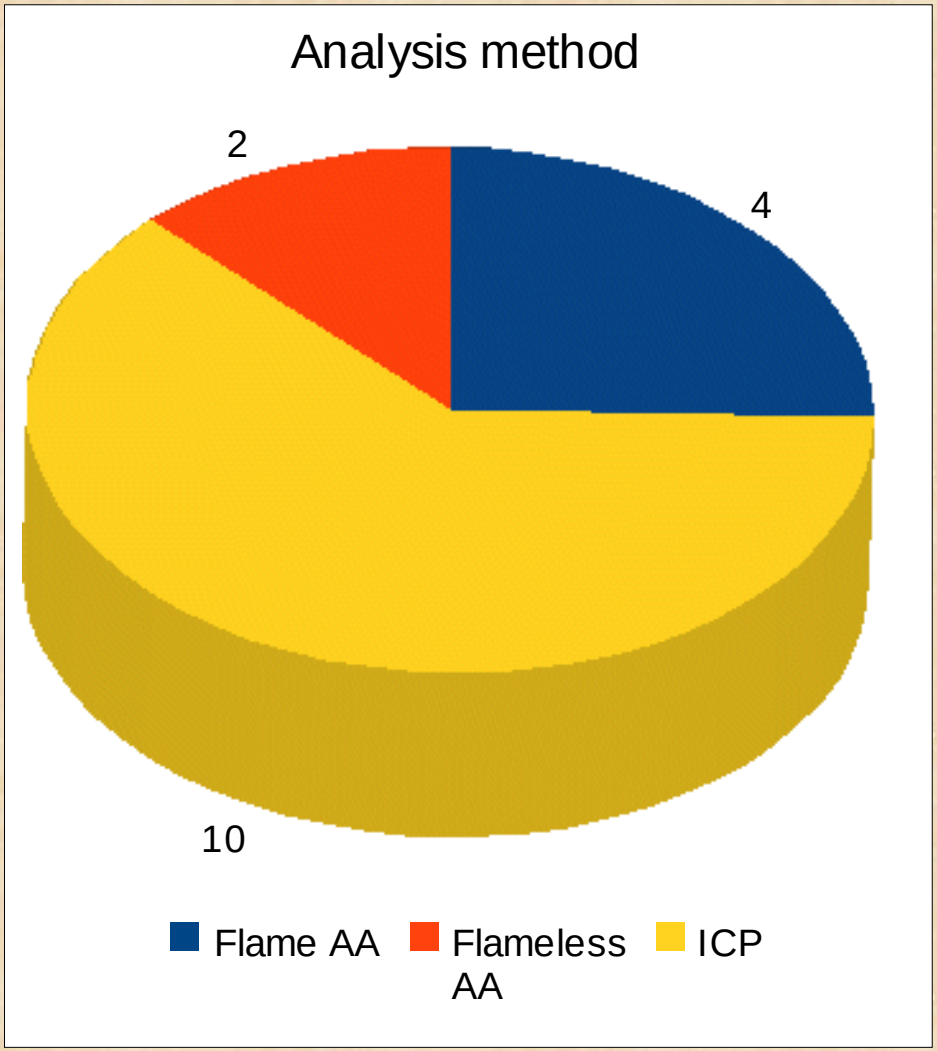
Useful address: http://www.dguv.de/bgia/en/gestis/limit_values/index.jsp
A database of limit values for chemical substances from around the world

Country	Method		Source
France	NFX 43 257	inhalable dust sampling	AFNOR
	NFX 43 259	respirable dust sampling	
	NFX 43 275	analysis method	
	Fiche 003	metals & metalloids – sampling & analysis	INRS
Germany	VDI 2265	determination of total dust levels	VDI – Association of German Engineers
	VDI 2268	chemical analysis of particulate matter : Cd in particulate emissions by atomic spectrometric methods	
	BGI 505-54	procedure for the determination of Cd (similar to ISO 11174)	BGI
	TRGS 402	determination and assessment of the hazard from the use of dangerous substances : inhalable dust	Technische Regel für Gefarhstoffe
	TRGS 403	evaluation of exposure to mixed substances in workplace air	
United Kingdom	MDHS 10/2	sampling & analysis of Cd in air	UK Health & Safety Executive
	MDHS 14/3	sampling of respirable & inhalable dust	
	MDHS 71	analytical quality in workplace air monitoring	
	MDHS 91	metals in workplace air by XRF	
	MDHS 99	metals in air by ICPAES	
INTERNATIONAL	EN 689	guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy	CEN
	EN 13890	procedures for measuring metals & metalloids in airborne particles	
	ISO 11174	determination of particulate Cd & compounds	ISO
	ISO 15202	determination of metals by ICP-AES	

Useful address: http://www.dguv.de/bgia/en/gestis/analytical_methods/index.jsp
A database of validated methods for the analysis of workplace substances

Laboratories / analysis method





Quality assurance

- How can we have confidence that our cadmium dust-in-air results are meaningful ?

  - where there is more than one limit, identification of the chemical species present may be required – the relevant limit may set specific monitoring requirements eg inhalable or respirable sampling and full-shift or short-term sampling
  - selection of suitable sampling pump eg to EN 1232
  - use of correct sampling head, flow-rate, filter and sampling time
  - correct fitting of sampler on operator to sample breathing zone
  - use of a suitable filter digestion and analysis method

Quality assurance ...

- Confidence in the analysis is vital – particularly if an external laboratory is used

- The ideal would be a laboratory certified by a third-party agency eg to ISO/CEN 17025 “General competence of testing & calibration laboratories” (& other relevant standards) for the particular work being carried out

  Virtually every country has a national body authorised to carry out such certifications eg UKAS in Britain, COFRAC in France, DKD in Germany etc. Many such national bodies also work together in the European Co-operation for Accreditation (EA).

- An external lab proficiency scheme for the analysis of Cd dust sampling filters is available – WASP – more information later

Plant	Country	Comments
B1	CZ	Sampling & analysis by regional hygiene authority – ISO 17025
B2	FR	External laboratory COFRAC approved
C1	BE	WASP participant
M1	NO	external accredited lab
M3	NL	WASP participant
P2	UK	WASP participant

High results ...

Everybody gets a high dust-in-air result from time to time – how do we see if it is significant ?

If a spillage or other problem has been reported, this may well account for the result

In almost all responses, the same person carrying out the same job(s) would be re-tested as soon as possible

A repeated high result would lead to an investigation of the plant being used and of the worker in question. Use of static sampling might be used to confirm a suspected plant problem, to locate a plant problem or to confirm that corrective action has been effective

Results reporting

Site	Country	Results to operator		Results to safety committee (or similar) ?	Published in-house ?	
		All	only fails	Y / N	Y / N	Names ?
B1	CZ	N/A	N/A	Y	Y	N/A
B2	FR			Y	Y	N
B3	FR	Y		Y	Y	Y
B4	DE	Y		Y	N	
B5	SE	Y		Y	Y	Y
C1	BE		Y	Y	Y	Y
M1	NO	N	N	Y	Y	Y
M2	BE	Y		Y	Y	N
M3	NL	N		Y	Y	N
M4	DE			Y	Y	
M4	IT	Y		Y	Y	Y
P1	UK	Y		N	N	
P2		Y		Y	Y	N
R1	DE	Y		Y	Y	
R2	FR	Y		Y	Y	
R3		Y		Y	Y	

Cadmium « dust in air » sampling at Saft SA

Philippe-René Kreher (NER) and Benoit de Fournoux (BDX)

ICdA H&S Comittee - March 10th, 2009

Photos D.R.

General principles of prevention

- **Identify risks, and evaluate risks which cannot be eliminated**
- **Replace dangerous products with less dangerous products**
- **Prioritise collective protection before individual protection (very French!)**
- **Train employees**
- **Organise prevention**

(hygiene, ventilation, medical)

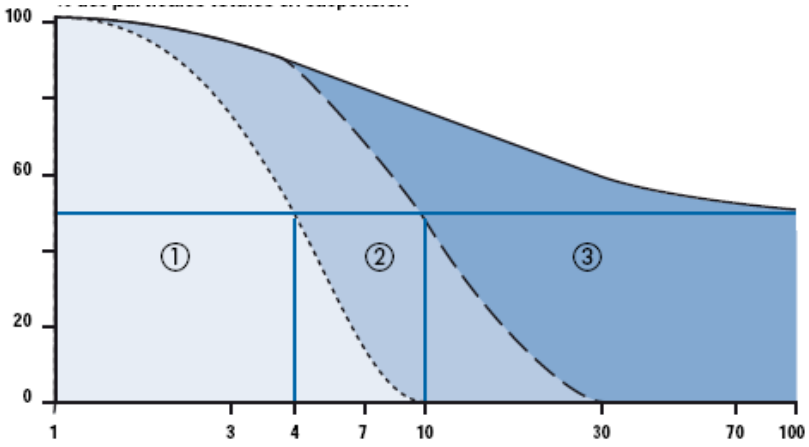
Experience

- **Thirty years of Cd dust monitoring**
- **Air control procedure written and updated since 1980**
- **Before 2002, Cd levels analysed by SAFT** (non compliant levels reported to management)
- **Since 2002, Cd levels analysed by an external laboratory** (ministry of employment approved by COFRAC – in line with ISO 17025)
- **Selection of COFRAC approved testing contractor ensures stardards are followed**
  - New provider selected 4Q/2008
  - Consistency of results is excellent between old and new

Methodology

- **Two methods used**
  - **Personal** air sampling:
    - To check if the worker is well protected
    - Incorporates intervention within machine, worker behavior, all non-machine related impacts
  - **Static** air sampling:
    - To analyze workplace in a more detailed way

- **Inhalable dust is analysed**
  - OEL in FR are:
    - **Guidance** (not mandatory)
    - **Inhalable** fraction
    - **8hr TWA** (and STEL)
  - Saft policy is stricter than FR OEL



Compliance and Prioritization strategy

- **COMPLIANCE**
  - Common provisions:
    - If multiple shifts at WP: one sampling only
    - If several identical WP in plant: one sampling only
  - NER:
    - Personal only
    - One campaign per year
  - BDX:
    - Personal and static
    - One campaign per year

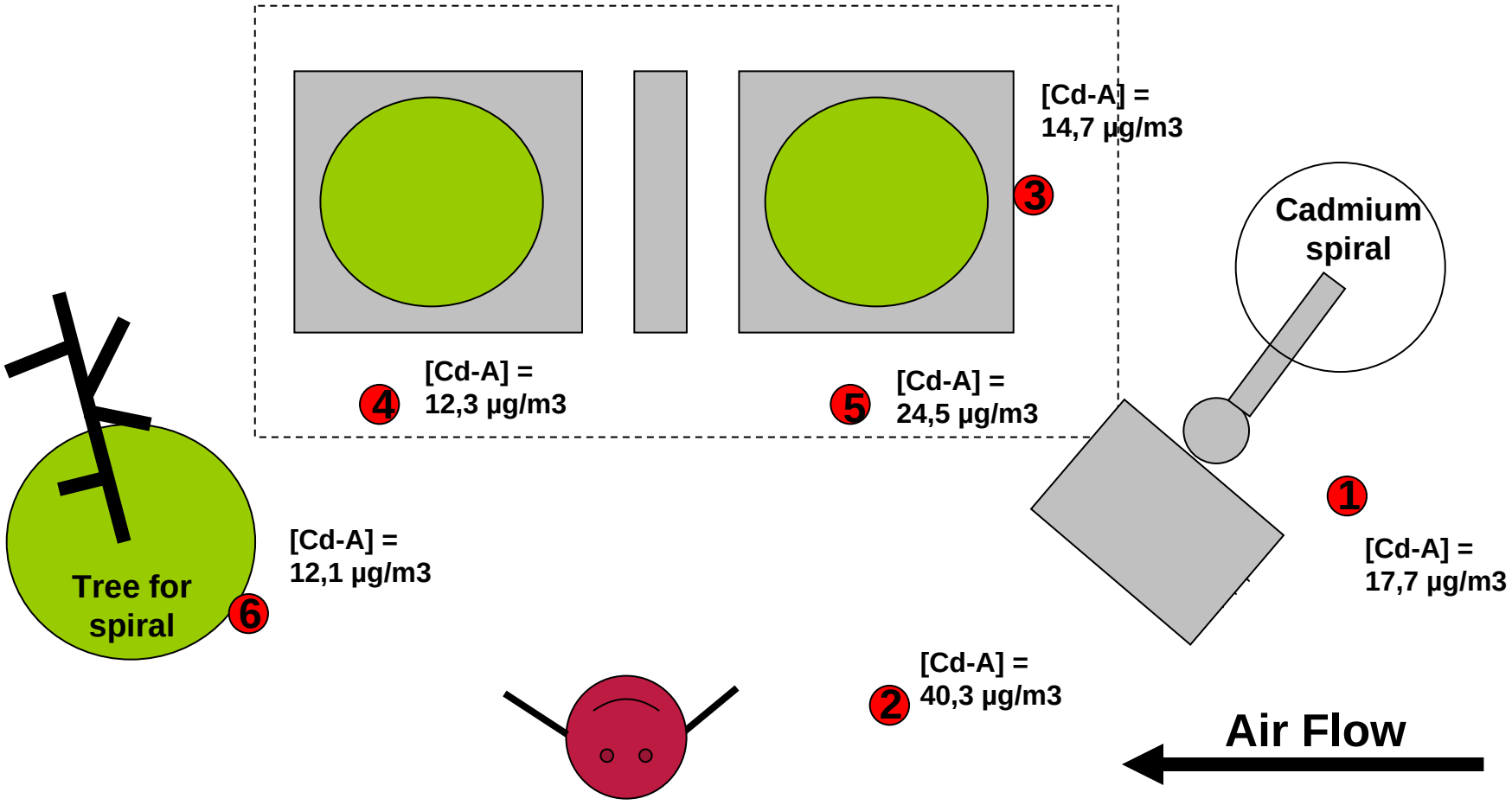
- **PRIORITIZATION STRATEGY**
  - Workshop air quality improvements are essentially driven by **personal** air sampling results
    - CdA > 14µg/m3
    - Or presence of Cd on the ground
    - Medical surveillance programme feed-back
    - From upstearm towards dowstream of general plant airflow

After prioritization: Improvement Projects

- **BDX:**
  - Detailed WP audit with joint team with CHSCT (Hygiene Ctee)
  - Comprehensive review of
    - Equipment,
    - Organization
    - Worker professional hygiene
- **NER:**
  - Ad-hoc project team
  - Static sampling conducted to identify « leaks »
  - See next slide for example

Improvement: example of [Cd-air] detailed review at a workplace

● = static dust sampling



Difficulties (1)

- **Comfort:**
  - Some workers complain about pump weight and noise. Weight and pipe restrict ability to intervene in machines.
  - Different perceptions linked to quality of labor relations
- **Cross-contamination:**
  - Before 2002, the same (internal) laboratory controlled process quality and air quality
  - Variability noted then was blamed on cross-contamination
- **Period selection:**
  - Summer period is selected with dry air, probably yielding a less favorable situation
  - Process which generates hightest level of Cd
- **Employee tracking:**
  - If employee changes workplace during personal sampling, result not representative of any specific workplace!
- **Proper maintenance of air pumps needs to be conducted:**
  - Air speed in ducts is an indicator of air filtration problem

Difficulties (2)

- **We have to guarantee a very small level in the air despite several changing conditions:**
  - Size of the person
  - Number of human intervention within machine during 8hr shift
  - Different products manufactured in a given workplace yield different results
  - Air temperature
  - Air flow around machinery
  - Air humidity
  - Hygiene and movement habits of worker

Positives

- **Outsourcing of sampling and testing of air quality:**
  - Enhances credibility of process
  - Ensures better employee participation and commitment
- **Need to conduct testing in areas where [Cd-A] = 0 to show risks are nil in these areas:**
  - Creates a joint vision between employees and management on « high Cd » and « low Cd » areas
  - Creates confidence that unfit people are truely placed in zero exposure jobs
- **Welcome to show management:**
  - Money is well spent and generates measureable improvements
  - Limits employee health risk and employer legal risks

Conclusions

- **Difficulties in the future to improve further because of very low level already achieved:**
  - 2l/mn => 1m^3/8hr
  - 20 microg/m^3 caught in cartridge
  - Small incident can modify sample results significantly
- **Education on hygiene and movement habits is critical to further success**

James M. Brown Limited

Stoke-on-Trent, UK

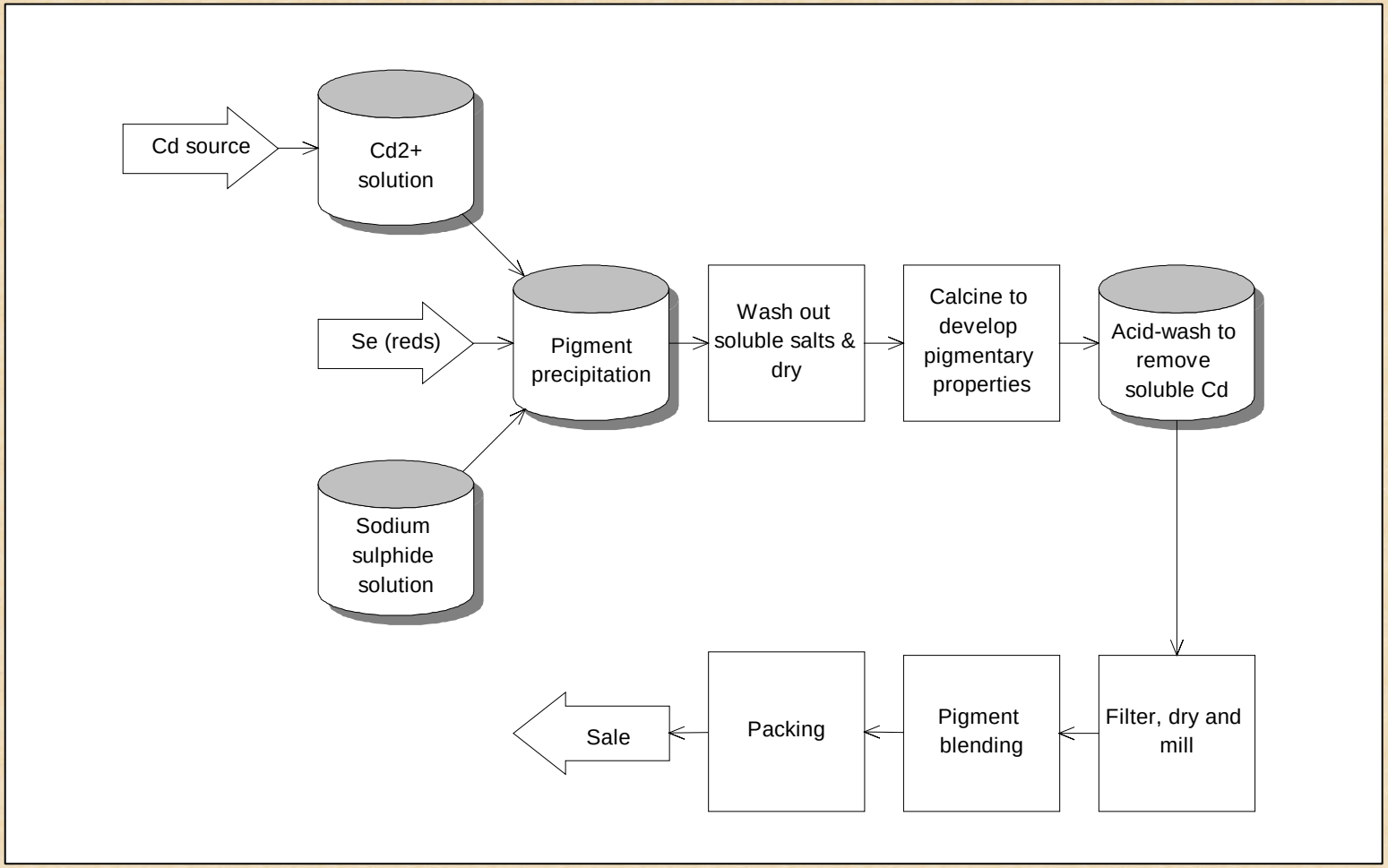
Cadmium dust-in-air monitoring

Phil Rowley

ICdA health & safety committee
Brussels, Tuesday 10th March 2009

James M. Brown site

Pigment manufacturing process

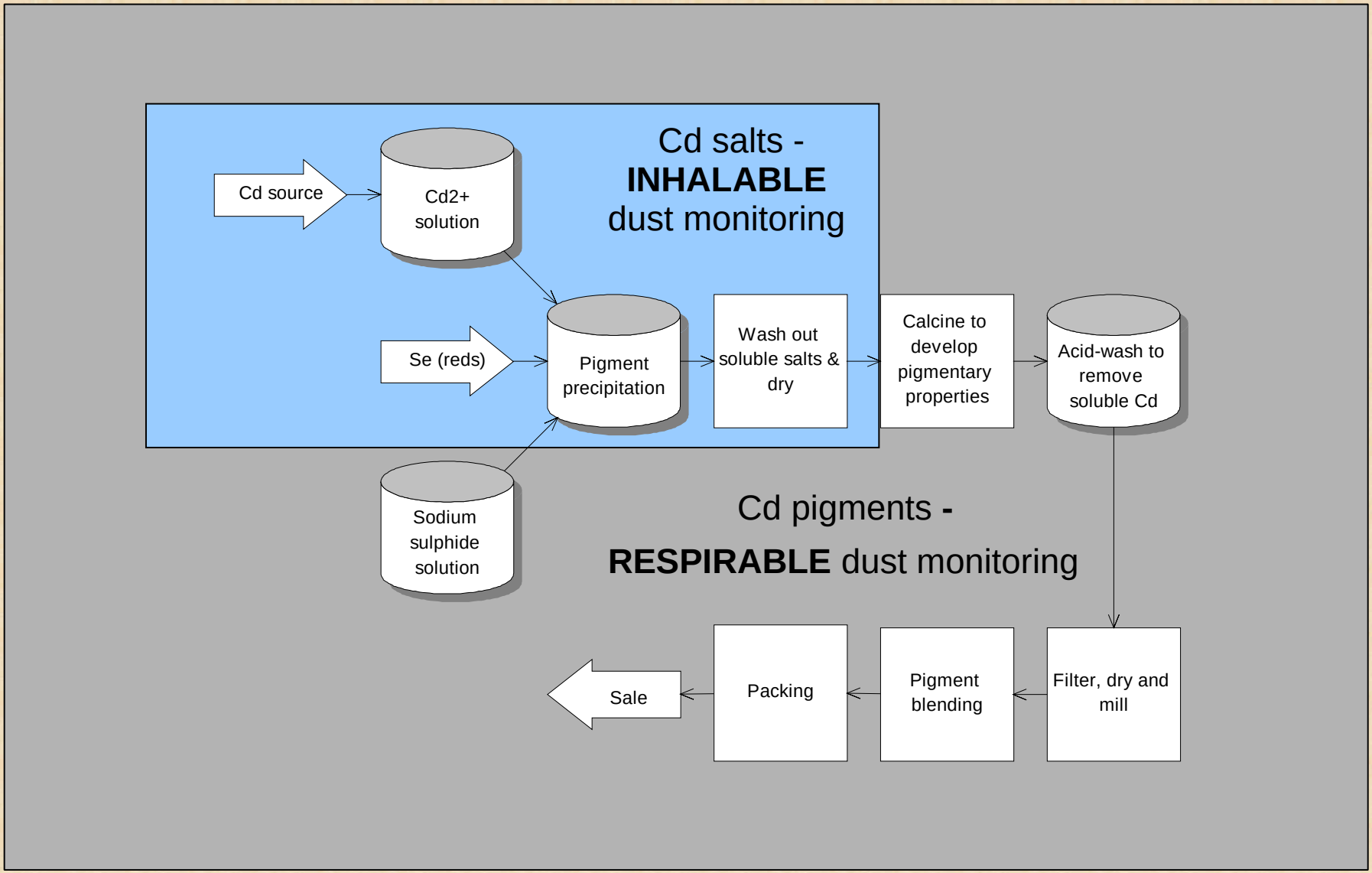


Current UK dust-in-air limits

set by UK Health & Safety Executive document EH/40 - official Government agency

Material	Limit(s)	Period	Type
Cadmium oxide (fume)	0.025 mg m^{-3} (as Cd) 0.05 mg m^{-3} (as Cd)	8 hours 15 minutes	**Inhalable** **Inhalable**
Cadmium sulphide & cadmium pigments	0.03 mg m^{-3} (as Cd)	8 hours	**Respirable**
Cadmium metal and cadmium compounds not listed above	0.025 mg m^{-3} (as Cd)	8 hours	**Inhalable**

JMB monitoring scheme



UK HSE “MDHS” documents

UK HSE has produced nearly 100 documents in its MDHS series - “Methods for the determination of hazardous substances”

Most – possibly all - of the MDHS methods have been validated to comply with EN 482 “Workplace atmospheres – general requirements for the measurement of chemical agents”

EN 482 requires that the overall uncertainty should be :-

< 30 % for results between 0.5 x and 2 x the limit

< 50 % for results between 0.1 x and 0.5 x the limit

Relevant UK HSE “MDHS” documents

MDHS 14/3	General methods for sampling and gravimetric analysis of respirable and inhalable dust
MDHS 10/2	Cadmium and inorganic compounds of cadmium in air
MDHS 71	Analytical quality in workplace air sampling
MDHS 91	Metals and metalloids in workplace air by X-ray fluorescence spectrometry
MDHS 99	Metals in air by ICP-AES

from:- www.hsl.gov.uk/publications/mdhs_current.htm

JMB dust monitoring

Monitoring almost exclusively full-shift personal testing – except for investigation work, plant modifications etc, where short-term personal or static sampling might be used.

26 persons being tested every 6 months

Testing for inhalable or respirable dust, depending on plant area and jobs being done. This generally breaks down to “mainly pigment dust” (respirable) or “mainly non-pigment dust” (inhalable).

As most workers may do more than one job per shift, we have to keep records of tasks carried out during each sampling.

UK HSE uses the CEN / ISO definitions of “inhalable” and “respirable” laid down in EN 481 “Workplace atmospheres. Size fraction definitions for measurement of airborne particles”

Sampling pumps used : SKC 224-PCTX4 with internal timer. Each pump is serviced and calibrated externally every year.

Pump flow-rate checked before and after sampling using SKC calibrator.

In-house test method used, covering equipment selection and preparation, treatment and analysis of membranes : based closely on MDHS 10/2

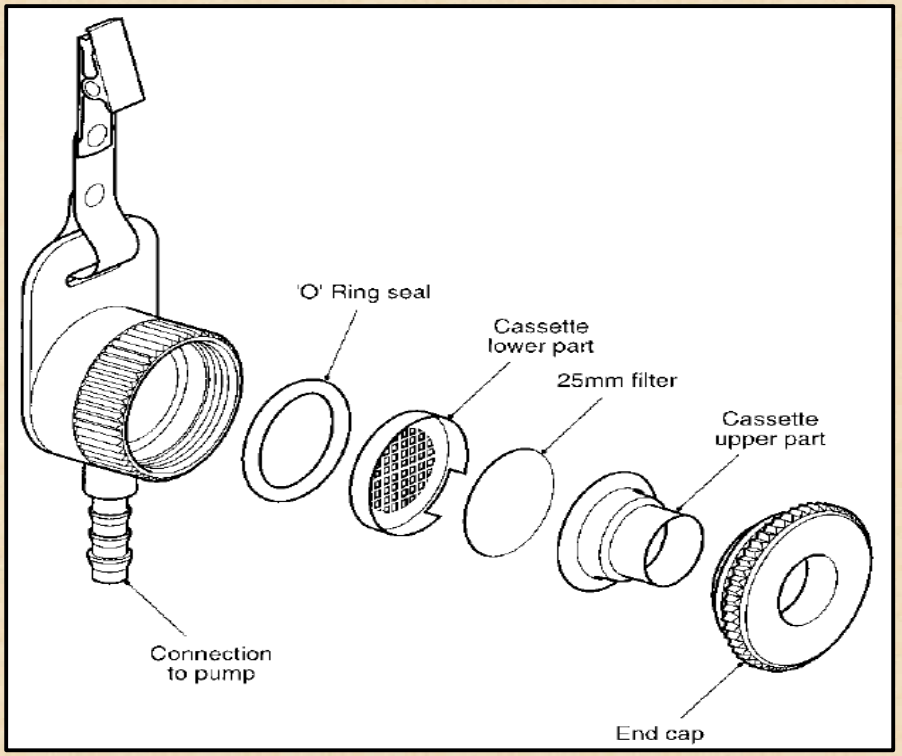
Dedicated analysis equipment and glassware used : located in positive pressure filtered-air clean room.

Membranes leached / dissolved in 5 cm^3 50 % Aristar nitric acid and 100 µl Analar 50 % hydrogen peroxide - made up to 25 cm^3

Blank membranes processed every run

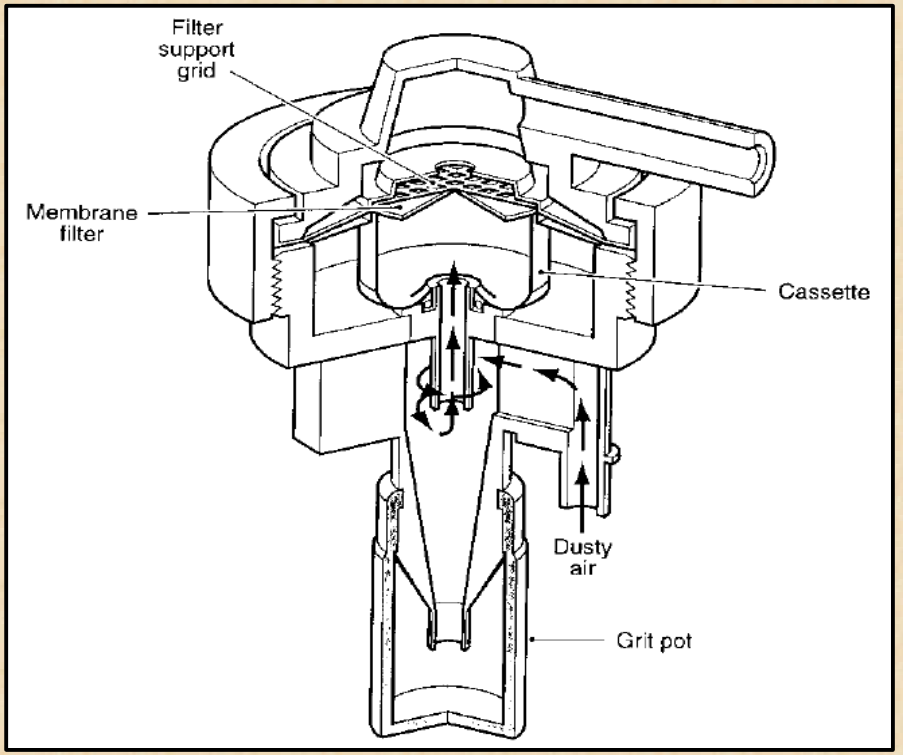
Determination by flame AA at λ = 228.8 nm with background correction, using matrix-matched standards

Inhalable dust sampling



SKC IOM Multidust sampler 225-70A
with 25 mm Whatman 0.8µm membrane filter
Sampling rate: 2 litres / minute

Respirable dust sampling



SKC Plastic cyclone with 37 mm plastic cassette 225-69-37
with Whatman 0.8µm membrane filter
Sampling rate: 2.2 litres / minute

Job record sheet

If there are any problems please ring Hannah on 204

XXXXXXXX Department

Name :- Date :- Pump number/letter :-

Job	Time spent on job	Amount of material used

Was respiratory protection worn during the test ? Yes / No

If yes, please specify type :-

Did any spillages occur during the test ? Yes / No

If yes, please give details :-

Dust-in-air results

All results are given to the person monitored

In the case of any result over the relevant limit, the same person is retested twice doing the same job as soon as this can be arranged

All results reported to health & safety committee with names

All results made public (within company) in safety committee meeting minutes - results anonymised

Results open to HSE inspection at any time including names.

UK “WASP” external lab QA scheme

“WASP” - Workplace Analysis Scheme for Proficiency

Established by UK Health & Safety Executive in 1988

Has approximately 200 participants worldwide

Covers metals and organic solvents

UK “WASP” proficiency scheme ...

WASP appears to be the only QA scheme covering cadmium dust-in-air analysis.

For Cd/Pb/Cr, the samples distributed are membrane or glass-fibre filters with known quantities of all three metals spiked on as soluble salts.

Sets of four samples are sent to each participating lab every three months. The labs have one month to analyse the samples and return their results.

Each laboratory receives a report comparing their results with other participants and receives a category 1 (good), 2 (satisfactory) or 3 (unsatisfactory) rating.

UK “WASP” proficiency scheme ...

Analyte	loading range µg	Medium
Pb	**15 – 150**	**3 substances provided together on a single membrane filter**
Cd	**5 – 50**	
Cr	**50 – 500**	
Pb	15 -150	3 substances provided together on a single glass-fibre filter
Cd	5 – 50	
Cr	50 – 500	
Cr, Ni, Fe and Mn	5 – 200	Welding fume on membrane filters

Solution-spiked filters

JMB participates in this series for Cd & Pb

Actual welding fume, captured using a multi-place sampler

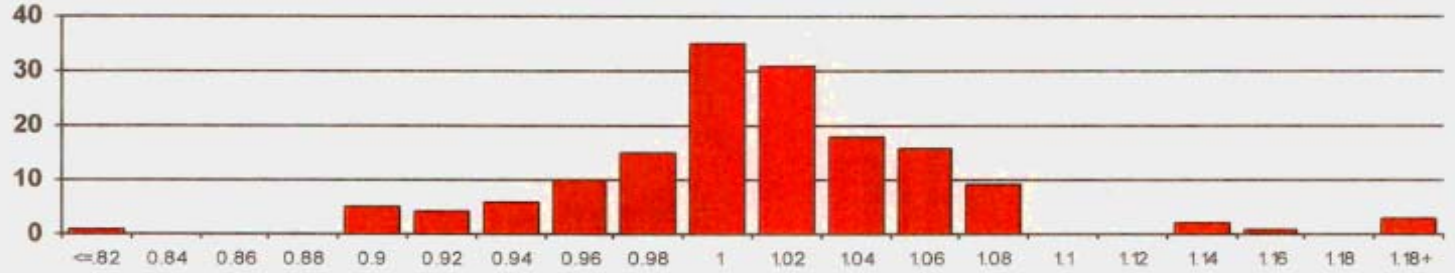
WASP report – part 1

WASP Results

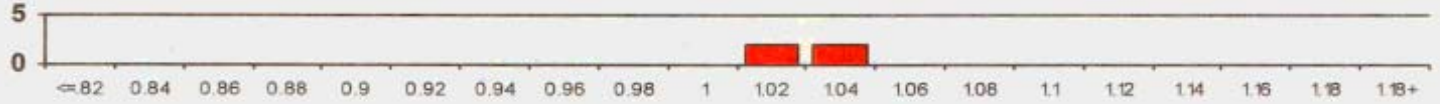
Round: 79 Laboratory: 134

Cadmium on Membrane Filters

Frequency Count of Results for this Analyte



Results for this Laboratory



Summary of your results and their ratio to the mean

sample number	your result	'true' result	Difference(%)	standardised results
1	37.75	36.77	2.66	1.027
2	16.50	16.04	2.87	1.029
3	9.75	9.75	0.00	1.000
4	22.50	22.43	0.31	1.003

RPI	performance category
< 16	1
16 to 65	2
> 65	3

WASP report – part 2

Reference Value Used: No **mean:** 1.01 *RPI Reference Value:* 36

Results for Your Laboratory:

Number of outliers: 0
Performance Index (PI): 4
RunningPerformanceIndex (RPI): 5
Performance Category: 1

Results for All Participants:

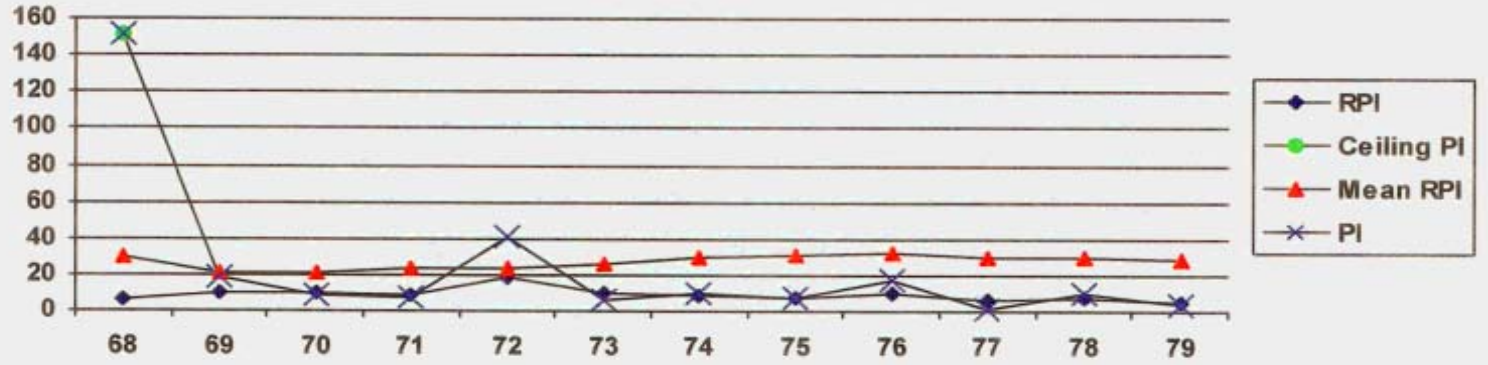
Mean PI: 20.21 **Median PI:** 10
Mean RPI: 27.96 **Median RPI:** 14

Your laboratory is ranked 8 **out of** 35 **labs.**

additional statistical data (see the statistical protocol paragraphs 12 to 18)

analysis of variance: **Delta:** 0.014597 **SSW:** 0.000689 **Coefficient of variation:** 2.879

RPI Plot for your Laboratory



WASP technical contact details

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Fax: +44 1298 218553

www.hsl.gov.uk/proficiency-testing/wasp.htm

JMB dust results vs CdB & CdU

Dust results above the limit happen rarely – and often prove to be due to sampler contamination

We have a small number of workers who joined the company 25 or more years ago, when dust levels were significantly higher. Their results are relatively high due to existing body burden

More recent starters all have CdB / CdU well below ICdA guidelines

We don't employ any workers who smoke

Conclusions ...

Dust-in-air monitoring over many years, using UK HSE “MDHS” methods supported by participation in the WASP external QA scheme, together with process and plant improvements, means that it is rare for a dust result to fail

Virtually all plant dust-extraction (LEV) is now interlocked with the equipment it serves, ensuring that it is always operating when necessary

We insist on the use of PPE (mainly “Airstream”-type helmets) in dusty areas – even though the measured levels are within the relevant limits.

AIR QUALITY RECOMMANDATIONS - 30 mn

purpose of discussion:

AGREE on GOOD PRACTICE
i.e.
generate a good practice Guidance Sheet

Two Questions

Checking site compliance

- Checking site compliance with requirements:
  1. What should we check?
     - ✓ Inhalable or respirable?
     - ✓ STEL or 8hr-TWA?
     - ✓ What should be the ICdA recommended value?
  2. Where?
     - ✓ Static or personal?
  3. How often?
     - ✓ As needed - yearly - or else?
  4. Should we recommend certification?
     - ✓ Should we select an internal or external measurement service provider?
     - ✓ Should the provider be certified by an EA certification body?
     - ✓ Should the provider be ISO/CEN 17025 (General requirements for the competence of testing and calibration laboratories) certified?
     - ✓ Which sampling and analysis standard should the provider use?
     - ✓ Should the provider be a member of a proficiency scheme (WASP)?

Developping a strategy to improve a site situation

- Creating a strategy to improve a site situation:
  - How to set priority criteria?
    - ✓ Based on static or personal?
    - ✓ Based on number of people in area?
    - ✓ Based on the extent of exceedance of limit (measured – limit)?
    - ✓ How can we use input coming from the medical surveillance programme?
    - ✓ What other information can be used (Cd, CdO visible on the floor)?
    - ✓ Other possible decision factors:
      - Cost
      - General air flow in workshop
      - ...

Setting up an EU OBSERVATORY ON CADMIUM OCCUPATIONAL EXPOSURE

20 mn

Recommendation to the Board

Reminder of purpose of trustee

- Good internal benchmarking tool
  - Win-win seal: If you share your data with the rest of the industry, industry will share its data with you
- Ability for industry to verify that it is making progress
  - One can discuss only what is measurable
  - The rest is essentially BS
- Ability for industry to communicate with authorities
  - See efforts of the Pb industry

Main questions

1. Should the trustee be internal or external to ICdA?
2. Which level of details should be share with trustee (actual measures or only averages by band)
3. Additional data to be shared with trustee
4. Which statistics should the trustee generate for industry?
    1. Baseline
    2. Additional
5. Which analysis/assessment should the trustee generate?

Should the trustee be internal to ICdA or an external contracted party?

- Internal:
  - Good trust
  - lower credibility
  - No out of pocket cost
- External:
  - Theoretical risk of leaks
  - Higher credibility vis-à-vis outside world if properly selected
  - Able to write external opinion (similar to auditors)

Which level of details should be share?

A ----- or ----- B

	Average [Cd-U]	Number of employees
<2µg/g creat	1.3	34
Between 2 and 5 µg/g creat	3.4	12
Between 5 and 10g/g creat	8.2	5
>10µg/g creat	13.0	3
TOTAL		54

Year of Birth	Smoking status	Cd-U (µgCd/g creat)
1976	Y	0.9
1990	N	0.7
1963	N	3.7
1961	Y	3.4
1973	N	0.4
1956	Y	2.8

Which data should be shared with the trustee?

- Sex?
- Smoking status?
- Smoking history?
- Exposed or unfit?
- Should employees be assigned a worksection code?
  - Batteries: CH-emistry, EL-ectrodes, BA-ttery assembly, MA-intenance
- Cd-B?
- Cd-Air?
- Proteine excretion?
- Should employees be assigned a unique identifier (same across the years)?

Which statistics should the trustee generate?

- Baseline analysis - distribution by exposure category:
  - Everyone pooled
  - By sex
  - Unfit removed
- If requested consensus:
  - By industrial sector
    - ✓ Batteries
    - ✓ Metals refining
    - ✓ Chemicals+pigments+recycling
  - Within industrial sectors, by worksection?

Analysis by trustee?

- On comprehensiveness
- On exposure evolution
- On risk trend

Final approval?

- Yes/No?

Discussion Paper

Setting up a data trustee to consolidate occupational Cd exposure information across EU industry

1. Decision of the ICdA General Assembly (October 16th 2008)

"The H&S Ctee shall analyze the pros and cons of setting up a Cd occupational exposure observatory and make a recommendation to the Board"

- What?
  - Analyze the pros/cons and the feasibility of setting up an occupational exposure EU Data Trustee (see lead industry)
  - Data trustee would consolidate data of EU industry relative to exposure levels
- Who?
  - Board sub-committee will work on this and report to Board before end of February 2009 (!) for final decision.
  - Decision during web conference of Board on Feb 19th 2009 to have H&S Ctee present pros and cons and make a recommendation.
- Why?
  - Would be used internally for individual sites to benchmark themselves against industry and possibly externally to communicate to authorities about our commitment to improve our risk situation and results

2. Objectives of such a follow-up

- It is a requirement of the EU (Cd) risk assessment process that where risks are identified, a risk management programme must be developed by the EU,
- It is industry's responsibility to propose the appropriate risk management measures and to communicate on its progress,
- The data can be communicated to EU or national authorities,
- It is interesting for members to compare their own data with data of some categories of industries (batteries production, pigments…),
- A follow-up is interesting only if there is a long-term involvement of the companies (at least 3 years).

3. Pros and Cons

- **Pros:**
  - Good internal benchmarking tool
  - If industry effort is serious: it gives enhanced credibility when communicating with regulatory bodies about or activities
  - Will nicely link with UCL/Phime study on kidney effect threshold and confounding factors

- **Cons:**
  - If we start, we have to continue for some time
    - BUT if H&S improvement is part of doing business, so do we have a choice anyway?
  - It will be expensive
    - BUT we do not know until we have a price quote
  - It could backfire if the results are bad
    - BUT no need to publicly share the results if they are bad,
    - we will anyway be in trouble through other channels if we do notg improve
  - We will create a legal risk by sharing confidential data
    - BUT not if only the right anonymous information is disseminated under appropriate procedures to the right trustee

4. Which data should be collected?

- **Company details and site information:**
  - Company name, plant name, contact details
  - Details on materials: average composition of Cd chemical compounds to which workers are exposed.
  - Number of employees: those under medical surveillance due to cadmium compound exposure
  - Population covered: only employees part of the surveillance programme (cut off criteria may be different from site to site, pls refer to inclusion criteria in ICdA Guidance document).
  - Question: what about temporary workers?
- **Sampling methods and analytical methods:**
  - They have to be listed for each bio-indicator. They are very important for establishing the consistency and homogeneity of the data.
  - Bio-indicators of cadmium exposure (BI)
    - Urinary cadmium [Cd-]U : based on the Cd Risk Assessment, it is the best exposure indicator (24h diuresis or spot sample?)
    - Blood Cadmium [Cd-B] reflects mainly short-term exposure. Is this information useful?
    - Low molecular weight protein excretion (RBP: retinol-binding protein and/or beta2-microglobulin or other excreted protein) are indicators of renal function. Is this information useful?
- **Reporting of bio-indicators data:**
  - Data must be anonymous but can be centralized according to different formats:
    - For each BI, communicate either anonymous individual values (with or without a code number for each employee, see below). Under this method, there is no approximation when calculating mean, median, standard deviation, trends, etc,

    OR
    - For each BI, collect only the mean and the number of samples for each range of BI (for example: 0-1, 1-3, etc…). If the ranges are

narrow and the population big enough, the result is good. Of course, in this case, the different ranges of values have to be the same for all the sites and employee identification is no longer useful.

- **Other data**
  - Sex, age, smoker/former/non-smoker: is this required?
  - Smoking history (in pack years): is this required?
  - In may be that in some countries it is not possible to get this information: is this the case?
  - Workplace category: is this interesting?
  - The categories have to be defined, either for all the companies together, either by group of companies having the same kind of production.
- **Employee identification**
  - It is possible to ask the companies to define a permanent and anonymous code number for each employee: does this bring value?
  - The only interest of this code number is to allow the follow-up of the workers who stay a long time in a company: BUT is this the goal of such a reporting initiative?
- **Periodicity and date of sampling:**
  - The periodicity of BI sampling varies between sites, companies and countries. For cadmium bio-indicators, it could preferable to consolidate the data once a year (for example during Q1 of each year, on the previous year), with two simple and efficient principles:
    - One person, one data point
    - The data reported is the most recent value of the bio-indicator (it means that the "age" of the sampling can be 1 month or up to 20 months…).
- **Presentation of results**
  - Tables and graphs are to be defined. Usually, it is very simple.
  - See Pb industry example

5. Who will centralize and process the data?

- **One person from ICdA:**
  - There could be a confidentiality problem
  - We need to ensure system is not on shoulders of one person but on shoulders of an organization
- **Or a trustee, separate from ICDA**
  - We have already received the OK from Pr Bernard from UCL to do this for us along with an "enhanced comment" of the findings.
  - next step would be to ask for a price quote

6. Discussion of the project and proposal for the ICdA board

- Recommendation: yes/no?
- Inside/outside consolidation?
- Exact data reported?
- Data points reporting or distribution reporting?
- If individual reporting; with individual ID number or numberless?

International Cadmium Association

Recent meeting with SCOEL

Work update
+
ICdA response

Meeting with SCOEL on Feb 24th 2009

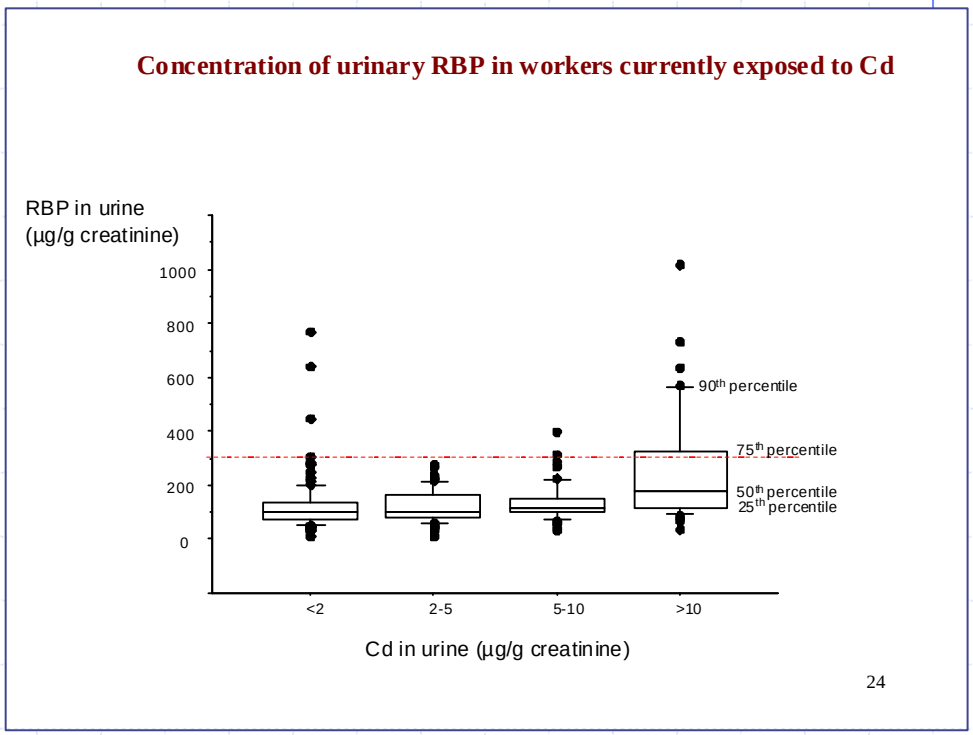
- 72nd SCOEL meeting will be held on March 11th 2009
- SUMDOC (sumlmary document) will be proposed early April
- Main recommandations:
  - Respirable [Cd-Air] = 4 µg/m3
  - [Cd-U] = 2µg Cd/ g Creatinin

What to do about $[Cd\text{-}air]_{resp}$ = 4?

- Analysis:
  - Is this level appropriate to ensure risk control (to ensure Cd-U stays low)?
  - Is it technically reachable?
  - Would transitional arrangements be necessary?
  - Can your « service provider » monitor this?
  - Conclusion: it is essentially a matter of ressource allocation
- Do we have science-based arguments to challenge this proposal?

What to do about [Cd-U] = 2?

- Analysis:
  - Recommandation stricter that SE regulation!
  - Is it reasonable based on science?
  - Dose-effect relationship seems not supportive of such a level!
  - Studies are on going under REACH Cd consortium and will be useful
- Possible consequences:
  - May require that currently exposed employees be removed
  - Are there sufficient fall-back positions for such moves?
  - Money in itself is insufficient to manage this risk



What to do about [Cd-U] = 2?

- What shall we argue:
  - Make case that strict [Cd-U] threshold is weakly supported by most recent occupational data + existing experience-based programmes
  - Introduce Green/Orange/Red zones concept
  - Bring Swedish Arbetmiljöverket on our side
- Practical consequences:
  - Switch H&S Ctee 4 (medical surveillance) and 3 (PPE)
  - Respective dates are 16/06 and 15/09 in Brussels
  - Invite Arbetmiljöverket specialist for SE law presentation in 3rd H&S Ctee meeting
  - Invite plant medical doctors to attend presentation
  - Report to SCOEL