



imec

ENGINEERED NANO MATERIAAL: RISK BANDING EN MONITORING

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INHOUD

- Identificatie van Risico's
 - Materiaaleigenschappen
 - Werkpostanalyse
- Risico Evaluatie: Risk Banding
- Air Sampling
- Preventieve maatregelen (collectief en individueel)
- Conclusies

IDENTIFICATIE VAN RISICO'S:

MATERIAAL EIGENSCHAPPEN

Engineered nanomaterial hazard assessment form

Chemical/ Physical property of the used ENP	No	Yes		Unknown or not applicable
			Hazard band	
Solubility/Persistance/ Dispersion				
Water soluble parent material (uncoated) ?				
Biopersistant material (coating included) ?		X		
Does the ENP have a high dispersion capacity	X			
Shape and dimensions				
High aspect ratio nanoparticle ? (length/diameter ratio > 3/1 ? (fiber shaped nanoparticle)		X		
Powders with particle size < 10 nm ?		X		
Particle size > 10 nm < 100 nm ?	X			
Do the ENP aggregate or agglomerate ?				
Are the ENP embedded in a matrix ?		X		
Are the ENP dispersed in a liquid?	X			
Does the ENP have irregular shape ?	X			
Toxicity				
Toxic parent material (G classes CLP) ? (including cancerogenic, mutagenic, reprotoxic properties)	X			
ENP contains transient metal ? (from surface treatment, catalyst residue, doping)				NA
Is the nanomaterial functionalized by adding molecules with toxic, mutagenic, reprotoxic elements ?	X			
Does the ENP have a known highly reactive surface ?				U

MATERIAAL EIGENSCHAPPEN

Inclusief:

- Nano materiaal in ge-aggregeerde of ge-aglommereerde toestand
- Nano materiaal dat vrijkomt bij onderhoud van proceskamers of bij breken/klieven van wafers

IDENTIFICATIE VAN RISICO'S:

WERKPOST ANALYSE

WERKPOSTANALYSE

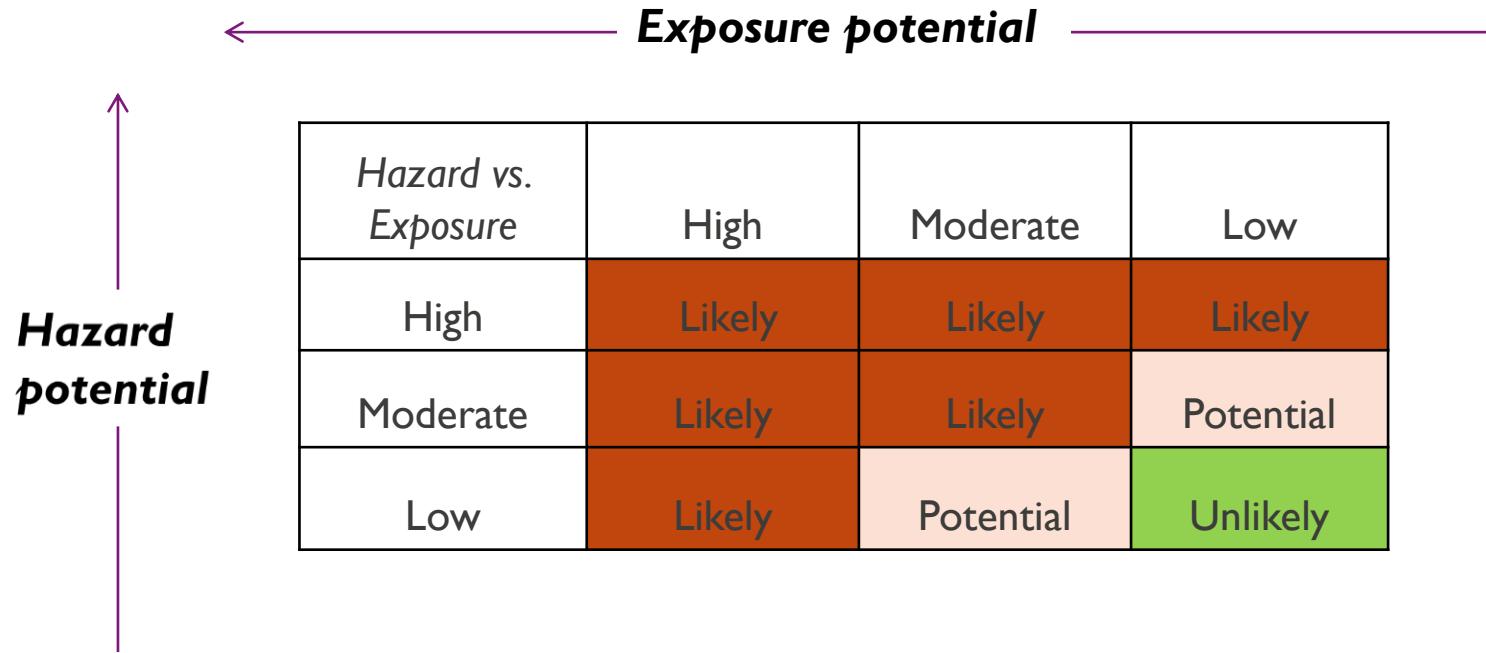
- Opsplitsen van een activiteit - vb. het onderhoud van een reactor - in taken (= deel activiteiten)
 - Openen van een reactor
 - Reinigen van een reactor oa.vacuum cleaning
- Per taak nagaan of er een mogelijkheid is op blootstelling aan engineered nano materiaal, chemische stoffen, biochemische stoffen of fysische agentia; nagaan wat de ergonomische risico's zijn.



RISICO EVALUATIE :

RISK BANDING

RISK BANDING



DEFINING HAZARD BAND

HAZARD	HAZARD BAND
WATER INSOLUBLE MATERIAL - BIOPERSISTANT MATERIAL	HH
HIGH DISPERSION PROPERTY (DUSTINESS)	HH
HIGH ASPECT RATIO	HH
FIBRE / NEEDLE SHAPED MATERIAL	HH
POWDERS WITH DIAMETER < 10 NM	HH
TOXIC (CMR) PARENT MATERIAL OR TRANSITION METAL (CATALYST) OR FUNCTIONALIZED WITH TOXIC,CMR MATERIAL	HH
HIGH SURFACE REACTIVITY	HH
AGGREGATED OR AGGLOMERATED MATERIAL	HM
IRREGULAR GEOMETRICAL SHAPE	HM
WATER SOLUBLE MATERIAL	HL
ENM EMBEDDED IN SOLID MATRIX	HL
ENM DISPERSED IN LIQUID	HL
ENM WITH LOW DISPERSION CAPACITY	HL

DEFINING EXPOSURE BAND

EXPOSURE	EXPOSURE BAND
MANIPULATIONS DONE WITHIN THE BREATHING ZONE (< 0,5M)	EH
MANIPULATIONS THAT MECHANICALLY DISRUPT MATERIAL (SCRAPING, CUTTING, SLICING, POLISHING, ...)	EH
SPRAYING OF AEROSOLS CONTAINING ENM	EH
MECHANICAL CLEANING OF PROCESS CHAMBERS CONTAINING ENM (SCRAPING, BLASTING, VACUUM CLEANING)	EH
OPENING AND CLEANING OF DUST COLLECTION SYSTEMS USED TO CAPTURE ENM	EH
MANIPULATIONS DONE WITHIN THE NEAR FIELD (> 0,5 M, < 1M)	EH
DURATION OF MANIPULATIONS LONGER THAN 4 H AND 3 DAYS / WEEK	EH
CLEANING OF REACTORS BY WET WIPIING	EM
AMOUNT OF ENM EXCEEDS 1 G	EM
MANIPULATIONS ARE DONE WITHIN THE FAR FIELD > 1 M	EL
AMOUNT OF ENM L< 1 G	EL

Engineered nanomaterial hazard assessment form

Chemical/ Physical property of the used ENP	No	Yes	Hazard band	Unknown or not applicable
Solubility/Persistance/ Dispersion				
Water soluble parent material (uncoated) ?			HL	
Biopersistant material (coating included) ?		X	HH	
Does the ENP have a high dispersion capacity	X			
Shape and dimensions				
High aspect ratio nanoparticle ? (length/diameter ratio > 3/1 ? (fiber shaped nanoparticle)		X	HH	
Powders with particle size < 10 nm ?		X	HH	
Particle size > 10 nm < 100 nm ?	X		HM	
Do the ENP aggregate or agglomerate ?			HM	X
Are the ENP embedded in a matrix ?		X	HL	
Are the ENP dispersed in a liquid?	X		HL	
Does the ENP have irregular shape ?	X		HM	
Toxicity				
Toxic parent material (G classes CLP) ? (including cancerogenic, mutagenic, reprotoxic properties)	X		HH	
ENP contains transient metal ? (from surface treatment, catalyst residue, doping)			HH	X
Is the nanomaterial functionalized by adding molecules with toxic, mutagenic, reprotoxic elements ?	X		HH	
Does the ENP have a known highly reactive surface ?			HH	X

Hazard Assessment form

Name: Date:

Room:

Kind of material (chemical compounds):

Description of use:

Engineered nanomaterial hazard assessment form			
Chemical/ Physical property of the used ENP	No	Yes	Unknown or not applicable
		Hazard band	
Solubility/Persistance/ Dispersion			
Water soluble parent material (uncoated) ?		HL	
Bopersistant material (coating included) ?		HH	
Does the ENP have a high dispersion capacity			
Shape and dimensions			
High aspect ratio nanoparticle ? (length/diameter ratio > 3/1 ? (fiber shaped nanoparticle)		HH	
Powders with particle size < 10 nm ?		HH	
Particle size > 10 nm < 100 nm ?		HM	
Do the ENP aggregate or agglomerate ?		HM	
Are the ENP embedded in a matrix ?		HL	
Are the ENP dispersed in a liquid?		HL	
Does the ENP have irregular shape ?		HM	
Toxicity			
Toxic parent material (G classes CLP) ? (incl.carcinogenic, mutagenic, reprotoxic properties)		HH	
ENP contains transient metal ? (from surface treatment, catalyst residue, doping)		HH	
Is the nanomaterial functionalized by adding molecules with toxic, mutagenic, reprotoxic elements ?		HH	
Does the ENP have a known highly reactive surface ?		HH	

Exposure Assessment form

Name: Date:

Room:

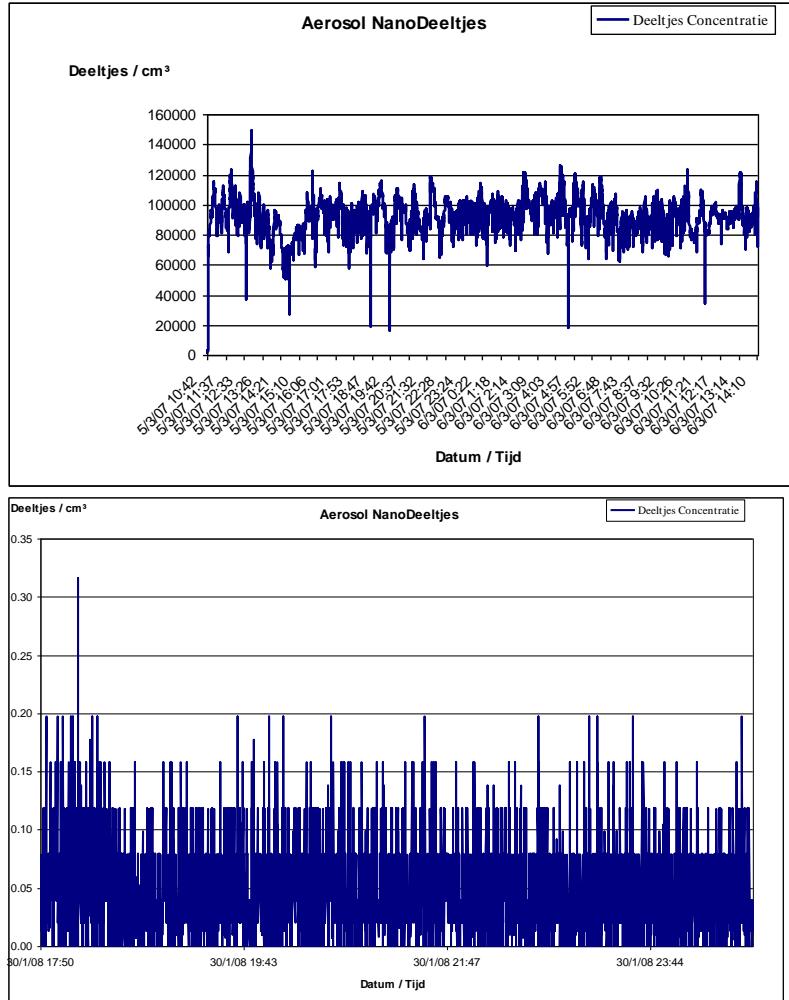
Kind of material (chemical compounds):

Description of use:

Engineered Nanomaterial Exposure Assessment Form				
Activity/Manipulations/Conditions:	N	Y	Exposure potential Band	Unknown or not applicable
Proximity and duration of manipulations				
Are the manipulations being done within the breathing zone < 0,5m ?			EH	
Are the manipulations are being done within the near field >0,5 m ; < 1m ?			EM	
Are the manipulations being done within the far field > 1m (*)?			EL	
Is the duration of the manipulation longer than 4 hrs/ day and more than 3 days/week ?			EM	
Activity				
Could the manipulations mechanically disrupt the material ? (ie. scraping, cutting, slicing, polishing, fracturing, milling, dry blending)			EH	
Do the manipulations involve spraying of aerosols containing ENP's (including pouring, sonication, vortexing and centrifuging)			EH	
Do the manipulations involve mechanical cleaning of (CVD) reactors (scraping, blasting vacuum cleaning, ...)			EH	
Do the manipulations involve cleaning (CVD) reactors by wiping ?			EM	
Cleaning dust collection systems used to capture nanoparticles			EH	
Amounts involved				
Does the amount manipulated per experiment exceed 1g?			EM	
Is the amount manipulated per experiment less than 1g ?			EL	

AIR SAMPLING

- Bij “Likely” en “Potential “ risk band
- Condensation particle counters (1 portable toestel en 1 verplaatsbaar toestel)
- Eliminatie van de achtergrond door cleanroom
- Monitoring én karakterisatie (SEM,TEM)
- Video footage tijdens metingen, synchrone “time stamp”
- Conclusies bijzonder moeilijk



STATUS OF PARTICLE MEASUREMENTS

METHODOLOGY

- TS 3007 portable particle counter
- Actions of the operator are recorded

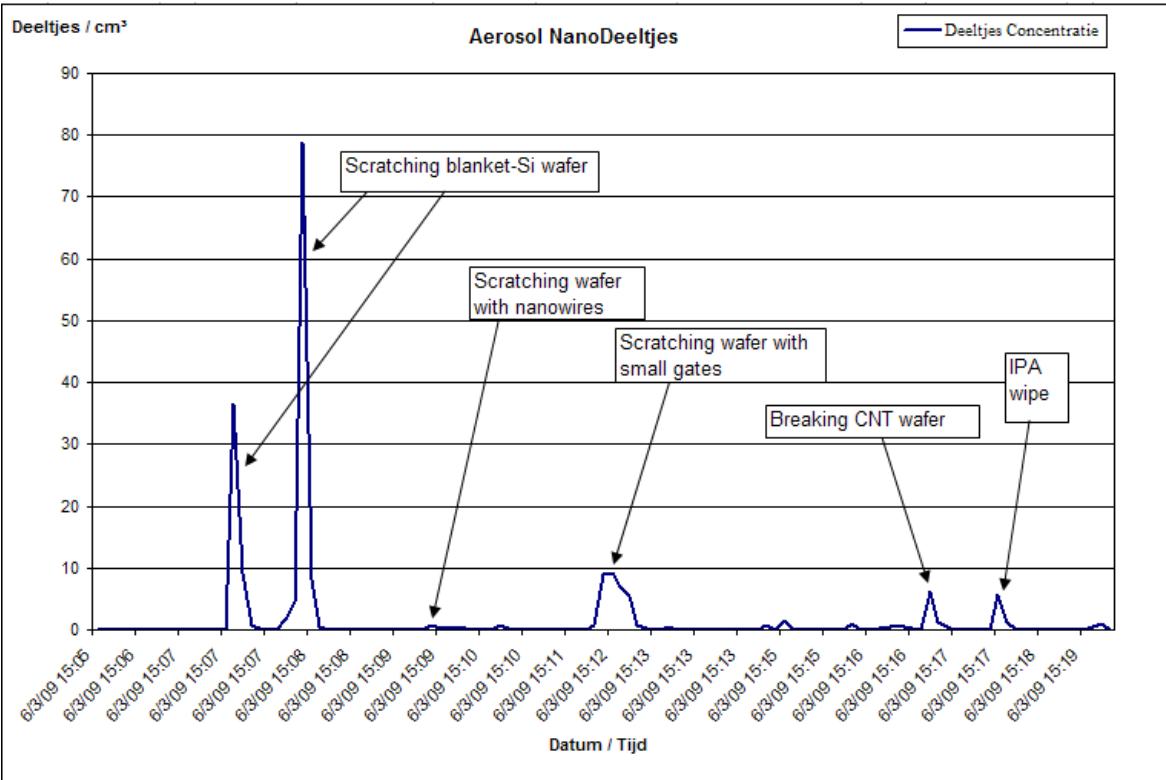
- Background – 1- 3 min
- Overall operations < 30 min
- 2nd background measurement

- Swab samples taken for XRF analysis (GWC)
 - Outer surface
 - Floor
 - Visible/suspected contamination
 - Inner surface of the door

Detectable diameter range: 10nm to > 1 µm



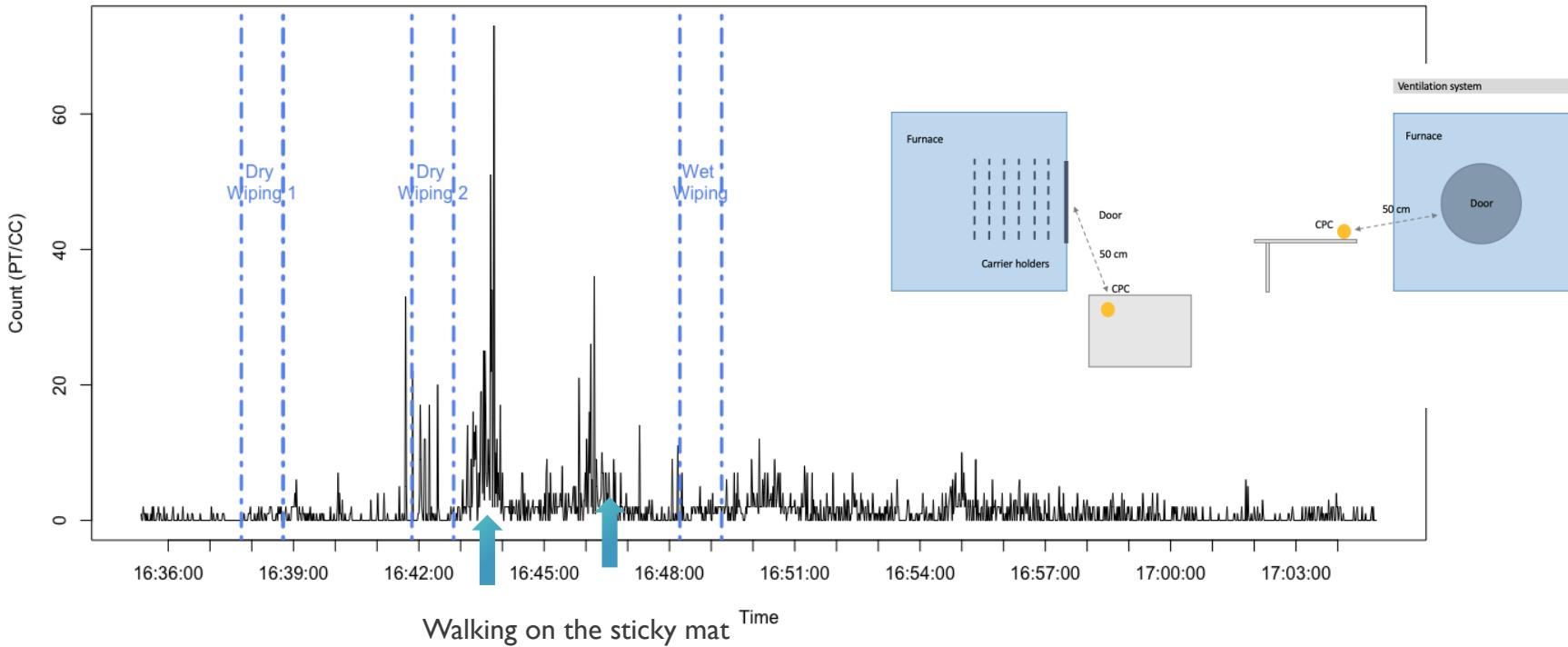
Plotting and statistical
analysis in R



WET VS DRY WIPING

AIR SAMPLING

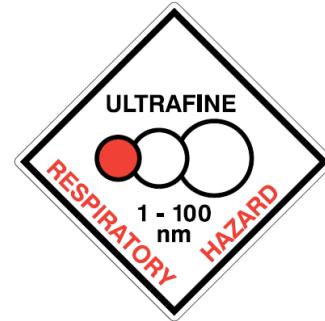
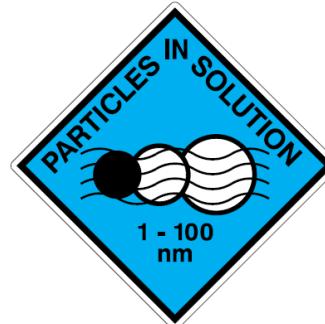
Overview of Veeco Furnace Wiping Trial 22/07/2019



PREVENTIEVE MAATREGELEN

COLLECTIEVE BESCHERMINGSMAATREGELEN

- Training (basic en advanced)
- Signposting en labeling
- Housekeeping : clean workbench



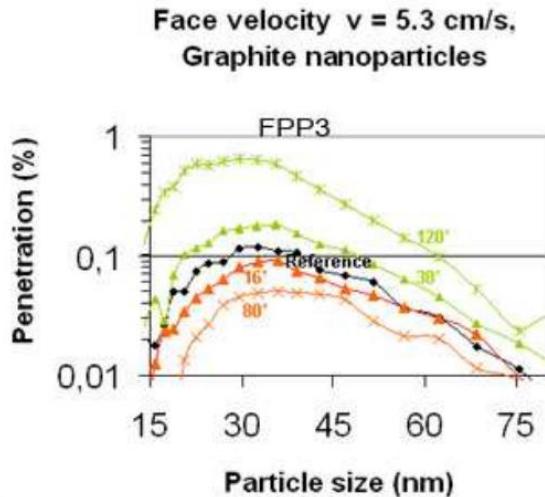
COLLECTIEVE BESCHERMINGSMAATREGELEN

- **Gesloten werkomgeving**
e.g. glove box
- **Geventileerde gesloten werkomgeving** (indien gesloten werkatmosfeer niet mogelijk)
e.g. biosafety cabinet
- **Gedeeltelijk gesloten werkomgeving met ventilatie** (indien voorgaande niet mogelijk)
e.g. fume hood, elephant trunk, wetbench



INDIVIDUELE BESCHERMINGSMAATREGELEN

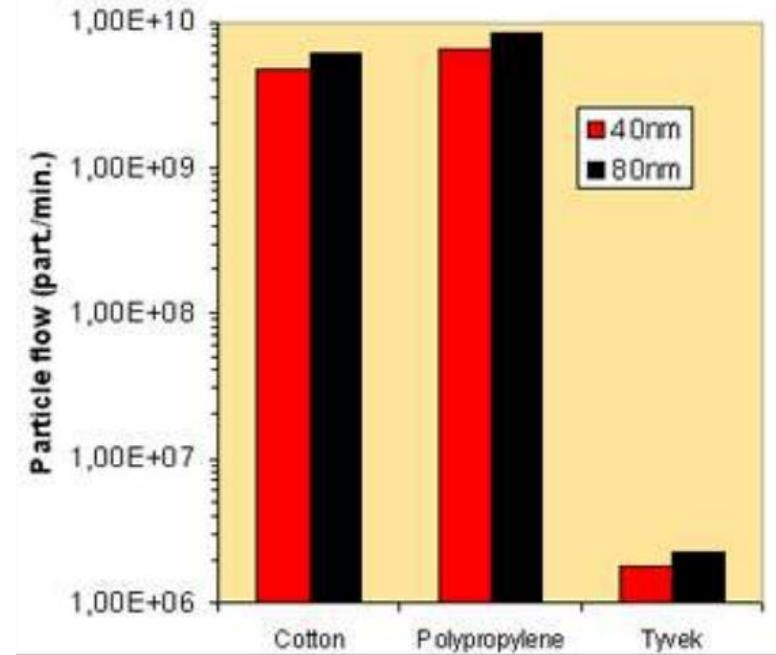
- FFP3 – maskers (geen volledige bescherming)



- SCBA (zware ergonomische belasting)

INDIVIDUELE BESCHERMINGSMAATREGELEN

- Tyvek pak en handschoenen



VERZENDEN VAN NANO MATERIAAL

UN 2811



**Nanomaterials
Not for Office Delivery**



CONCLUSIES

- Zeer moeilijk om nano-toxicologische eigenschappen te bekomen (REACH)
- Risico analyse (banding) dient te gebeuren door EHS expert
- Regelmatisch criteria voor hazard banding herbekijken ifv. meetresultaten (vacuum cleaning)
- Metingen door externe labo's bevestigen steeds bedrijfsinterne metingen
- Opleiding en sensibilisering van personeel absoluut noodzakelijk (online)