Measurement of dustiness of bulk materials that contain or release nano-objects or submicrometer particles and usage for mitigating exposure

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What is dustiness?

Dustiness

- Propensity of bulk material to release particles in response to mechanical stimulus

Conventional dustiness methods

- EN15051
- Health related dustiness mass fraction (e.g. respirable, thoracic, inhalable) expressed in mg/kg
- Rotating drum and Continuous drop - Accepted standards for micrometer-size particles

New Measurands:

- Can dustiness of powders containing nanoparticles be adequately characterised by their mass fraction only?
- N/mg; m^2/mg, size-distribution data?

CEN mandate work – Pre-normative research

- Absence of a harmonized approach limits use of dustiness methods
- Five European Standards developed by CEN/TC 137 WG3 committee members:
  - Measurement of dustiness of bulk materials that contain or release nano-objects or submicrometer particles – Part 1 to 5: General guidance and requirements; Rotating drum method; Continuous drop method; Small rotating drum method; Vortex shaker method.
- In support, pre-normative research conducted by CIOP-PIB (Poland), HSL (UK), IGF (Germany), INRS (France), NRCWE (Denmark), TNO (Netherlands) and under the lead of INRS to:
  - Develop and test a harmonized approach for measuring dustiness for bulk materials
  - Assess the repeatability and reproducibility for a given test method

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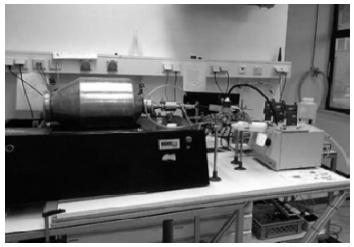
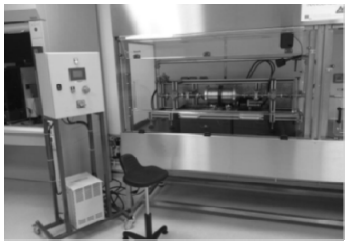
CEN mandate work - Pre-normative research

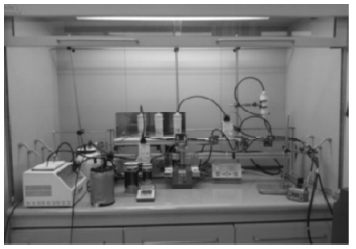


Rotating drum (RD)

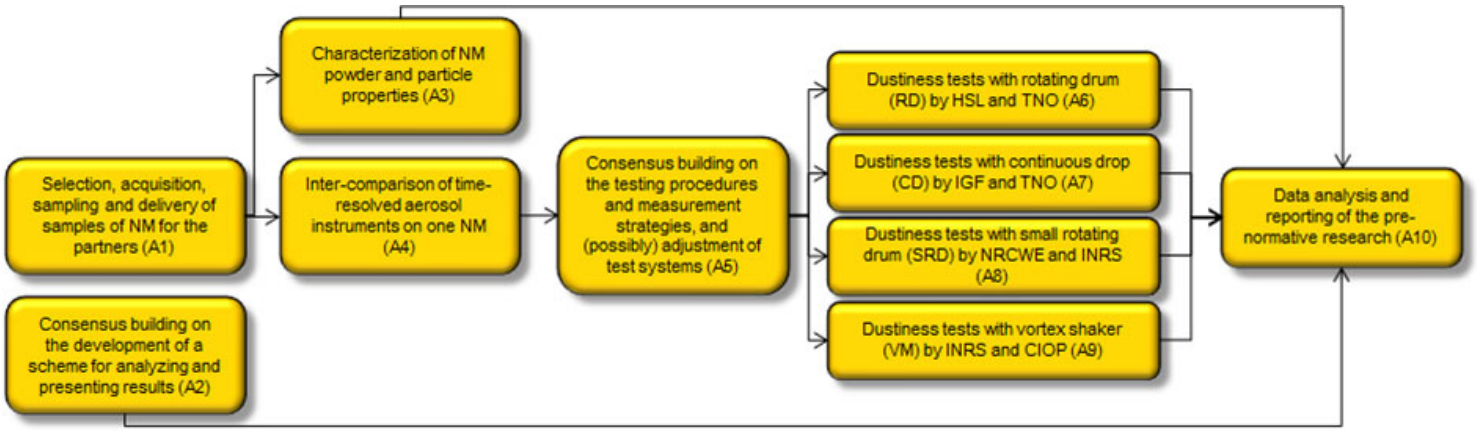
Continuous drop (CD)



Small rotating drum (SRD)



Vortex shaker (VS)



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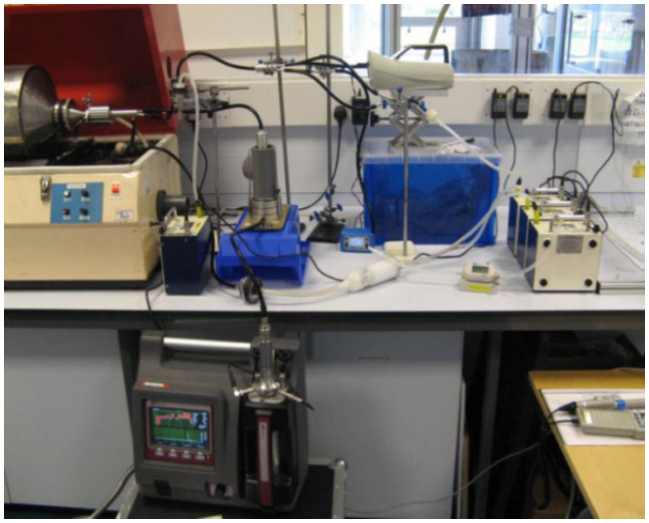
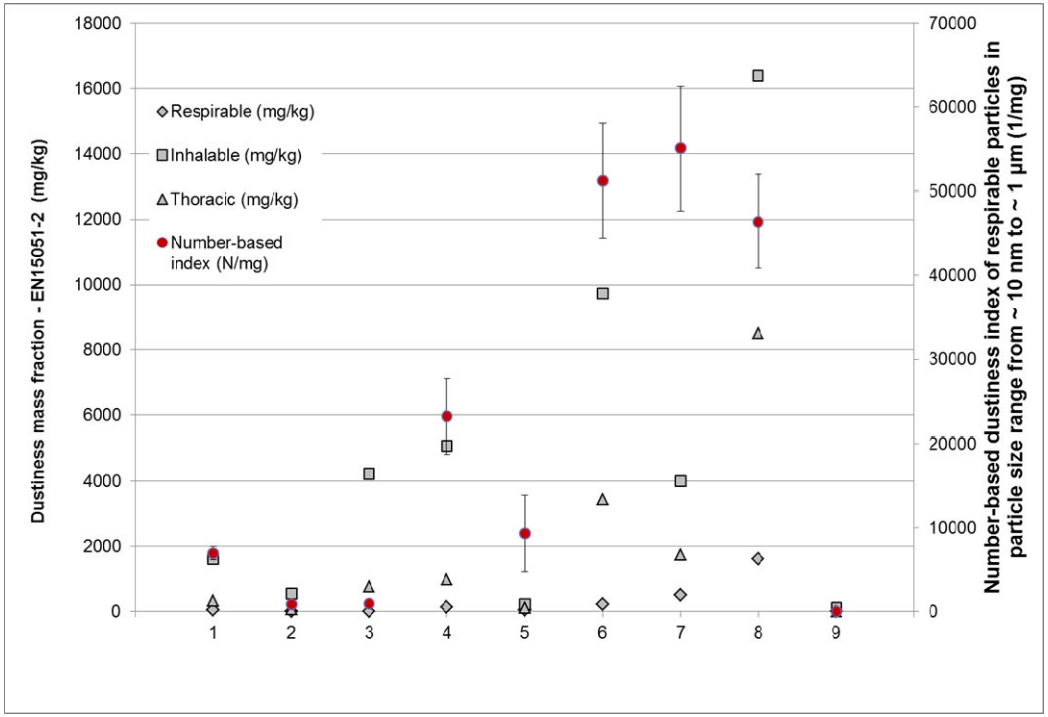
CEN mandate work - Pre-normative research - Rotating drum (HSL / TNO)



- Respirable, thoracic and inhalable dustiness mass fraction (mg/kg): Separate testing (EN 15051-1 and EN 15051-2)
- Number-based dustiness index of respirable particles in particle size range from ~ 10 nm to ~ 1 µm (1/mg)
- Number-based average emission rate of respirable particles in particle size range from ~ 10 nm to ~ 1 µm (1/mg·s)
- Number-based particle size distribution as d*N*/dlog*d*i
- Morphological and chemical characterization of the particles including NOAA

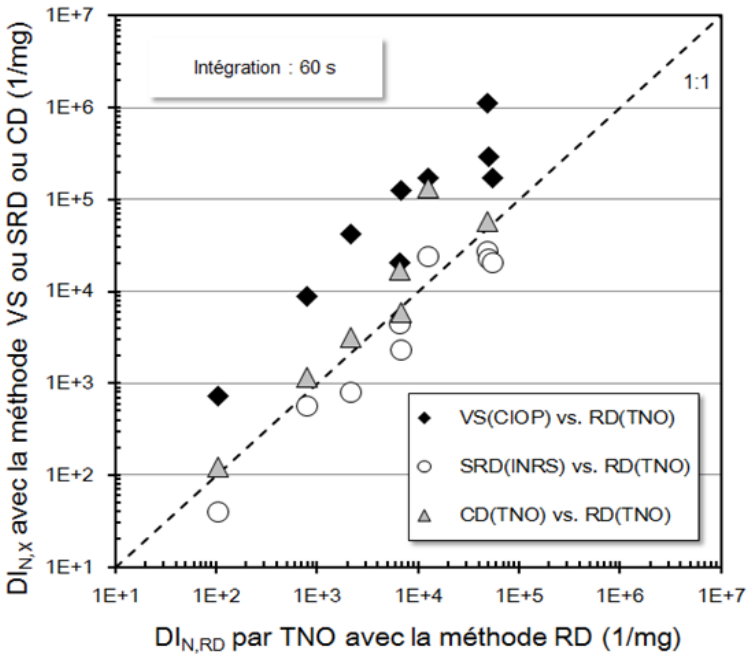
CEN mandate work - Pre-normative research - Rotating drum (HSL / TNO)

- Dustiness mass fraction (mg/kg) (EN15051-2) and Number based dustiness index (N/mg)



	Manufacturer primary size (nm)	Manufacturer SSA (m^2/mg)
TiO_2 (1)	~ 5-10	350
TiO_2 (2)	~ 15-25	90
TiO_2 (3)	21	50
$CaCO_3$ - Surface modified for printing ink (1)	15-40	>40
$CaCO_3$ (2)	15-40	Not specified
SiO_2	31	~300
$BaSO_4$ (1)	~37	40
$BaSO_4$ (2)	~37	40
TiO_2 (4)	~ 200	9

CEN mandate work – Pre-normative research



- Comparaison of number-based dustiness indices for a dustiness method X in relation to rotating drum:
  - Methods are not correlated.
  - VS provides significantly greater number of dustiness indices than other methods
  - VS method uses more energy (vibration)

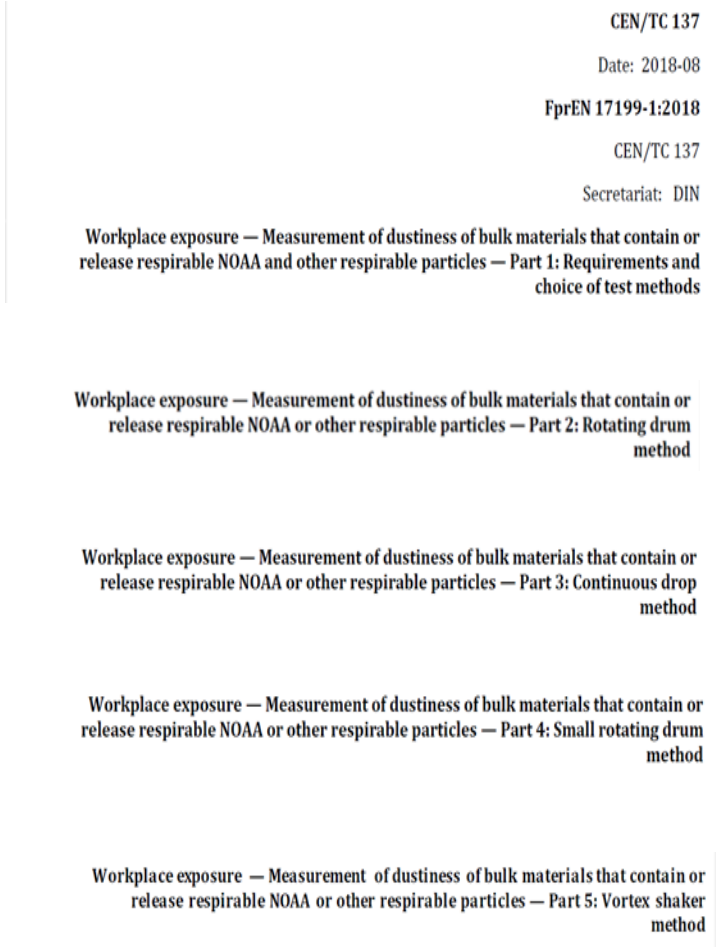
- ELPI / ELPI+ particle size distribution:
  - In general, monomodal distribution observed
  - In some cases, bimodal distributions observed
  - Highest aerodynamic equivalent diameter mode between ~ 1 µm and ~ 2.5 µm
  - Four methods produce aerosols of similar particle size

Dustiness and risk assessment

- Important determinant for worker exposure
- Used to rank bulk materials / powders
- Requested input parameter in control banding tools to evaluate and control the risk of exposure to nanomaterials in powder form
- Data have been recommended for nanomaterials exposure assessment by the OECD
- Starts to be of use in risk assessments

Conclusion

- Harmonised dustiness test methods - Important step for dustiness to be used in risk assessment
- New measurands proposed
- Rotating drum: good repeatability and reproducibility for new measurands (e.g. number based dustiness index, particle size distribution)
- Dustiness mass fraction (respirable, thoracic and inhalable) relevant for nanomaterials
- Five parts standards to be published in 2019 (CEN TC 137 WG3)



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Workplace exposure — Measurement of dustiness of bulk materials that contain or release respirable NOAA and other respirable particles — Part 1: Requirements and choice of test methods

Workplace exposure — Measurement of dustiness of bulk materials that contain or release respirable NOAA or other respirable particles — Part 2: Rotating drum method

Workplace exposure — Measurement of dustiness of bulk materials that contain or release respirable NOAA or other respirable particles — Part 3: Continuous drop method

Workplace exposure — Measurement of dustiness of bulk materials that contain or release respirable NOAA or other respirable particles — Part 4: Small rotating drum method

Workplace exposure — Measurement of dustiness of bulk materials that contain or release respirable NOAA or other respirable particles — Part 5: Vortex shaker method

Thank you for listening

Questions?

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