Annex II : Posters

**Development of a control banding tool adapted to nanomaterials**
by the French Agency for Food, Environmental and Occupational Health & Safety (Anses)

**Nanosafety Research Centre**
by the Finnish Institute of Occupational Health (FIOH)

**Airborne nanoparticle exposures: Sampling strategy issues & example of a field study**
by the French Institute for Health and safety at work (INRS)

**Working with nanomaterials - Current development in Slovenia**
by the Slovenian Ministry of Labour, Family and Social Affairs

**Initiatives in the Netherlands : Nano Reference Values, practical tool and nanotechnology actionplan**
by the Social Partners in the Dutch Social Economical Council and the Dutch Trade Unions

**Sampling of nanoparticles on working places**
by the Belgian Federal Public Service Employment, Labour and Social Dialogue

**Nano Health and Environment Commented Database (NHECD)**
supported by the Joint Research Centre of the European Commission
I. OBJECTIVES:

Control banding (CB) is an occupational risk management approach where hazards and exposures are ranked and combined into bands of similar risk. CB may be useful for control of nanomaterials, risks but a way to rank hazards and exposures is needed. Control banding (CB) is an occupational risk management approach where hazards and exposure to substances are ranked and combined to bands of similar risk with associated standardized control measures.

Control banding approach consists of three steps:

1. Plan: Analyze hazards and exposures, information, attribute control bands and define an action plan.
2. Implement: Set up the control measures and start the routines as defined in the action plan.
3. Check and correct: Regularly monitor workplaces, review knowledge and control measures, correct the control bands or action plan when needed.

II. Control banding approach consists of three steps:

1) Plan: Analyze hazard and exposure information, attribute control bands and define an action plan. Action Plan definition:

- Hazard Band
- Emission Potential
- Product Information
- Exposure Information

Progressive transition

Chemical Risk Quantitative Assessment
Chemical Risk qualitative Assessment

Control Banding
## V. Control band definition

1. **CL 1:** Natural or mechanical general ventilation
2. **CL 2:** Local ventilation: extractor hood, slot hood, etc.
3. **CL 3:** Enclosed ventilation: ventilated booth, etc.
4. **CL 4:** Continuous ventilation: continuously closed systems.
5. **CL 5:** Full containment + review by a specialist: seek expert advice.

### III. Hazard band definition

<table>
<thead>
<tr>
<th>Hazard bands</th>
<th>Emission potential bands</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBS</td>
<td>EP4</td>
</tr>
<tr>
<td>HBS2</td>
<td>EP2</td>
</tr>
<tr>
<td>HBS3</td>
<td>EP1</td>
</tr>
<tr>
<td>HBS4</td>
<td>E4</td>
</tr>
</tbody>
</table>

According to the physical form of the powder:

- **Solid:** Band (1B)
- **Liquid:** Band (1B) + dispersion (2B) + evaporation (3B)
- **Powder:** Band (1B) + volatility (2B) + dustiness (3B)
- **Aerosol:** Band (1B) + volatility (2B) + dispersion in liquid (3B)

### IV. Exposure band definition

- **EP1:** Low emission potential
- **EP2:** Medium emission potential
- **EP3:** High emission potential
- **EP4:** Very high emission potential

Band modification due to the physical form of the material:

- **Solid:** Band (4B)
- **Liquid:** Band (3B) + volatility (2B) + evaporation (1B)
- **Powder:** Band (3B) + volatility (2B) + dustiness (1B)
- **Aerosol:** Band (2B) + volatility (1B) + dispersion in liquid (0B)

Band modification due to the emission potential of the material:

- **EP4:** Band (4B)
- **EP3:** Band (3B) + volatility (2B)
- **EP2:** Band (2B) + volatility (1B)
- **EP1:** Band (1B)

Band modification due to process operation:

- **Spraying:** Band (1B) + volatility (1B) + dispersion in liquid (0B)
Nanosafety Research Centre at the Finnish Institute of Occupational Health (FIOH)

Director: Kai Savolainen, Research Professor

Facts about Nanosafety Research Centre

• Start date January 1, 2011, continues work that started in 2004
• One of FIOH’s strategic research activities
• Annual budget about 2.6 million €; from external competitive research funding sources 800 – 850 K€
• Human resources 21 person years; totally 38 individuals work for the Centre
Structure of the Nanosafety Research Centre

Coordinator
Executive Board

1. Particle characterization, structure of nanoparticles and exposure assessment
2. Measuring of nanoaerosols
3. Immunotoxicology
4. Immunopathology
5. Genotoxicology
6. New and emerging risks of nanotechnologies

THEMATIC AREAS (project driven)

Internal partners
ADVISORY BOARD
- Science - Partners - Customers

External partners
- Domestic - International

Target groups
IMPLEMENTATION
- Scientific publications - Scientific presentations - Communication via media - Tailored training and guidance - Workshops - Good practices

WORK PLACES IN FINLAND
FINNISH - SCIENTIFIC COMMUNITY, AUTHORITIES - ENTERPRISES - CITIZENS
INTERNATIONAL - SCIENTIFIC COMMUNITY - REGULATORS - INTERMEDIARY ORGANISATIONS

Nanosafety Research Centre
Original scientific publications
Continuous future scanning - identification of needs
Reviews and publishing on scientific forums, lectures, networking
Good practices, nanosafety guides and handbooks, web pages, communication via media
Solutions to the customers

Research projects funded by EU and national sources to understand the effect
Practical cooperation with enterprises, sampling and processing of information
Tools to the customers, nanoparticle guides and handbooks, training materials
Cooperation with authorities and enterprises (domestic and EU)
Tailored nanosafety training and guidance

Cooperation
Production of nanostructures and characterization
Sampling strategies, sampling
Reviews and publishing on scientific forums, networking
Good practices, nanosafety guides and handbooks, web pages, communication via media
Tailored nanosafety training and guidance
The main mission of the Nanosafety Research Centre at FIOH

• Provides solutions on safe handling of engineered nanomaterials (ENM) and nanotechnologies to the stakeholders and target groups including:
  - workers, workplaces in Finland
  - employers, enterprises in Finland
  - public at large, mainly in Finland, but also in EU
  - employers, enterprises in Finland
  - national and EU-level stakeholders (EU Commission, EU Agencies, Business Europe, ETUC)
  - workers, workplaces in Finland
  - public at large, mainly in Finland, but also in EU
  - regulators, decision makers including FIOH Board, and appropriate ministries

• Active RUSNANO Collaboration on safety & stand

• Means to exploit the work of the Centre on safety of ENM, NT

  • High quality research
  • Practical guidance to stakeholders through publications, newspapers, media (TV, radio)
  • Networking in Finland, EU and beyond
  • National and international scientific events (EURONANOSH, Helsinki, 2007; 4th NANOEH, Helsinki, 2011; 5th NANOHEALTH, Helsinki, 2013; EU-USA WORKSHOP on nanosafety, Helsinki, 2012; SENN'2012)

• Education of students and other audiences

• EU-USA WORKSHOP on nanosafety, Helsinki, 2012; SENN'2012)
FIOH coordinates the activities of EU Nano-safety Cluster bringing together all FP7 funded projects on nanosafety research.

- **Facts:**
  - 22 EU-funded, about 10 national projects
  - EU-contribution 120 million €
  - 80 partners, hundreds of scientists

- **Preparation of 8th FP for R & I:**
  - EU Nanosafety Vision 2015-2020
  - EU Strategic Research Agenda of Nanosafety Research

**Preparation of the preparation:**

- 80 partners, hundreds of scientists
- EU-contribution 120 million €

**Facts:**

- Funded projects on nanosafety research
- FIOH coordinates the activities of EU Nanosafety Cluster
Join us in the next step of the nanosafety discussion!

SENN2012 International Congress on Safety of Engineered Nanoparticles and Nanotechnologies
28-31 October 2012, Helsinki, Finland

www.ttl.fi/senn2012

The goal of the SENN2012 Congress is to summarize and share the latest knowledge regarding the safety of engineered nanomaterials and nanotechnologies.

This meeting is a must for those dealing with nanosafety issues in:

- materials science
- measuring technologies
- risk assessment and risk management
- hazardous and emerging nanomaterials
- toxic effects
- standardization
- health

The Congress arrangements are funded by the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 211464.

Contacts:

- SENN2012 programme: senn2012@ttl.fi
- Registration and practical information: senn2012.congress@tavicon.fi
  Tel: +358 3 233 0400
  www.ttl.fi/senn2012

The Congress is organized by the "NANODEVICE" EU 7th Framework Programme Project and its partners, and the Finnish Institute of Occupational Health.
Airborne nanoparticle exposures: Sampling strategy issues

- Most current instruments are not ‘personal,’ produce real-time measurement data.
- Need field-ready approach (single) particle characterization.
- Althomine nano-scale particles can originate from multiple indoor and outdoor sources.

Several issues:

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Sampling strategy

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Exposure criteria (cond't)

Sampling strategy (cond't)

Nanoparticle Emission Assessment Technique (NEAT)

Proposed by NIOSH to help occupational hygienists

Proposed in OECD document (No 11 - Series on the safety of manufactured materials)

If results suggest a potential for exposure, a more comprehensive and quantitative approach may be adopted.
There are many questions that remain to be addressed, and it is foreseen for the next 10+ years a continuing extended research in the fields of cycle of the nanoparticles & nanomaterials.

The number of studies is almost negligible compared to the number of exposure situations that can be distinguished throughout the complete life cycle of the nanoparticles. The number of studies is almost negligible compared to the number of exposure situations that can be distinguished throughout the complete life cycle of the nanoparticles. The number of studies is almost negligible compared to the number of exposure situations that can be distinguished throughout the complete life cycle of the nanoparticles.

Need for an harmonized approach for measuring strategy (with different levels of sophistication), data analysis reporting and storing has to be developed and a international consensus found.

**Conclusion**

*Sampling strategy (cond't)*

<table>
<thead>
<tr>
<th>Source (No other)</th>
<th>Small particles +</th>
<th>medium particles +</th>
<th>large particles +</th>
<th>Agglomerates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>&gt; 0.05</td>
<td>&gt; 1.05</td>
<td>&gt; 0.05</td>
<td>&lt; 1.05</td>
</tr>
<tr>
<td>No Source</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>&gt; 1.05</td>
<td>&gt; 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Source</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>&gt; 0.05</td>
<td>&gt; 1.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Decision logic criteria (Nanosh EU project)*

Elements: TEM, EDX, NMP

Electron Microscopy

Concentration

Electron Microscopy (single event)

P-value Ratio

Hood all

Hood other

Vials - over
Airborne nanoparticle exposures: Example of a field study

Institut national de recherche et de sécurité

Nano-TiO₂ as powders. Potential for exposure during bagging operations in a plant that produces both pigment grade TiO₂ and nano-TiO₂ as powders.
activity/time as variable (i.e., near-field approach).

Background measurements were addressed for real-time instruments with

mass-based sampling (respirable aerosol fraction) at fixed positions.

Real-time and averaged size distribution measurements

Real-time concentrations (number, deposited surface-area)

Multi-channel strategy was based on:

Example / bagging pigment grade and nano-TiO2

Hall 1 - Pigment grade

Hall 2 - Nano (A)

Hall 1 - Nano (B)

Very few published data

Several releases are possible

Conditioning in 25kg paper bags and 600kg plastic big bags

Manufactured plant delivering pigment grade and nanostructured TiO2

Example / bagging pigment grade and nano-TiO2
Example / bagging pigment grade and nano-TiO₂

Evolution with time of the aerosol at the workstation Nano (A) on day 1.

Table:

<table>
<thead>
<tr>
<th>Workstation</th>
<th>Pigment grade</th>
<th>Nano (A)</th>
<th>Nano (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>117 (+20)</td>
<td>284 (+20)</td>
<td>489 (+20)</td>
</tr>
<tr>
<td></td>
<td>160 (+30)</td>
<td>84 (+30)</td>
<td>763 (+30)</td>
</tr>
<tr>
<td></td>
<td>461 (+10)</td>
<td>401 (+10)</td>
<td>1047 (+10)</td>
</tr>
</tbody>
</table>

% TiO₂:

- Day 1: 74
- Day 2: 74
- Day 3: 74

Specific surface area BET (m²/g):

- Day 1: 390
- Day 2: 390
- Day 3: 390

Primary size (nm):

- Day 1: 1063
- Day 2: 1063
- Day 3: 1063

Median size (nm):

- Day 1: 1800
- Day 2: 1800
- Day 3: 1800

Number:

- Day 1: 5-10
- Day 2: 5-10
- Day 3: 5-10

Volume:

- Day 1: 480
- Day 2: 480
- Day 3: 480

Respirable TiO₂ mass (µg/m³) concentrations at the 3 workstations.

Source: Wiesner et al. 2010
Only the aerosols coming from nano-TiO2 bagging are made of nanostructured particles with high specific surface area.

Bagging operations release aerosols in the respirable size range for both pigment grade TiO2 and nano-TiO2.

The smallest nano-TiO2 objects that have been sampled from workplace atmosphere and visualized by SEM were compact aggregates of ~100 nm.
Electron microscopy etc.),

nanoparticles & nanomaterials (particle size & liquid, nanodisparities

- developing and developing protocols for the characterisation of
- developing and developing tools for data interpretation,
- developing and testing strategies for measuring exposures,
- studying the performance of measuring instruments,
- documenting knowledge on nanomaterials in the workplace,
- nanomaterials/nanoparticles,

helping companies/laboratories in their efforts to prevent risk of using

INRS conducts field studies in the objective of:

Field studies

Example of a field study:

Airborne nanoparticle exposures:
Example / cleaning of a reactor containing nanoAg

Task: cleaning done manually every day

- Using a flexible abrasive (sandpaper-like)
- Academic research lab on coatings
- Lab-scale reactor (cold plasma-deposition)
- Thin films (~1.50 nm) containing silver
- Nanoparticles in a polymeric matrix
- (SICCOYHZ)
Adherent particles in the range 300 nm to 10 µm are released at the source.

Task: manual sandpapering of the reactor with abrasive paper (humidified with EtOH)

Example  / cleaning of a reactor containing nanoAg

Example  / cleaning of a reactor containing nanoAg
Example / cleaning of a reactor containing nanoAg
Do we have an emission (potential for exposure) and an exposure to fume hood?

- Similar observations were made on the release particles collected in the fume hood.
  - No matrix-free silver nanoparticles have been observed.
  - Nanometer-sized and micrometer-sized airborne particles.
  - The abraded surface coating material seems to be the main source for both reactor and SEM-EDS analyses show only wear particles from the surface of the reactor.

Example / Conclusions
Example / Conclusions

All these three elements together were here important.

EM led to a complete picture of the situation. Neither the traditional exposure sampling approach (wet chemistry), nor the use of real-time instruments only or even the single particle chemical analysis by a microscope provide suitable means to inform the people involved and guide them in terms of preventive measures or to find alternative solutions.

That further workplace measurements of this type can be made for important seems representative of many academic research laboratories. It seems as the environment, the process and the cleaning operation studied here
Working with nanomaterials

Current development in SLOVENIA

Nataša Kramar, Ministry of Labour, Family and Social Affairs, Slovenia, 2011

Photos made by: Dr. Maja Remškar, Solid State Physics Department, Jožef Stefan Institute, Ljubljana, Slovenia

Public awareness of nanoparticles and nanosafety issues

Edition of the book "NANOPARTICLES AND NANOSAFETY"

Jožef Stefan Institute, Slovenia

Workshops on NANOTECHNOLOGY FOR NATIONAL STAKEHOLDERS, EFSA FOP, Ministry of agriculture, forestry and food, Slovenia

Edition of the book "RISK MANAGEMENT OPTIONS FOR NANOTECHNOLOGY"

Jožef Stefan Institute, Slovenia

Edition of the book "NANOTECHNOLOGY DAYS, Slovenian Chamber of Commerce"

Edition of the book "PHOTO BLOCKADE"

Dr. Maja Remškar, Solid State Physics Department, Jožef Stefan Institute, Ljubljana, Slovenia
Detector of nanoparticles invented at Jožef Stefan Institute, Slovenia

Differential mobility analyzer
Condensation particle chamber

Concentrations: up to $2.4 \times 10^6$ NPs/cm$^3$

Particle Size Range: 10 to 487 nm

Large concentrations of nanoparticles may be present in occupational environments, which deserve particular attention from the standpoint of exposure.

Workplace Exposure - detection of nanoparticles

Nataša Kramar, Ministry of Labour, Family and Social Affairs, Slovenia 2011

Cleaning time
Working time

Concentration Particle Chamber
Differential Mobility Analyzer

Model 3034

TSI model

Invented at Jožef Stefan Institute, Slovenia
Fireworks at the celebration of 20th anniversary of independence of the Republic Slovenia

Duration: 5 minutes

1. Front: 22:38 (150 nm; 19,000 particles/cm³)
2. Front: 23:20 (60 nm; 24,000 particles/cm³)

Distance: ~300m
Wind: 1 m/s NE (away from the station)

Estimate: 10¹⁵ nanoparticles released

Preparation of proposals for managing the risk:
- for working places (EU/national level)
- for consumers
- Intersectoral cooperation

Activities in the future in Slovenia

Participation of Slovenian Scientists in RA of nanomaterials (OECD/EU level)
Preparation of proposals for managing the risk:
- for working places
- for consumers

Intersectoral cooperation
- Involvement of industry/NGOs (exchange of views)

Awareness raising for general population

Photo: Craters of volcanic ash, Iceland volcano eruption, Eyjafjallajökull, May 1st and 2nd, 2010

More detailed analyses of companies' production/place on the market and their products

Nataša Kramar, Ministry of Labour, Family and Social Affairs, SLOVENIA, 2011
Warning against development of nanotechnology does not make any sense, since this is certain part of our bright future. Reminding on the hazard is wisdom that always brings benefits in unknown...
Nano Reference Values (NRV)

A joint initiative of the Social Partners in the Dutch Social Economical Council (SER): A precautionary approach for a safe workplace

Provisional occupational limit values

NRVs are 8-hour time weighted average concentration (8hr-TWA)

- Provisional limit values
- Background-corrected
- Warning level for risk management

Nano Reference Values (NRV):

Manufactured Nanomaterials (MMN)
Process-generated NPs (PGNP)
Engine-generated NPs (e.g. electrical equipment)

NRVs for:

Airborne nanoparticles (NP) at the workplace:

- Engine-generated NPs (e.g. electrical equipment)
- Manufactured Nanomaterials (MMN)
- Process-generated NPs (PGNP)

NRV for peak exposures - 15-minute TWA: NRV_{15min-TWA} = 2 \times \text{NRV}_{8hr-TWA}

NRVs for conventional compounds

A practical and simple tool
Provisional limit values for nanoparticles

A precautionary approach for a safe workplace

in the Dutch Social Economical Council (SER):

A joint initiative of the Social Partners

NRVs for:

- Engine-generated NPs (e.g. electrical equipment)
- Manufactured Nanomaterials (MMN)
- Process-generated NPs (PGNP)

NRVs are 8-hour time weighted average concentration (8hr-TWA)

- Provisional limit values
- Background-corrected
- Warning level for risk management

Nano Reference Values (NRV):
### Class Description

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Daily</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example 1</td>
<td>Rigid, biopersistent nanofibers for which effects similar to asbestos are not excluded</td>
<td>40'000 particles/cm³</td>
<td>8-9 h SWCNT or MWCNT or metal oxide</td>
</tr>
<tr>
<td>Example 2</td>
<td>Biopersistent granular nanomaterials in the range of 1 and 100 nm</td>
<td>&lt; 6,000 kg/m³</td>
<td>&lt; 20,000 particles/cm³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-biopersistent granular nanomaterials in the range of 1 and 100 nm</td>
<td>&gt; 6,000 kg/m³</td>
<td>&gt; 40'000 particles/cm³</td>
</tr>
</tbody>
</table>
6. Select and implement appropriate control measures

5. Determine control level (via Control Banding)
4. Classify the probability of exposure
3. Identify work activities
2. Classify health hazards
1. Map used or produced nanomaterials/nanoproducts

The Action Plan:

6 steps to a safe nanoworkplace

Information on nanomaterials and nanoproducts in the absence of detailed information.

Result: A practical and simple tool to organize Guidance Working Safely with Nanomaterials and Nanoproducts.
Contact details:

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Pieter van Broekhuizen

E-mail: fvbroekhuizen@ivam.uva.nl
pvbroekhuizen@ivam.uva.nl

Tel.: +31 (0)20 525 5080
3 x Trade Union

Nanotechnology Actionplan of Dutch Trade Unions

Track 1
Awareness and concerns of workers regarding working with nanoproducts and their wishes for information.

- Survey
- Interviews during company visits
- Tools available and made together with employees
- Suitable for working condition catalogs
- 150 Employees and 10 companies involved
- 15 Employees ambassador

Track 2
Developing tools for workers to support working safely with nanoproducts

- Suitable for working condition catalogs
- Risk inventory for working with nanoproducts
- Tools available and made together with employees
- 150 Employees and 10 companies involved

1. Concrete mortar industry (FNV Bouw)
2. Car repair shops (FNV Bondgenoten)
3. Medical centers (Abvakabo FNV)
Team and Contact details:

IVAM: Dr. Fleur van Broekhuizen
Email: fvanbroekhuizen@ivam.uva.nl
Tel.: 0031 20 525 6502

-Puur Ontwerp: Ermin de Koning

-Puur Ontwerp: Josje Salentijn

-Salentijn Consult: Josje Salentijn
Sampling of nanoparticles

Working places

The laboratory of industrial toxicology (Belgium) since 2007 is performing measurements of nanoparticles on working places.

Measurement techniques

- Diffusion charging (active surface deposited in different lung compartments) expressed in $\mu m^2/cm^3$.
- Analytical electron microscopy.
- « Classical » Occupational hygiene measurement techniques (ICP, elemental carbon, ...).
The measurements cover:

- Synthesis of TiO$_2$ nanoparticles
- Synthesis of carbon nanotubes
- Welding of stainless steel
- Vulcanisation of rubber
- Centre of automobile inspection
- Bagging of carbon black
- Synthesis of carbon nanoparticles

Provisional results (1/2)

<table>
<thead>
<tr>
<th>Tracheobronchial Fraction ($\mu$m²/cm³)</th>
<th>Alveolar Fraction ($\mu$m²/cm³)</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.21</td>
<td>31.0</td>
<td>Bagging of carbon black</td>
</tr>
<tr>
<td>8.8</td>
<td>41.4</td>
<td>Synthesis of TiO$_2$ nanoparticles</td>
</tr>
<tr>
<td>13.6</td>
<td>63.3</td>
<td>Synthesis of carbon nanotubes</td>
</tr>
<tr>
<td>43.4</td>
<td>169.0</td>
<td>Welding of stainless steel</td>
</tr>
<tr>
<td>70.1</td>
<td>217.2</td>
<td>Vulcanisation of rubber</td>
</tr>
<tr>
<td>243.7</td>
<td>1145.2</td>
<td>Centre of automobile inspection</td>
</tr>
</tbody>
</table>

Very often « classical » industrial processes (combustion, welding...) generate much higher quantities (expressed as surface area per unit volume of air) as modern nanotechnological processes.

**Workplaces**

Federal Public Service Employment, Labour and Social Dialogue
Provisional results (2/2)

• Measurements of nanoparticles: a lot of “trial and error” (personal exposure measurement devices?)

• Carbon nanotubes (CNT) are a priority

Ailene Demortier: Tel: +32 2 208 37 81
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• Agglomerate of nanoparticles of carbon black in workplace air

Contact
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Aline Demortier:
Aline.demortier@emploi.belgique.be

Fibre-like bundles of CNT and isolated CNT in workplace air

200 nm

Fibre-like bundles of CNT and isolated CNT in workplace air

200 nm

Provisional results (2/2)
Use Mozilla or Google Chrome (IE not yet)

Try-out period has started for In-vivo/in-vitro

URL: http://nhecd.jrc.ec.europa.eu

Repository > 10 000 papers on impact of Nanoparticles
Each paper is tagged by a large system of taxonomies on in-vivo/in-vitro, occupational and ecotox domain
In-vivo/in-vitro, occupational and ecotox domain
Intelligent search extracts some relevant info from reference
You can do Basic Search and Intelligent Search

Why and How this Database and URL

Innovative and complementary knowledge system on nanoparticles on health, safety and the environment

Including a knowledge repository on the impact of nanoparticles on health, safety and the environment

To build a free access, robust and sustainable system

Nano Health and Environment

Commented Database (NHECD)

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