4th Health & Safety Committee

Brussels

October 13th, 2009

International Cadmium Association

1.Introduction

9h30:9h45

International Cadmium Association

Attendance list

Companies	Names
BOLIDEN	ENGLYST Vagn
FLORIDIENNE	KOLACINSKI Benoît
“ “	SMITS Laurent
GAZ	KELLEY Barry
HOPPEKE	HENKE Dieter
JAMES&BROWN	DEAN Chris
“ “	WINBOW Howard
NYRSTAR	AVERLAND Nathalie
“ “	DE GROOF Mark
NYRSTAR BUDEL	JONGEN Richard
“ “	SCHUURMANS Erik
ROCKWOOD	BOOTH Mark

Apologies received from	
ACCUREC	WEYHE Reiner

Companies	Names
PORTOVESME	ZUCCA Aldo
“ “	SALIS Stefano
SAFT	de METZ Patrick
“ “	BOBROVSKA Anna
“ “	De FOURNOUX Benoît
“ “ “	KREHER Jean-Philippe
“ “	SÖDER Tommy
SNAM	NOTTEZ Eric
XSTRATA	RODERMUND Rolf
ICdA	CANOO Christian
IZA	VAN ASSCHE Franck
Consultant	GOMEZ Mario

Welcome…

Provisional agenda

Themes	Minutes	Schedule
1. Introduction 1. Attendance list 2. Agenda	15	9h30 - 9h45
2. Approval of the minutes of the 3rd H&S committee (June 16th, 2009)	5	9h45 - 9h50
3. Objectives of the meeting: the place of individual and collective hygiene procedures in the ICdA guidance document *(Patrick de Metz)*	30	9h50 -10h20
4. Analysis of individual & collective hygiene procedures questionnaire responses *(Mario Gomez)*	30+30	10h20 -11h20
5. Coffee break	15	11h20 - 11h35
6. Some key points and discussion about individual & collective hygiene procedures *(Patrick de Metz)*	40+30	11h35 - 12h45

Provisional agenda

Themes	Minutes	Schedule
LUNCH		12h45-14h00
7. **Restitution of OCdBIO (Occupational Cadmium Bio Indicators Observations) 2008 Data** *(Professor Bernard)*	60+15	14h00 -15h15
8. **SCOEL provisional recommendations regarding OEL and BLV. SUMDOC (Summary Documentation) and industry response strategy** *(Patrick de Metz)*	40+15	15h15 - 16h10
9. **Setting of 5th H&S committee and long term planning** 1. Proposed date February 2nd, 2010 2. Theme: Medical surveillance program. Implementation details, procedures, solutions. 3. Long term planning	10	16h10 -16h20
10. **Any other business**	10	16h20 - 16h30

2. Approval of the minutes of the 3rd H&S committee (June 16th, 2009)

9h45:9h50

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3. Objectives of the meeting: the place of individual and collective hygiene procedures in the ICdA guidance document *(Patrick de Metz)*

9h50:10h20

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3-Objectives of Meeting and structure of the ICdA Guidance Document Octobre 2009[1].ppt

4. Analysis of "individual and collective hygiene procedures" responses

Mario Gomez
ICdA H&S Consultant

October 13th, 2009

10h20:11h:20

The purpose of this discovery questionnaire is to get an overview of the procedures and practices regarding “individual and collective hygiene procedures” , and if possible to identify best practices and to set new benchmarks.

0. The questionnaire

F:\Questionnaire hygiene procedures_Cd ICdA 16_09_2009.doc

00. Questionnaire responses

Company	Number of sites answering
Nyrstar	**2**
Boliden	**1**
Xstrata Zinc	**1**
Saft	**4**
Hoppecke	**1**
Gaz	**1**
Floridienne	**1**
Snam	**1**
Portovesme	**1**
Accurec	**–**
James&Brown	**1**
Rockwood Pigments	**1**

The following analyze is based on the 15 answers
The results are given in percentage of plants (not considering headcounts)

1. Equipment and cleaning of work places

1.1 Work places

frequency of the cleaning of work places

the cleaning is done : **once a shift 47%**

once a day 40%

for remaining 13% there is no fixed frequency but various answers “as requested”, “when necessary”,…

who does the cleaning?

93 % the operator is in charge of the cleaning, 20% with assistance of specialized teams

equipment for cleaning

87% vacuum cleaners are available

checklists

13% the cleaning is controlled with a checklist

1. Equipment and cleaning of work places

1.2 Traffic and storage areas

frequency of the cleaning of traffic and storage areas

the cleaning is done : **once a day 53%**
once a week 20%
for remaining 27% there is no fixed frequency but various answers "not relevant", "as requested", "once a week",…

method of cleaning

only 71% dry sweeping is forbidden

79% traffic and storage areas are cleaned with a wet road sweeper

1. Equipment and cleaning of work places

1.3 Upper parts, building structures, horizontal surfaces

periodical cleaning of upper parts

67% the cleaning of upper parts is periodically done

frequency

when relevant the frequency is :

once a year 80%

for others “1 to 2 time per year”
and “during preventive maintenance”

method

90% vacuum cleaners are used, and
additional **90%** wet cleaning

1. Equipment and cleaning of work places

1.4 Dust collectors

periodical cleaning of upper parts

73% the emptying of (main) dust collectors is periodically done

frequency

when relevant the frequency is :

once a year 45%

for others “twice a year”, “as required” , “when full”,

“depending on losses of pressure”

2. General hygiene rules

2.1 Smoking

rule for smoking

27% smoking is forbidden on the site

Smoking policy when permitted on the site:

hand's washing

100% when authorized there is an obligation to wash one's hands

clothes changing

7% (one case) only in civilian clothes

2. General hygiene rules

2.2 Meals

places to take meals

93% meals are limited to designated areas and undergoing a special procedure

hand's washing

93% hand washing is mandatory

clothes changing

60% partial cloth change is required
13% total cloth change
13% no cloth policy (to be confirmed)
7% air shower and total cloth change (1 case)

2. General hygiene rules

2.3 Beverages

prevention measures: where, when, type of container, free or against payment…
67% prevention measures are existing

Some precised “only fountain water or in canteen”, “no glass no can”, “only bottles”

2.4 showers

shower policy
80% taking a shower is mandatory
7% depending on the working area
13% no obligation

how many really take a shower?
The fulfillment of shower obligations is estimated:
for 5 sites from **98% to 100%**
1 site 90%, 1 site 80% , 1 site 75 %
6 sites have not specified

2. General hygiene rules

2.5 Work clothes

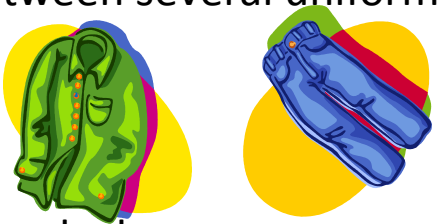
frequency of the changing

Work clothes are changed: **daily 53%,** twice a week 20%
thrice a week 7%, for others “when necessary”

Choice and type of uniform

41% people have the possibility to choose between several uniforms

The standard is 22% one piece uniform
78% two pieces uniform



No particular answer regarding women, for most sites no women work in exposed areas

Internal cleaning or sub-contracted?

93% cloth cleaning is sub-contracted

87% the sub-contractor is informed about Cd related risks and obligations
13% rest (2 sites) indicated **this will be a point of attention**

2. General hygiene rules

2.6 Personal Protective Equipment PPE

protective equipments

all employees entering shop-floor are equipped :

100% safety shoes
100% work gloves
93% safety glasses
87% disposable gloves are available

fulfillment of 8hr TWA OEL

80% it may be achieved by wearing a mask during the 8hr shift

respiratory protection

80% wear ventilated helmets and/or P3 rubber masks
64 % use P3 paper masks in addition to ventilated helmets and/or P3 rubber masks
7% (1 site) uses P2 rubber-P2 paper and P3 paper
7% (1 site) uses P2 paper, 7% (1 site) uses P3 paper
nb: total is higher than 100%, there are multiple answers

2. General hygiene rules

2.6 Personal Protective Equipment PPE

mandatory wearing

80% is related to Cd-air exposure at the work place
13% (1 site) during maintenance operations, 7% (1 site) not specified

storage of masks

53% when not used masks are properly stored or secured in a plastic bag

fit tests

67% fit tests are accomplished on the wearing of masks

changing and cleaning of masks

masks are changed: **daily 67%,** weekly 20%, for others "when required" and "after use"
cleaning is done **92% by hand,** 8% in a washer
20% use a special cleaning liquid

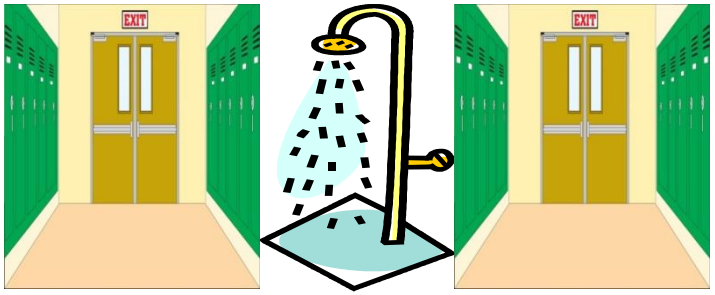
73% rules regarding wearing of PPE apply to all employees, including visitors, entering exposed areas

3.Design of locker, shower and snack rooms

Locker and shower rooms

73% locker and shower rooms are separated in dirty and clean areas

60% the shower room is located so that employees have to go through the shower room



Snack rooms

67% there are special procedures for snack rooms (specified in some cases : hand washing, partial cloth change, …)

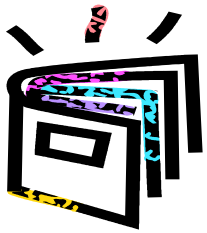
4. Training and audits

New employees

100% new recruited employees are individually trained on personal hygiene and behavior

73% they receive a booklet containing general hygiene and safety rules

47% "quiet gesture" is teached



Additional trainings

27% yearly additional training, in other case "every 2 years", "when required", "when moving of work place", "on demand"…

Checks and audits

93% wearing of PPE is periodically check, 43% documented

Check and audits are performed:

60% The Doctor

47% The Health and Safety Manager

53% The Supervisors

nb: total is higher than 100%, there are multiple answers

Some thoughts…

My purpose is not to give a global mark, like after an audit with a xx% of completion but to give you a feed-back based on my experience on lead … there is a lot of similarities with cadmium in the techniques (dust collectors, filters) protective equipments (gloves, respirators), procedures (separation of lockers in dirty and clean areas, obligation to shower), medical surveillance,…

All the main factors are generally properly taken into consideration

-procedures
-organization and equipments
-PPE
-training and audits

There is a good balance between **technique** and **behavior**

one example: available PPE — fit test

Some thoughts…

There is a high level of completion and confidence in hand's washing and showering policies : 98 to 100% people effectively taking a shower is impressive !

is the effectiveness of hand's washing and showering controlled, and how? *In lead business we used spray-tests to display residual lead , on hands but also on masks*

The right equipments and methods have to be used

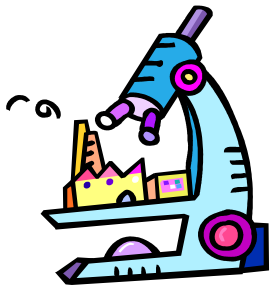
Is it possible to improve the design of locker and shower rooms?

Some thoughts…

There is a huge diversity of masks (ventilated helmets, rubber or paper masks, P2 or P3)
But the efficiency depends highly on the following items:

-is the mask properly worn?
-is the mask properly stored when not used?
-has the mask been properly washed?

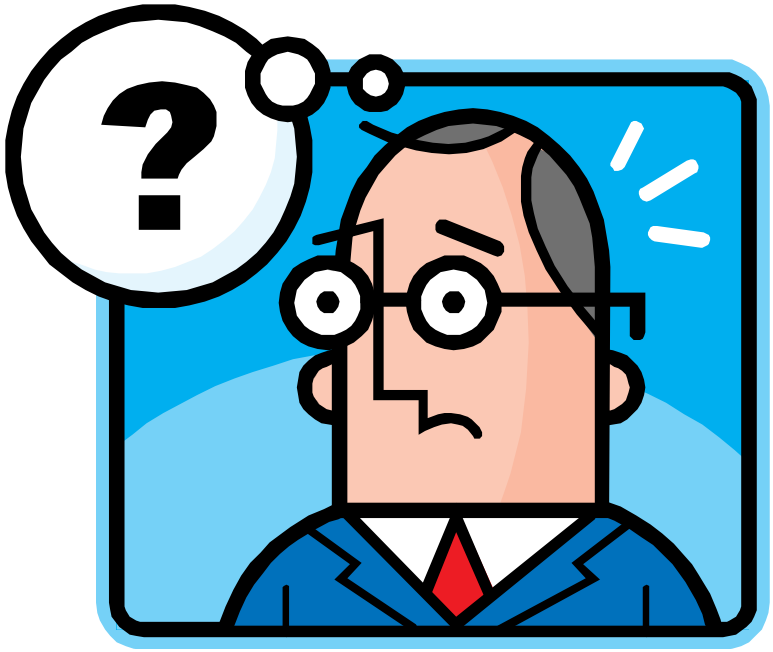
Checks and audits: health and safety is not only of the responsibility of the Doctor and the H&S Manager, is it possible to involve more the Supervisors?



smoking
eating or drinking in inadequate conditions
inadequate hand's washing or showering

are important risk factors

And we all have to deal with the key factor, which is ***the behavior…***



Any question ?

Thank you for your attention….

5. Coffee break

11h20:11h35

6. Some key points and discussion about individual & collective hygiene procedures *(Patrick de Metz)*

11h35:12h45

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6-Main Cleanliness and Hygiene Points v2.ppt

Lunch

12h45:14h00

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7. Restitution of OCdBIO (Occupational Cadmium Bio Indicators Observations) 2008 Data *(Professor Bernard)*

14h00:15h15

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4th H&S Committee Brussels October 13th, 2009

ICdA Bernard octobre 2009.ppt

8. SCOEL provisional recommendations regarding OEL and BLV. SUMDOC (Summary Documentation) and industry response strategy

(Patrick de Metz)

15h15:16h10

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9. Setting of 5th H&S Committee and long term planning

16h10:16h20

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1. Proposed date February 2nd, 2010

2. Theme:

- Medical surveillance program
- Implementation details, procedures, solutions.

3. Long term planning

10. Any other business

16h20:16h30

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Objectives of the fourth ICdA H&S Ctee meeting

- -

CLEANLINESS AND HYGIENE

- -

The primary tools of risk management

Patrick de Metz

Objective of the ICdA H&S Committee

- Disseminate the ICdA Guidance document to ICdA member companies and their key personnel
- Dissemination programme is expected to be approx. 10 sessions long. Each session focusing on specific sections of the Guidance:
  - Session 1: H&S Ctee set up, organization and planning
  - Session 2: air quality measurement
  - Session 3: medical surveillance programme - principles
  - **TODAY**: Session 4: individual and collective hygiene procedures
- Contents:
  - Share on the « WHY » and « WHAT » of each section
  - Exchange on current practice
  - Identify and share best practice

Structure of the ICdA Guidance Document

- Chapter ONE gives an overview of cadmium effects to human health in an occupational setting and summarizes the existing knowledge (2005) about thresholds

- Chapter TWO contains four sections which deal with the setting up of a « comprehensive health protection and monitoring programme »:
  - Ensuring plant cleanliness (air, **workplace and equipment**)
  - Proper personal protection equipment
  - **Ensuring the proper personal and group hygiene habits/procedures are in place**
  - Ensuring that a proper medical supervision programme is in place to detect any possible deviation

Topics of today's meeting

- **PLANT CLEANLINESS AND HYGIENE PROCEDURES**
  - Primary tools for risk management
- The Medical Surveillance Programme
  - Is only a safety net in case some elements in cleanliness and/or hygiene procedures fail!

Reminder: role of a medical surveillance programme

- A component of the « comprehensive health protection and monitoring programme »
- Normally unnecessary!
- Because in a « perfect world » risk is managed through:
  - Plant, equipment designed to minimize releases (see 2nd H&S meeting on [Cd-Air])
  - Individual and group hygiene procedures, including training… (see this meeting)
- If these components work, medical surveillance programme should be superfluous!
- But since systems (sometimes) fail, and Cd is a cumulative toxic substance:
  - We need to monitor health
  - We need to monitor accumulation
- The medical surveillance programme **is not** a system designed to rotate workers once they have reached « level high » and replace them with fresh (such as in the nuclear industry)!

Points covered during today's meeting

- **>1. Discovery questionnaire**: Review existing state of play regarding:
  - Cleaning of workplace and equipment procedures
  - General Hygiene rules
  - Design of lockers, showers and snack rooms
  - Training and audits

- **>2. Discussion** on selected topics
  - Scores are good, but not **surprisingly not excellent: s**everal topics with ~70% « compliance » rate!
  - Will be discussed today

International Cadmium Association

Health & Safety Committee

"INDIVIDUAL AND COLLECTIVE HYGIENE PROCEDURES" **– October 2009**

PLEASE DO NOT INCLUDE ANY COMMERCIALLY-SENSITIVE INFORMATION IN YOUR REPLY!

No individual files will be shared between members. The questionnaire was designed so that no confidential information is asked

Company & plant details

Company: _____ Plant name and city: _____ Country: _____

Main activity: Primary Metals☐ Chemicals☐ Batteries☐ Pigments☐ Recycling☐ Other (please specify)_____

Contact person for this questionnaire: _____ Telephone: _____ Fax: _____ E-mail: _____

1.Equipment and cleaning of work places

1.1. Cleaning of work places:

1.1.1. What is the frequency of the cleaning of work places?
Once a day☐ Once per shift☐ Others☐ describe_____…

1.1.2 Is the cleaning of the work place done by:
☐ The operator
☐ A specialized team

1.1.3 Are vacuum cleaners available at work places? Yes☐ No☐

1.1.4 Is the cleaning of work places controlled with a checklist? Yes☐ No☐

1.2. Cleaning of traffic and storage areas:

1.2.1. What is the frequency of the cleaning of soils?
Once a day☐ Once per shift☐ Others☐ describe_____…

1.2.2. Is dry sweeping forbidden, on shop-floor? Yes☐ No☐

1.2.3 Are traffic and storage areas cleaned with a wet road sweeper? Yes☐ No☐

1.3. Cleaning of upper parts, i.e. building structures, dust collectors, horizontal surfaces where dust may deposit:

1.3.1. Is the cleaning of upper parts periodically done? Yes ☐ No☐

1.3.2. What is the frequency of the cleaning of upper parts?
Once a year☐ Others☐ describe_____…

1.3.3 Which method is used to clean upper parts?
With vacuum cleaners☐ Wet cleaning☐ Others☐ describe _____…

1.4. Emptying of the dust collectors:

1.4.1. Is the emptying of the horizontal sections of the dust collectors periodically done? Yes ☐ No☐

1.4.2. What is the frequency of this operation?
Once a year☐ Others☐ describe_____…

2.General hygiene rules

2.1. Smoking

2.1.1. Is smoking forbidden on the site? Yes☐ No☐

2.1.2 If smoking is allowed, is it limited to restricted areas:
After obligation of washing one's hands? Yes☐ No☐
Only in civilian clothes? Yes☐ No☐

2.2. Meals

2.2.1. Are meals limited to designated areas only?
Yes☐ No☐ Others☐ describe_____…

2.2.2. Are workers required to undergo a special procedure before taking meals? Yes☐ No☐

2.2.3 In case of positive answer, which one?
Air shower☐ Partial clothes change☐ Total clothes change☐ Hand washing☐
Others☐ describe_____…

2.3. Beverages

2.3.1. Are there any prevention measures (where, when, what type of container or drinking fountain, free or against payment,…) on the drinking of water? *This is not an alcoholic policy related question*
Yes☐ No☐ describe_____…

2.4. Showers

2.4.1. All workers have to take a shower at the end of the shift? Yes☐ No☐

2.4.2. How is this policy enforced? describe_____…

2.4.3 If required, what percentage of workers do you estimate actually take this shower? ☐%

2.5. Work clothes:

2.5.1. What is the frequency of changing work clothes?
Daily☐ Weekly☐ Others☐ describe _____…

2.5.2. Have the workers the possibility to choose between several uniforms? Yes☐ No☐

2.5.3. In case of negative answer what is the standard
☐ one piece uniform
☐ two pieces (trousers and jacket) uniform

Please return by email before September 25th to gomez.mario@orange.fr.

2.5.4 Do women have more choice? describe_____…
2.5.5 Where is the cleaning of work clothes done?
☐ Internally
☐ Externally sub-contracted
2.5.6. If cleaning is sub-contracted, is the sub-contractor informed about risks (health, environment) and obligations (packaging of work clothes, medical survey,...) related to Cd? Yes☐ No☐ describe_____…

2.6 Personal Protective Equipment PPE:
2.6.1. All employees entering shop-floor have to be equipped with safety shoes? Yes☐ No☐
2.6.2. All employees entering shop-floor have to be equipped with safety glasses? Yes☐ No
2.6.3. Disposable gloves have to be worn by all people in exposed areas? Yes☐ No☐
2.6.4. Additional gloves have to be used by workers for safety reasons? Yes☐ No☐
2.6.5. The fulfillment of 8hr TWA OEL
☐ May be achieved by wearing a mask during the 8h shift
☐ Must be achieved by the air quality level in the workshops, the wearing of masks being limited to special situations like breakdowns, maintenance or cleaning operations
2.6.6. What kind of respiratory protection is available?
☐ Ventilated helmets
☐ P3 rubber masks
☐ P3 paper masks
☐ P2 paper masks
2.6.7. Is the mandatory wearing of respirator mask or helmet related to:
☐ Cd-air exposure at the work place Others☐ describe _____…
2.6.8. When not used is it required that masks and helmets are properly stored or secured in a plastic bag Yes☐ No☐
2.6.9. Are fit tests accomplished on the wearing of masks? Yes☐ No☐
2.6.10. Are the rubber masks changed and cleaned daily? Yes☐ No☐
2.6.11. What is the frequency of changing and cleaning of masks and ventilated helmets?
Daily☐ Weekly☐ Others☐ describe _____…
2.6.12. Which method of cleaning is used for masks and helmets?
☐ By hand
☐ In a washer
2.6.13. Is a special cleaning liquid used? Yes☐ No☐ Please specify____
2.6.14. Do the rules regarding wearing of PPE apply to all employees, including visitors, entering exposed areas?
Yes☐ No☐ Comments? ____

3.Design of locker, shower and snack rooms

3.1. Locker and shower rooms:
3.1.1. Are the locker and shower rooms separated in dirty and clean areas? Yes☐ No☐
3.1.2. Is the shower room located between these areas, so that employees have to go through the shower room? Yes☐ No☐

3.2. Snack rooms:
3.2.1. Do you have a special layout, procedures for snack rooms? Yes☐ No☐ describe _____…

4.Training and audits

4.1. New recruited employees
4.1.1. Are the new recruited employees individually trained on personal hygiene and behavior? Yes☐ No☐
4.1.2. Do new recruited employees receive a booklet containing general hygiene and safety rules? Yes☐ No☐
4.1.3 Is the "quiet gesture" teached (no throwing, no shaking, no rough handling,…)? Yes☐ No☐

4.2. What is the frequency of additional training? Yearly☐ Others☐ describe _____…

4.3. Are all the trainings documented? Yes☐ No☐

4.4 Wearing of personal protective equipment
4.4.1. Is the wearing of PPE periodically checked? Yes☐ No☐
4.4.2. Is this audit documented? Yes☐ No☐

4.5. Are personal hygiene checks or audits performed by:
☐ The Doctor
☐ The Health and Safety Manager
☐ The Supervisors

Provide an estimation of how many people are concerned by the rules described in the questionnaire ____

Please return by email before September 25th to gomez.mario@orange.fr.

ICdA Guidance Document
-
Plant cleanliness and Individual/collective hygiene procedures
-
Best practice

Patrick de Metz

First conclusions about discovery questionnaire

- Generally procedures are well implemented amongst the different sites
- But for a sub-set of important elements; awareness levels are only at or around 70%, strong but not excellent!
- Cleanliness:
  - 87% have vacuum cleaners available
  - 13% check list available
  - 71% forbid sweeping
  - 65% clean upper parts of building stuctures
  - 73% empty horizontal sections of dust collectors
- Hygiene:
  - 29% prohibit smoking on site
  - 60% partial clothe change before meals
  - 67% impose prevention measures for beverages
  - 80% require shower at end of shift
  - 86% accept masks in order to meet 8hr TWA OEL
  - 71% have clean/dirty sections in locker rooms
  - 71% impose special procedures for access to snack rooms

Topics discussed

- Cleanliness
  - Equipment
  - Upper sections
- Hygiene
  - Smoking
  - Drinking
  - Shower
  - Masks
- Plant design
  - Locker rooms
  - Snack rooms

Cleanliness/equipment

- 87% have vacuum cleaners available at work place
- 71% forbid sweeping
- 13% have a check list

- Direct risk from sweeping:
  - Remobilization
  - Remember kinetics of 1 to 100µg particules
  - 1: stay days in the air before landing
  - 100: stay seconds in the air before landing

- Alternative solutions:
  - Water based washing techniques:
  - Suction based techniques:

Cleanliness/upper sections

- 65% clean upper parts of structures
  - -> 35% never clean them
- 73% empty horizontal sections of dust collectors ducts (once a y or more)
  - -> 27% never do
- Direct risk:

Hygiene/smoking

- 27% prohibit smoking
- Questionnaire does not allow to see level of restriction on 73% remaining.
- But 100% require hand washing (prior of after?) smoking.

Hygiene/drinking

- 67% impose prevention measures for beverages
  - -> 33% do not impose anything!
- Direct risks from uncontrolled (water) drinking:
  - Contamination of bottle
  - Ingestion
- Possible solutions:
  - Screw-on top bottles, no nipple-type outlet
  - Mandatory throw away of bottles
  - Free by employer
  - Alternative: drinking fountains
  - Located in protected areas

Hygiene/shower

- 80% require shower at end of shift
  - -> 20% do not
- Direct risk from not showering:
  - Accumulation of particules in hair
  - Transportation of particules to private homes
  - Possible secondary contamination
- Possible solutions:
  - Clean and well structured locker-rooms
- Pay status of change time:
  - Paid or unpaid
  - Connection with time recording badges

Hygiene/masks

- 80% accept masks to meet 8hr TWA OEL
- Need for clarification

Plant design/locker rooms

- 73% have clean/dirty sections in locker rooms
- 60% have shower room in a middle section

- Direct risk from not segregating:
  - Similar to situation of no shower
  - Transfer of contaminants from dirty to clean wear
  - Transportation of particules to private homes
  - Secondary contamination

- Possible solutions:

Plant design/snack rooms

- 67% impose procedures for access to snack (lunch) rooms
  - -> 33% do not!
- Direct risk:
  - Contamination of food
  - Ingestion
- Possible solutions:
  - Take off jacket/top shirt AND wash hands
  - Go through locker room, shower and take new work clothe before main meal
  - Other?

Training

- Excellent on initial training: 100%
- Weaker in additional traning: 27%
- Good checking by Dr, H&S Mgr, Supervisors

THANK YOU

Biomonitoring of occupational exposure to cadmium: survey of current exposure levels

Alfred BERNARD

Unit of Toxicology and Applied Pharmacology
Catholic University of Louvain

Brussels, October 13, 2009

Cadmium: the basis for biomonitoring

Cadmium (Cd) is cumulative poison, which can affect several organs after prolonged exposure in the industry or the environment. Prevention of chronic Cd poisoning currently relies on three basic considerations:

. The kidney is the critical organ i.e. the first organ to be damaged following chronic exposure.

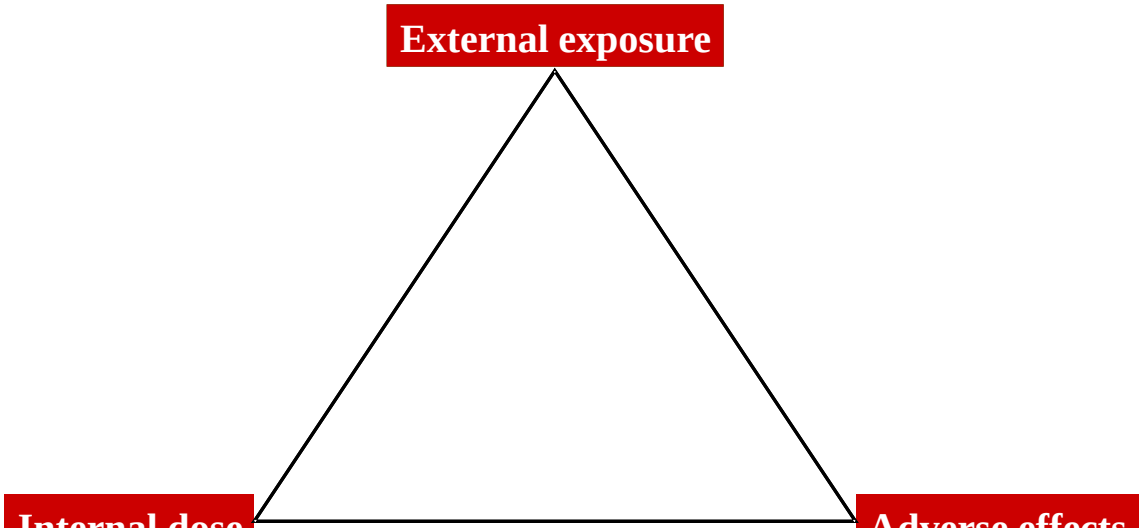
. The critical renal effect is an increased urinary excretion of low-molecular weight proteins (β_2-m, RBP or protein HC)

. The Cd body burden can be reliably estimated on the basis of urinary Cd, the concentration of Cd in blood being a reflection of recent exposure or cumulative exposure depending on the situations.

Tools for BM of exposure and early effects

Primary prevention = Cd-air

ENVIRONMENTAL MONITORING



Biomarkers of exposure

Biomarkers of effects/disease

Secondary prevention = Cd-B/Cd-U

BIOMONITORING

Tertiary prevention = RBP/β_2-m/Protein HC-U

Prevention of the risks of Cd in industrial workers: obtectives in the current practice

For long, the objective was to prevent early renal effects (in particular the tubular dysfunction as evidenced by urinary RBP or β_2-m >300 µg/g cr

→ Method: maintain Cd-U (estimator of the body burden) below a critical level (5 µg/g creatinine)

Now, the objective is to prevent the accumulation of Cd itself and thus avoid that Cd-U attains a certain level (5 µg/g and perhaps less in the future)

→ Method: maintain Cd-B below a certain level (5 µg/l)

Risks of Cd-induced renal dysfunction according to urinary Cd in occupationally exposed subjects

Cd-U (µg/g cr)	Risk of Cd-induced renal dysfunction (urinary RBP/ β_2-m >300 µg/g cr)
< 2	none
2-5	unlikely
5-10	only in highly sensitive subjects
>10	increases linearly with Cd-U

Bernard A, 1996

Distribution of urinary cadmium values in workers stratified according to risk of developing renal dysfunction (data from 18 EU sites)

Results were shown and discussed during the meeting

Current Action Levels for Managing Risks of Occupational Exposure to cadmium and its compounds

Table 1

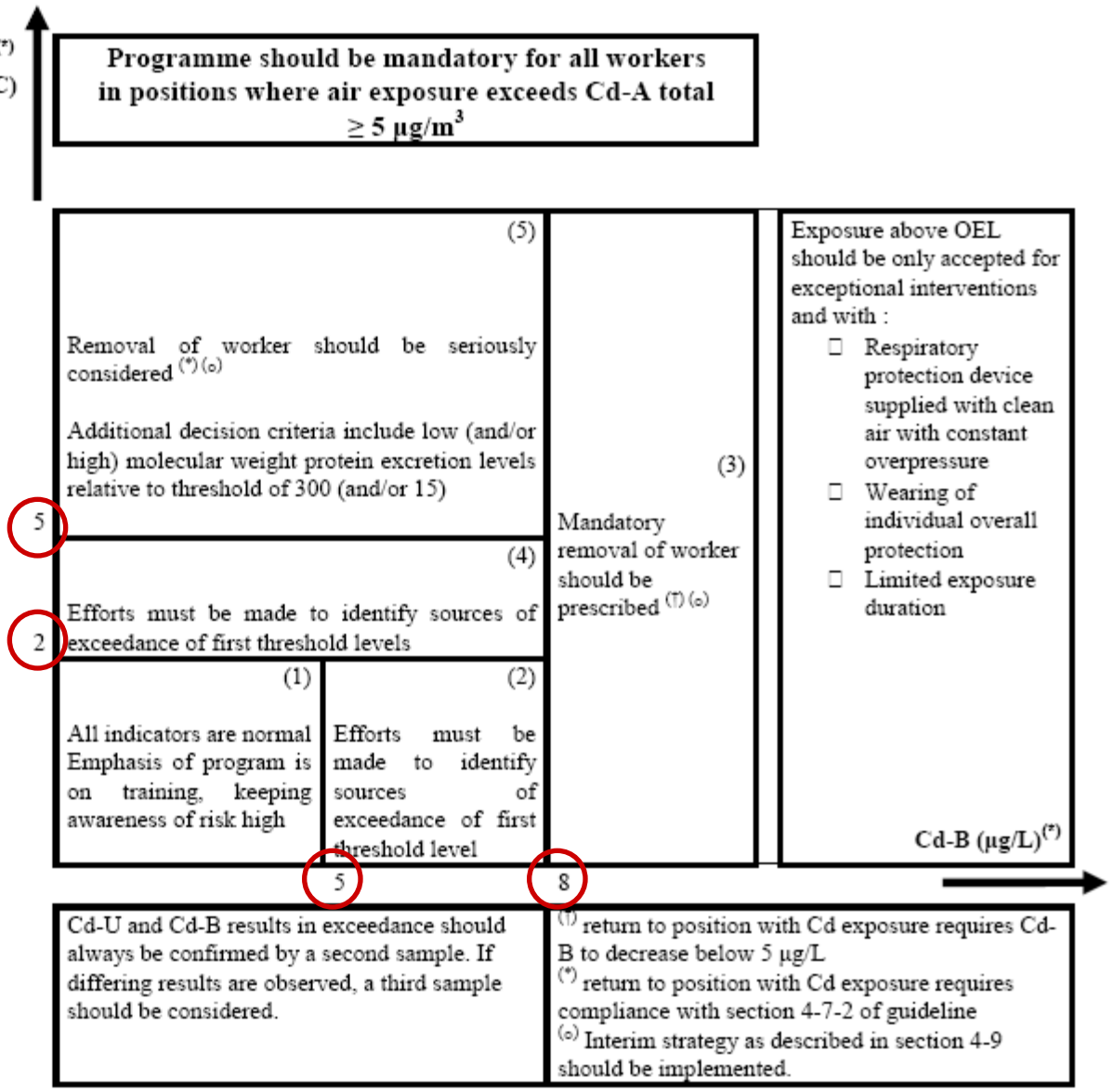
Indicative diagram of CADMIUM risk management in chronic moderate occupational exposure

Cd-U : must be done at least every 24 months, during the overall periodic medical review.

Cd-B : must be done at least every 12 months, during the Cd biological exposure control visit. Doctor may require higher frequency if Cd-A of worker is well above 5 (but below legal OEL).

Low and/or high molecular weight protein excretion : must be part of the annual biological exposure control visit.

Cd-A : (8hr TWA). Must be measured every year as part of overall plant compliance programme. Should be spot checked if worker moves from area (1) to (2) or above.



Distribution of urinary cadmium values in workers stratified according to current action levels (data from 18 EU sites)

Results were shown and discussed during the meeting

Distribution of blood cadmium values in workers stratified according to risk of developing renal dysfunction (data from 14 EU sites)

Results were shown and discussed during the meeting

Distribution of blood cadmium values in workers stratified according to the current action levels (data from 14 EU sites)

Results were shown and discussed during the meeting

Comparison of the distributions of Cd in urine and blood

Results were shown and discussed during the meeting

Suggestions

. To present the data separately for workers who are still exposed to Cd. In practice, the database might provide for each exposure category the number of workers who have been removed from Cd exposure (I guess a majority of those with CdU >5 µg/g creatinine)

. For workers removed from exposure, one might also consider the possibility to indicate the number of subjects with renal dysfunction (urinary RBP/ β_2-m >300 µg/g cr)

References

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SCOEL SUMDOC Proposals
-
ICdA proposed response

Patrick de Metz

SCOEL/SUM/136
(February 2009 – For public consultation)

- Main contents:
- Proposed BLV
  - To protect against cumulative systemic toxicity
  - Mainly kidney and bone effect
  - 2µg/gC
- Proposed OEL
  - To protect workers agaiants long term local effects
  - Respiratory, including lung cancer
  - 4µg/m3 respirable

Chronic Effect KIDNEY– OE Summary

- The Occupational Exposure Summary:

occupational exposure to Cd (Mueller *et al.*, 1989; Bernard *et al.*, 1995). A Cd body burden corresponding to a urinary excretion (Cd-U) of **5-10 µg Cd/g creatinine** constitutes a threshold at or above which these tubular effects have been observed (LOEL). The most recent and relevant studies having examined the dose-response relationship between Cd-U and renal effects in workers are summarised in Table 1.

Chronic Effects KIDNEY – OE Studies

Table 1. : Thresholds for renal effects in recent studies in occupational settings.

	type of industry	n	glomerular effect	tubular effect	threshold
Lauwerys et al. 1979	Electronic workshop Ni-Cd storage battery factory Cd-producing plants	-	HMW proteins ß2M-S creatinine-S	ß2M-U	**Cd-U : 10 µg/g creatinine** (G and T)
Jakubowski et al 1987	alkaline battery factory	102		ß2M, RBP	**Cd-U : 10-15 µg/g creat**
Shaikh et al. 1987	Cd smelter	53		ß2M	**Cd-U : 13.3 µg/g creat**
Verschoor et al. 1987	secondary Cd users	26		ß2M, RBP, NAG	**Cd-U : 5.6 µg/L**
Kawada et al. 1989	Cd pigment factory	29		ß2M, NAG	**Cd-U : < 10 µg/g creat**
					(NAG)
Bernard et al. 1990	non-ferrous smelter	58	albumin, transferrin, serum ß2M	ß2M, RBP, protein-1, NAG	**Cd-U : 10 µg/g creat**
Roels et al. 1991	Zn-Cd smelter	108	GFR decline		**Cd-U : 10 µg/g creat**
Toffoletto et al, 1992	Cd alloy factory	105		ß2M	**Cd-U : 10 µg/g creat**
Roels et al. 1993	Zn-Cd smelter	37	albumin, transferrin	ß2M, RBP and other markers	**Cd-U : 4 µg/g creat (G)** **Cd-U : 10 µg/g creat (T)**
van Sittert et al. 1993	Zn-Cd refinery	14		ß2M	**Cd-U : 7 µg/g creat**
Järup and Elinder 1994	battery factory	561		ß2M	**Cd-U : 1.5 µg/g creat (>60 y)** **Cd-U : 5 µg/g creat (<60 y)**

G :glomerular effects, T : tubular effects

Chronic Effects KIDNEY – GP studies

- The General Population Studies:

On the basis of the most recent studies conducted in Europe (Buchet *et al.*, 1990; Hotz *et al.*, 1999; Järup *et al.*, 2000), United States (Noonan *et al.*, 2002) and Asia (Jin *et al.*, 2002), it appears that renal effects can be detected in the general population for Cd-U below 5 µg Cd/g creatinine and even from **2 µg Cd/g creatinine or below**. These studies detected associations

to the left. In the Cadmibel study, it was found that, after adjustment for age, gender, smoking, use of medications and urinary tract disease, tubular effects (mainly increased urinary calcium excretion) occurred in the general population at Cd-U levels ≥ 2 µg/24 h (roughly equivalent to 2 µg/g creatinine). The association between renal parameters and Cd

Cadmibel study (Pheecad study) (Hotz *et al.*, 1999). In the OSCAR study, excretion of protein HC was found associated with Cd-U (0.18-1.8 µg/g creatinine) and the prevalence of elevated values (>95th percentile in a Swedish reference population) increased with Cd-U. The exact health significance of tubular changes observed at Cd-U levels < 5µg/ g creatinine is, however, uncertain and subject to contrasting scientific opinions. Some authors believe that

Chronic effects KIDNEY - Background

- The Background:
  - Dose/response is well documented in occupational settings
  - Kidney is target organ

Cd being a cumulative toxicant, the systemic manifestations associated with chronic exposure are related with the body burden of the element (liver and kidney content). Biological markers such as Cd-U allow to assess this body burden, and to integrate all sources of Cd exposure, including contaminated food and smoking. The use of such biomarkers of exposure in most epidemiological studies conducted in occupational settings has allowed to document dose-effect/response relationhips quite reliably. The kidneys (and possibly bone) represent the most sensitive targets of Cd toxicity upon occupational exposure (critical target organs).

Chronic Effects KIDNEY - Background

Dose-effect relationships between cadmium exposure and effects on kidneys.

Dose measure Cd-U (µg/g creat)	Dose measure Cd-B (µg/l)	Exposure	Effect	Reference
≤1		E	increased urinary N-acetylglucosaminidase and alanine aminopeptidase activity	Noonan et al. 2002
1 – 3		E	renal tubular effects (microproteinuria)	Buchet et al. 1990, Hotz et al. 1998, Jarup et al. 2000
	5.6 – 8.4	O	glomerular damage (reduced GFR)	Roels et al. 1989, Roels et al. 1991, Jarup et al. 1995
> 4	> 6.7	O	kidney stones	Jarup et al. 1993a

E : environmental; O : occupational exposure

In workers exposed to cadmium, a Cd body burden corresponding to a Cd-U of 5 µg/g creatinine is a LOAEL based on the occurrence of LMW proteinuria. There is consensus on the health significance of this threshold because of the frequent observation of irreversible tubular changes above this value and in view of its association with further renal alteration. The possible links between kidney and bone effects induced by Cd strengthen the health significance of these effects.

Chronic Effect KIDNEY - Reasonning

- Reasonning
  - Back to General Population; exact significance is questionnable
  - Workers must be sufficiently protected

Based on the most recent studies, it seems that renal effects can be detected in the general European population (mainly exposed by the oral route) for Cd body burdens at or even below 2 µg Cd/g creatinine (LOAEL). There is, however, a lingering scientific debate about the health significance of these early changes. This lower LOAEL in the general population compared to that identified in workers is thought to reflect, among other parameters, an interaction of Cd exposure with pre-existing, concurrent or subsequent renal diseases (mainly renal complications of diabetes) that are less prevalent in healthy young individuals in occupational settings. As workers exposed to Cd may, however, suffer from such diseases during or most often after their occupational career, and considering the long half-life of Cd in humans and its accumulation with age, it may be prudent to recommend a BLV that would provide a sufficient degree of protection in this respect.

Chrionic Effect KIDNEY - Conclusion

Biomonitoring of exposure.

While the measurement of urinary Cd (Cd-U) reflects the body burden of the element and predicts the health risk, the measurement of blood Cd (Cd-B) may provide complementary information to detect recent exposures and evaluate the impact of preventive measures to control exposure.

The following elements should be considered to derive a BLV for Cd and its compounds :
there is an abundant database on the health effects of Cd and its compounds (Cd is a data-rich substance),
the mechanisms of Cd toxicity are relatively well understood,
the available dose-effect/response relationships characterising the hazard of Cd and its compounds have been extensively and quite reliably documented in numerous human studies,
the mean urinary cadmium levels in European individuals with no occupational exposure to cadmium or living in an area with no specific cadmium pollution is generally below 1-2 µg/g creatinine.
the critical effect selected to define the point of departure in epidemiological studies (urinary excretion of LMW proteins reflecting tubular dysfunction) is a relatively early sign occurring before the onset of overt clinical manifestations of kidney disease,
the point of departure identified from human studies (5µg Cd/g creatinine) is a LOAEL. Applying an uncertainty factor of 3 to derive a NOAEL leads to a value of 1.7 µg Cd/g creatinine.
Cd and its compounds are considered as genotoxic carcinogens for which secondary mechanisms are important (Category C, Bolt and Huici-Montagud, 2008) and it is seems prudent to recommend that the body burden of the working force should not exceed upper values measured in the general population (Cd-U 2 µg/g creatinine)

-

.It is therefore proposed to recommend a **BLV of 2 µg Cd/g creatinine.**

Chronic Effect KIDNEY - Overview

1. Effect on Workers starting at 5
2. Effect on GP starting at 2 or lower
3. The following facts are well established:
   - Cd-U is a good biomarker to evaluate body borden
   - Dose/response relationship well established,
   - Kidney critical organ
4. For Workers, health significance of 5 is well established
5. For GP, lingering questions remain
6. Difference could be due to pre-existing conditions in GP
7. Such pre-existing conditions could exist with W
8. A Safety Factor of 3 should be applied t o the W threshold of 5
9. Recommendation that body burden for W should not exceed that of GP
10. **=> BLV = 2µg/gC**

Cd REACH Consortium KIDNEY study

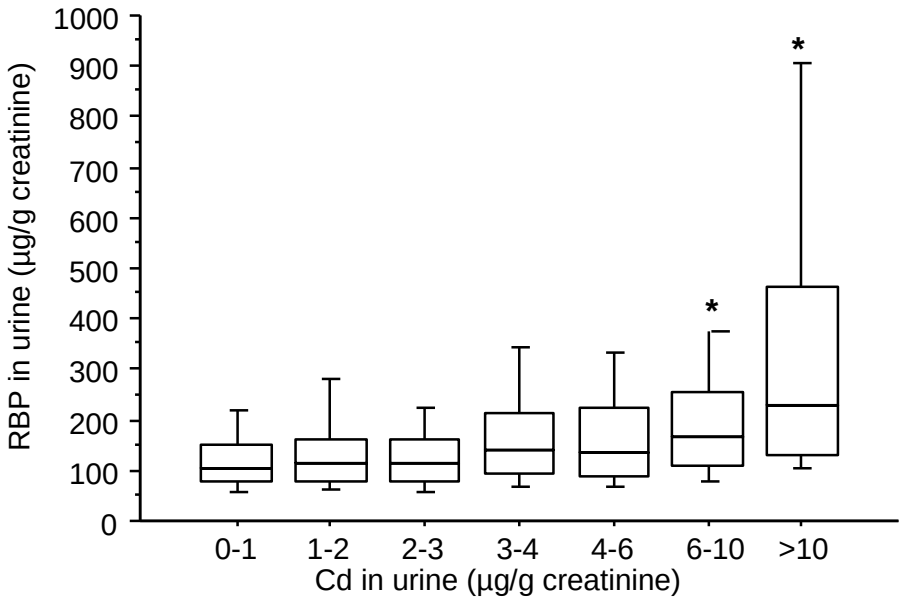
- Conducted within a cohort of a battery manufacturer's workers:

Characteristics of Cd-Ni battery workers

Country	n	Men (%)	Age (mean, yrs)	Never-smokers (%)	Ex-smokers (%)	Current smokers (%)
France (plant 1)	225	77.3	45.3	50.2	12.4	37.3
France (plant 2)	252	79.0	48.8	61.5	10.7	27.8
Sweden	113	68.1	40.0	54.0	21.2	24.8
USA	18	66.7	46.0	66.7	33.3	0.0
Total	608	76.0	45.8	56.1	29.9	14.0

Cd REACH Consortium KIDNEY study

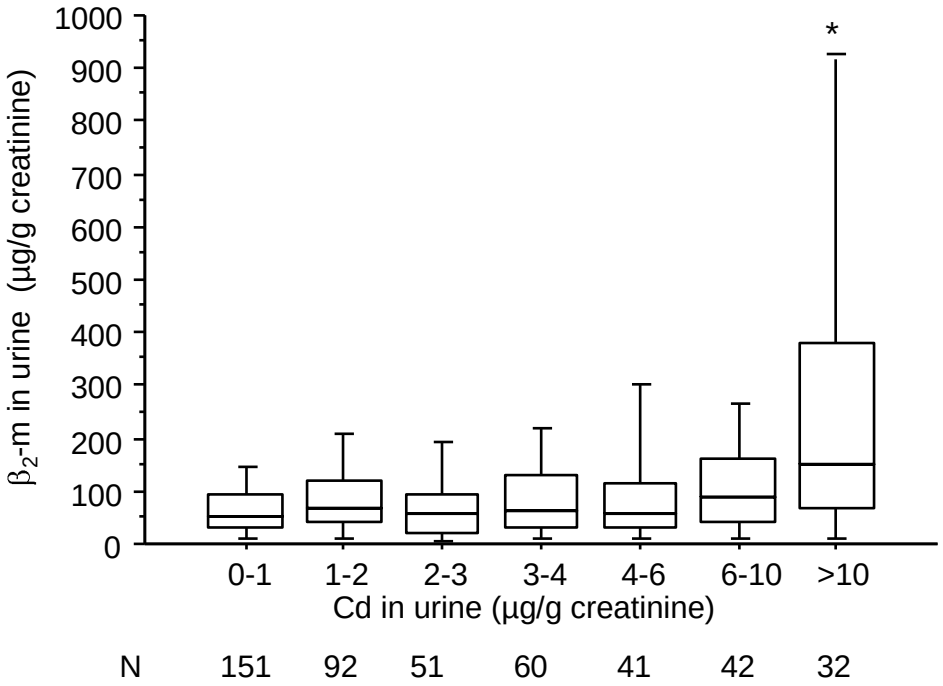
Dose-effect relationship between urinary RBP and urinary Cd in Ni-Cd battery workers



Values of RBP were adjusted for gender. Urinary samples with creatinine concentration < 0.3 and > 3 g/l were excluded. *significantly different from the group with CdU <1 µg/g creatinine (Scheffé test). See Table 2 for the characteristics of workers

Cd REACH Consortium KIDNEY study

Dose-effect relationship between urinary β_2-m and urinary Cd in Ni-Cd battery workers



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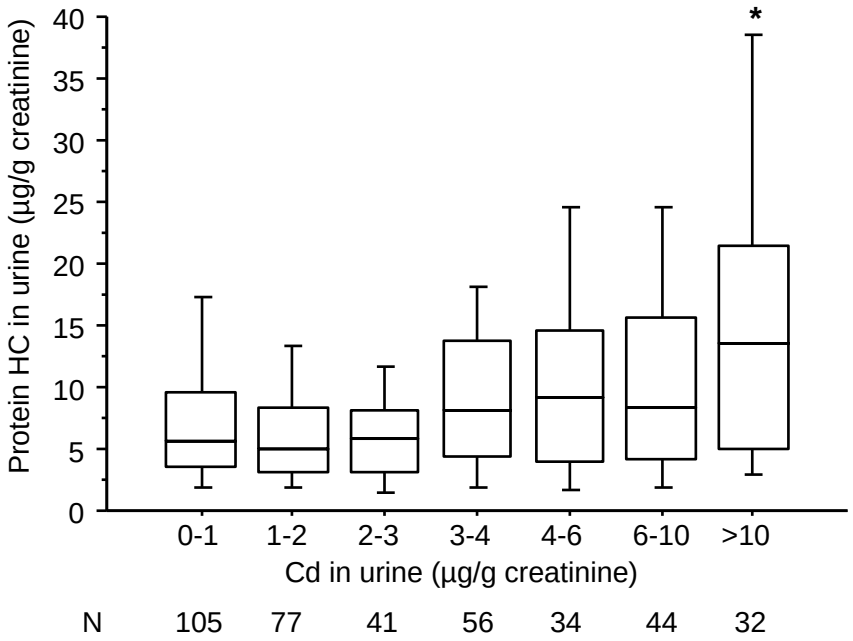
Cd REACH Consortium KIDNEY study

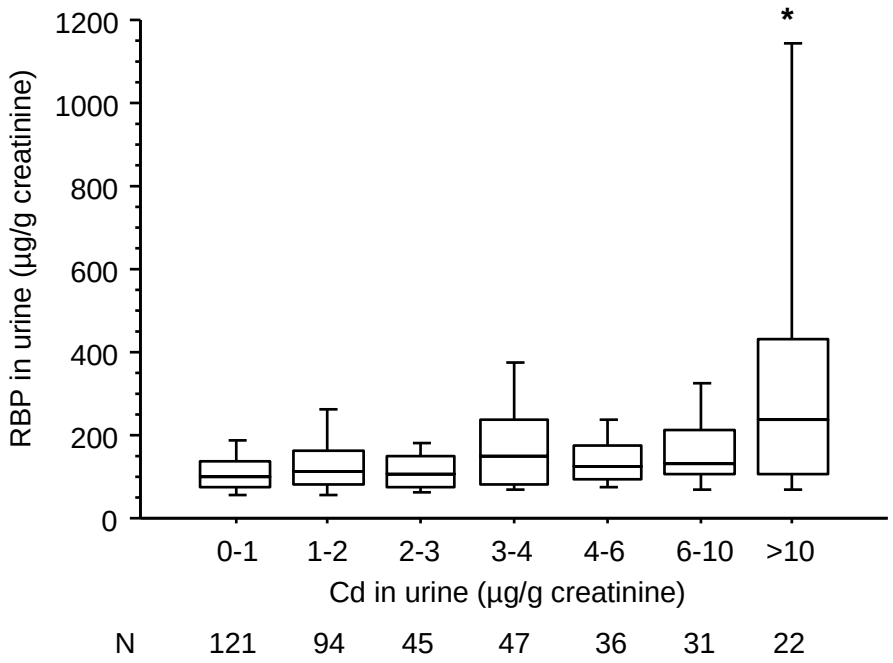
Dose-effect relationship between urinary protein HC and urinary Cd in Ni-Cd battery workers



Values of protein HC were adjusted for gender and smoking history (pack-years). Urinary samples with creatinine concentration < 0.3 and > 3 g/l were excluded. *significantly different from the group with CdU <1 µg/g creatinine (Scheffé test). See Table 2 for the characteristics of workers

Cd REACH Consortium KIDNEY study

Dose-effect relationship between urinary RBP and urinary Cd in Ni-Cd battery workers (never-smokers only)



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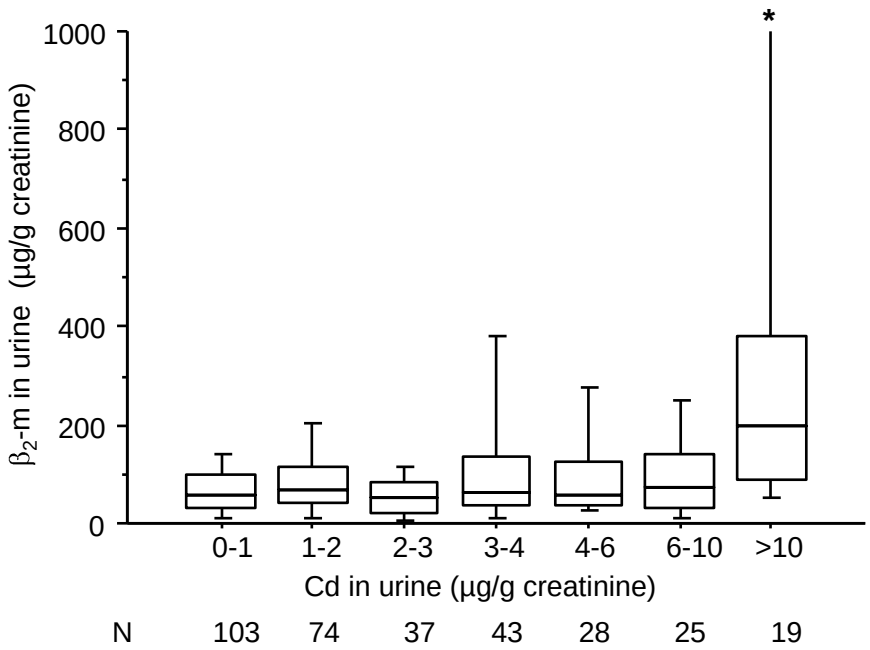
Cd REACH Consortium KIDNEY study

Dose-effect relationship between urinary β_2-m and urinary Cd in Ni-Cd battery workers (never-smokers only)



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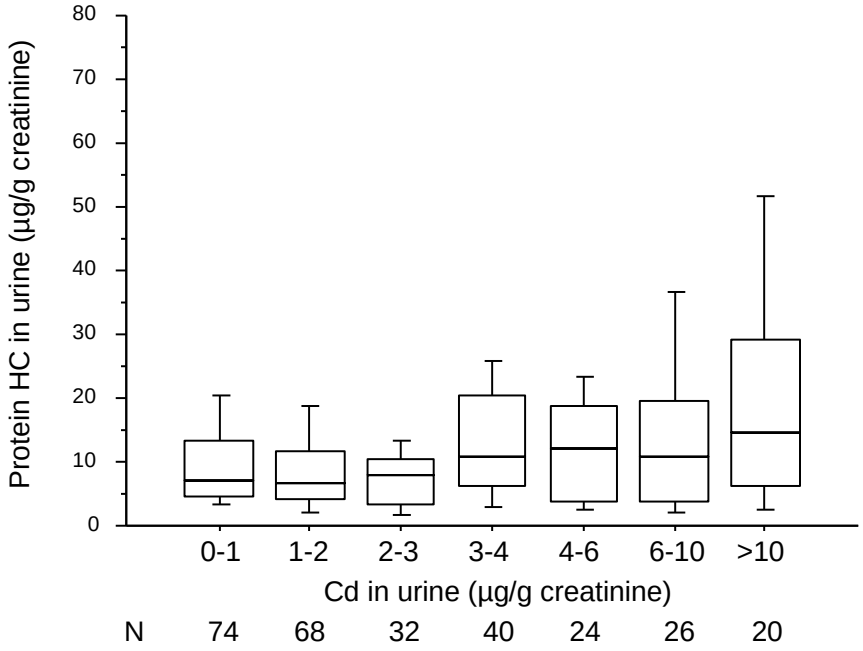
Cd REACH Consortium KIDNEY study

Dose-effect relationship between urinary protein HC and urinary Cd in Ni-Cd battery workers (never-smokers only)



Values of urinary protein HC were adjusted for gender. Urinary samples with creatinine concentration < 0.3 and > 3 g/l were excluded. *significantly different from the group with CdU <1 µg/g creatinine (Scheffé test).

Cd REACH Consortium KIDNEY study

Factors influencing the concentrations of urinary proteins

All workers

Dependent variable	n	Independent variables	Coefficient	Partial r	P
Log RBP-U (µg/g cr)	565	Log CdU (µg/g cr)	0.183	0.292	0.002
		Gender (male)	0.076	0.101	<0.001
Log B2-m-U (µg/g cr)	467	Log CdU (µg/g cr)	0.156	0.158	<0.001
Log protein HC-U (mg/g cr)	388	Pack-years	0.093	0.211	<0.001
		Log CdU (µg/g cr)	0.160	0.204	<0.001
		Gender	0.192	0.194	<0.001

ndependent variables tested: age, gender, retirement, pack-years, current smoking and Log CdU

Never-smokers

Dependent variable	n	Independent variables	Coefficient	Partial r	P
Log RBP-U (µg/g cr)	315	Log CdU (µg/g cr)	0.178	0.292	<0.001
Log B2-m-U (µg/g cr)	261	Log CdU (µg/g cr)	0.20	0.20	0.002
Log protein HC-U (mg/g cr)	228	Gender (male)	0.205	0.214	<0.001
		Log CdU (µg/g cr)	0.163	0.210	<0.001

Independent variables tested: age, gender, retirement and Log CdU

Cd compounds used as pigments

	Cd metal	CdO	$CdCl_2$	$CdSO_4$	CdS
EC No	231-152-8	215-146-2	233-296-7	233-331-6	215-147-8
CAS No	7440-43-9	1306-19-0	10108-64-2	10124-36-4	1306-23-6
Classification	Carc. Cat. 2; R45 Muta. Cat. 3; R68 Repr. Cat. 3; R62-63 T; R48/23/25 T+; R26		Carc. Cat. 2; R45 Muta. Cat. 2; R46 Repr. Cat. 2; R60-61 T; R25-48/23/25 T+; R26		Carc. Cat. 2; R45 Muta. Cat. 3; R68 Repr. Cat. 3; R62-63 T; R48/23/25 Xn; R22
MW	112.41	128.41	183.32	208.47	144.48
Physical form	White silvery solid	Brown powder	White crystals	Colorless crystals	Yellow-orange-brown crystals
Water solubility	Insoluble	Practically insoluble	1400 g/L @ 20°C	755 g/L @ 0°C	1.3 mg/L @ 18°C

Organic salts of Cd (stearate, laurate, myristate, palmitate) have fairly low solubility.

Cd compounds used as pigments

- Material oversight from SCOEL:
- "The properties of cadmium pigments are different from those of other cadmium compounds (including CdS), giving them a lower hazard profile.
  - This difference has been recognised in EU law for many years and cadmium pigments are specifically excluded from defined hazard classes and risk/safety phrases
  - as set by Directive 67/548/EC on "Classification and Labelling of Dangerous Substances"
  - or as proposed by Directive 1272-2008 "(GHS) Classification and Labelling Proposals".
  - Instead, cadmium pigments are covered by self-classification by manufacturers or importers on the basis of their chemical and physical properties."
- Also:
  - Confusion between pigments ($Cd_{(1-x)}Zn_xS$ and $CdS_{(1-x)}Se_x$) and
  - Massive coloring agents in glassware (CdS)

Cd compounds used as pigments

	Cd metal	CdO	CdCl2	CdSO4	CdS	Yellow Pigments $Cd_{(1-x)}Zn_xS$	Red Pigments $CdS_{(1-x)}Se_x$
EC No	231-152-8	215-146-2	233-296-7	233-331-6	215-147-8	232-466-8	261-218-1
CAS No	7440-43-9	1306-19-0	10108-64-2	10124-36-4	1306-23-6	8048-07-5	58339-34-7
Classification	Carc. Cat. 2; R45 Muta. Cat. 3; R68 Repr. Cat. 3; R62-63 T; R48/23/25 T+; R26		Carc. Cat. 2; R45 Muta. Cat. 2; R46 Repr. Cat. 2; R60-61 T; R25-48/23/25 T+; R26		Carc. Cat. 2; R45 Muta. Cat. 3; R68 Repr. Cat. 3; R62-63 T; R48/23/25 Xn; R22	**Specifically excluded from classification under Directive 67/548/EEC and under Regulation 1272-2008 (GHS) classification and labelling.**	
MW	112.41	128.41	183.32	208.47	144.48	Variable depending on Zn/Se content	
Physical form	White silvery solid	Brown powder	White crystals	Colorless crystals	Yellow-orange-brown crystals	Bright yellow powder	Brightly coloured powder (from yellow-orange, through red to deep maroon
Water solubility	Insoluble	Practically insoluble	1400 g/L@ 20 C	755 g/L@ 0 C	1.3 mg/L@ 18 C	Practically insoluble	Practically insoluble