TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Mechanical Engineering Institute of Process Engineering and Environmental Technology Research Group Mechanical Process Engineering

Quantification of nanoparticle releases

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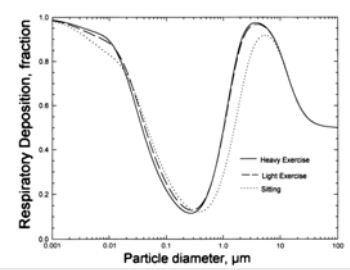
Motivation and Challenges

- ensure nanoparticle application
- safeguard health protection
- avoid environmental pollution

The fraction of particle matter deposited in the lung depends on particle size [1].

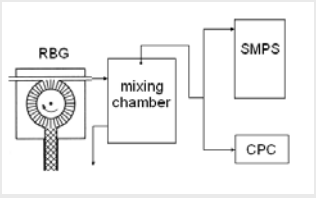


Measuring method – demands and solutions

- reasonable release energy → Dispersing shear stress typical for usage
- reasonable weighting of particle size fractions → Counting the number of released particles of a size range (nano-particles, submicron particles)
- accessible results → relate this number to the applied sample mass (=release rate)
  - Conversion into the concentration of a model-room

Maximum dispersing from powders

The number of releasable particles per sample mass depends on the dispersing intensity applied on the sample. To underline this, two different dispersing methods have been compared.

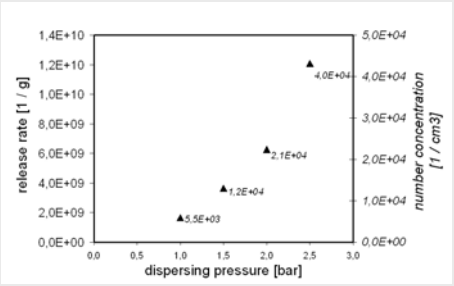


Experimental setup for maximal dispersing ("Worst case")

RBG ... Rotating-brush-generator
SMPS ... Scanning mobility particle sizer
CPC ... Condensation particle counter

The concentration in the mixing chamber was measured by SMPS and CPC. From this results the number of particles < 100 nm was calculated and related to the sample mass.
This gives the **release rate** of particles.

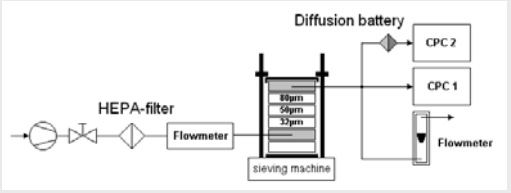
To interpret the release rate, the **number concentration in a model-room** (10 m2 floor area, 3 m high) was estimated if 100g of the sample would be dispersed [2].



release rate model-room concentration

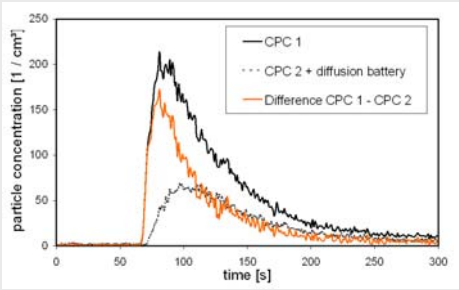
Practical relevant dispersing from powders

As a example for the practical handling of particle systems in industrial processes light bagging and conveying a sieving machine was used to disperse the sample.



Experimental setup for practical relevant dispersing using a sieving machine

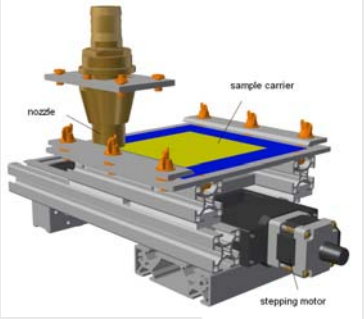
The sieving machine was an example for typical handling.
The number concentration was recorded by two CPCs.
One of this devices was equipped with a diffusion battery to distinguish between particles smaller and bigger than 100 nm.



release rate: $1.46 \cdot 10^5 \frac{1}{g}$ model-room concentration: $0.49 \frac{p}{cm^3}$

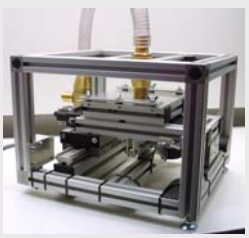
Practical relevant release from surfaces

Test rig

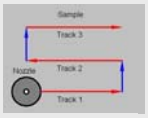


Under the nozzle, a sample can be moved in two directions.

The objective of the experimental investigations was to quantify the release of particles from fabrics coated with particle layers. A test rig was developed, consisting of a sample carrier and a shiftable nozzle.

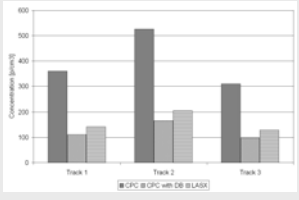


technical data	
nozzle diameter	5 mm
flow velocity	14,1 m/s
sample size	150 x 150 mm
sample feed rate	1 – 6 mm/s

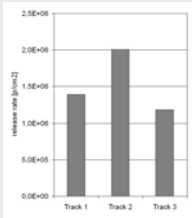


The diameter of the nozzle is larger than the dimension of the fiber under consideration but small enough to reach high shear stresses at low flow rates.

Results



From the differences between the number concentration of both particle counters the release rate of particles < 100 nm can be calculated.



Release rate of particles determined by two CPCs, one equipped with a diffusion battery.

[1] Aerosol technology, W. C. Hinds, Wiley 1999.
[2] Reinraumtechnik, L. Gail, H. Hortig, Springer-Verlag 2002

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