WORKING FOR A HEALTHY FUTURE

Relationship between dustiness/ viscosity and dermal exposure in deposition

Een studie ter ondersteuning van Dermal ART

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Stan de Poot

Hoofdvakstage Occupational and Environmental Health

Achtergrond

- REACH
- Modellen
- Inhalatoire blootstelling: Advanced REACH Tool (ART)
- Dermal ART
  - Conceptueel model (dermale blootstelling)
  - Mechanistisch model (Dermal ART)
  - **Knowledge gaps**
- Dermal Transfer Project

Doelstelling

- Onderzoeken van de relatie tussen:
  - **Stoffigheid** van een vaste stof en **dermale blootstelling**
  - **Viscositeit** van een vloeistof en **dermale blootstelling**

  - In:
    - Immersie
    - Oppervlakte contact
    - **Depositie**

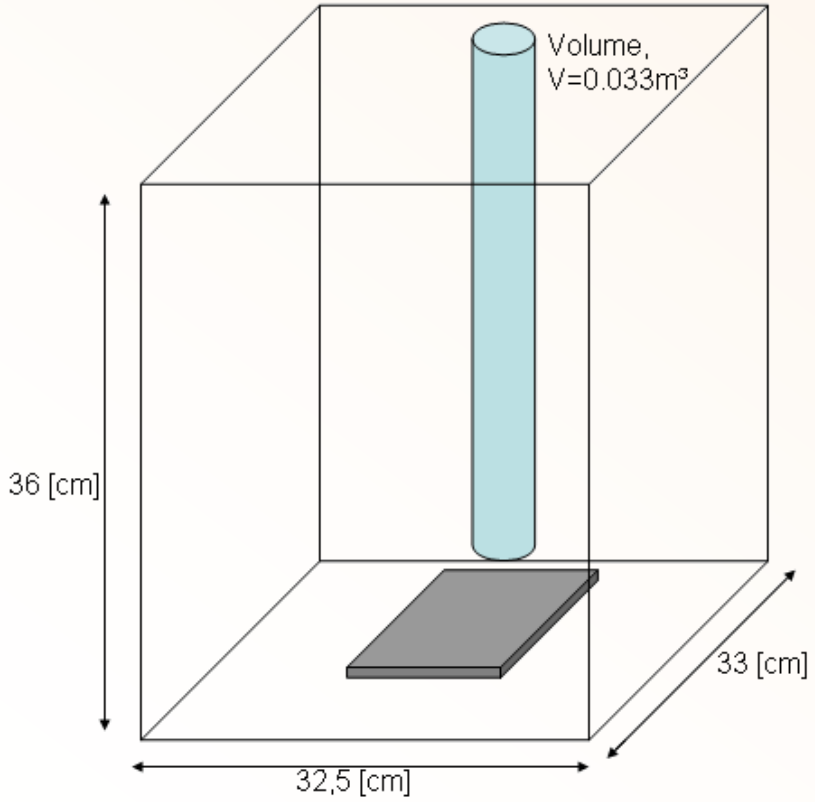
Methoden

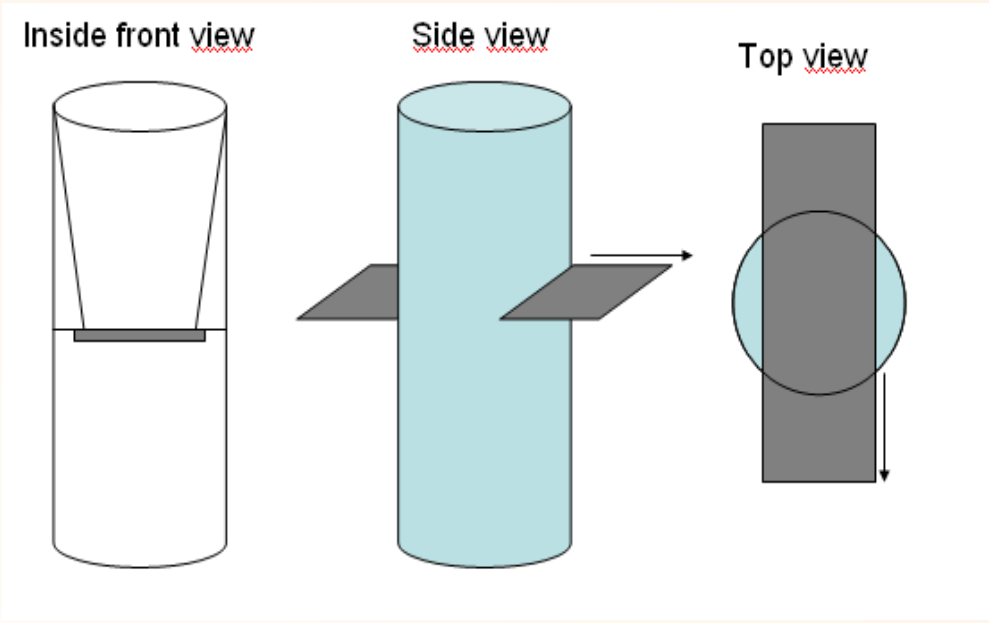
- Blootstellingsproeven:
  - Vrijwilliger (N=4)
  - Handen blootgesteld
    - Poeder: Hoge *vs* lage stoffigheid
    - Vloeistof: Verschillende viscositeit
  - Meten van blootstelling binnen in de box
  - Meten van dermale belading (vegen versus wassen, vegen versus katoenen handschoen)

- Stoffen:
  - Magnesiumsulfaat (laag), zinkoxide (laag) *vs* calciumacetaat (hoog)
  - Glycerine 20%, 50%, 87%

Methoden

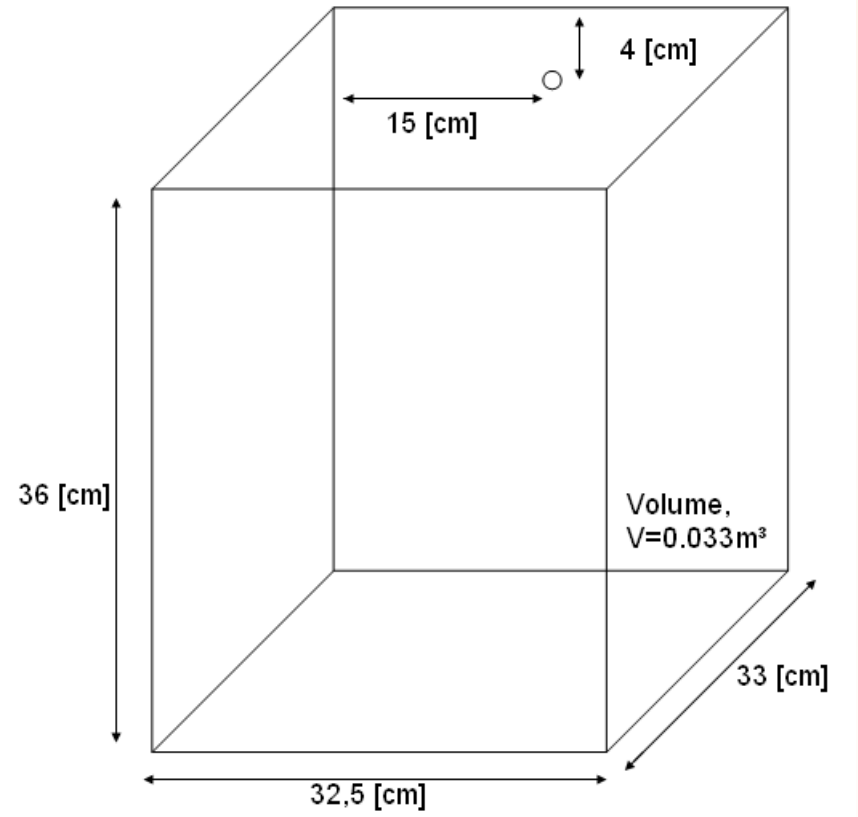
- Depositiebox voor vaste stof:



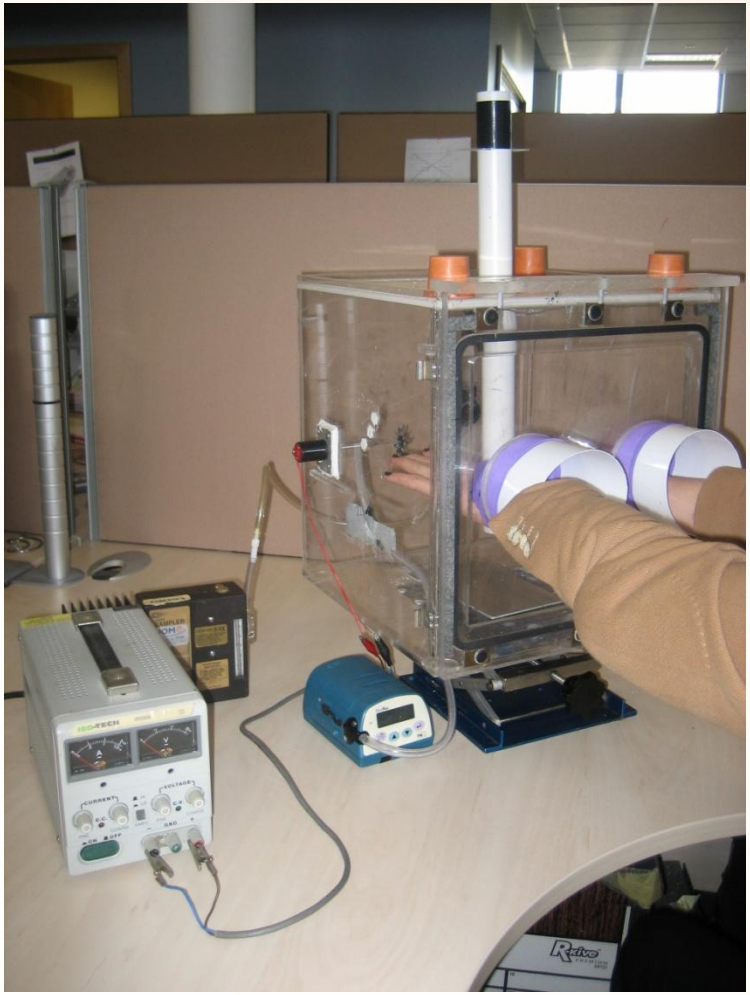


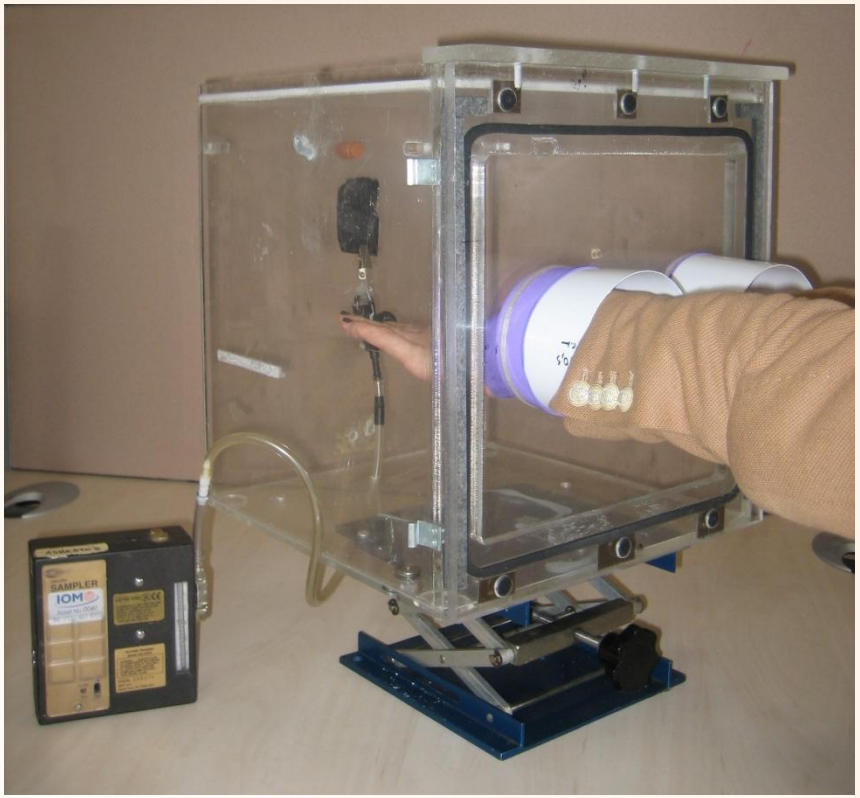
Methoden

- Depositiebox voor vloeistof:



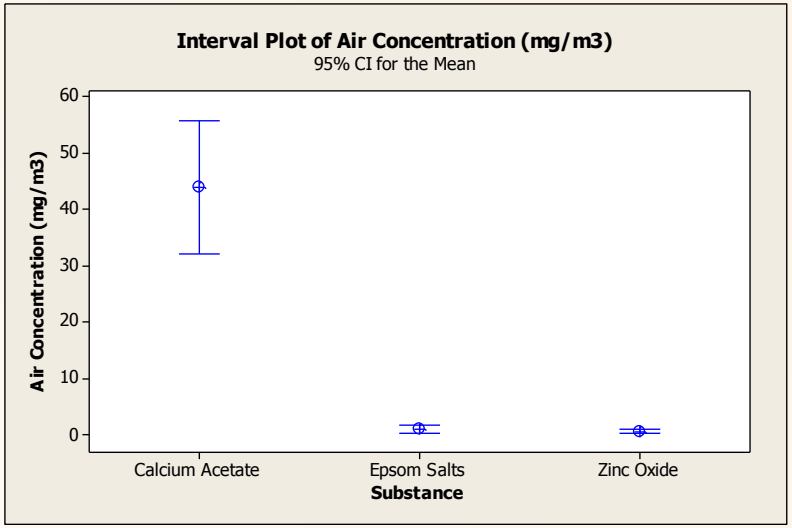
Methoden





Resultaten

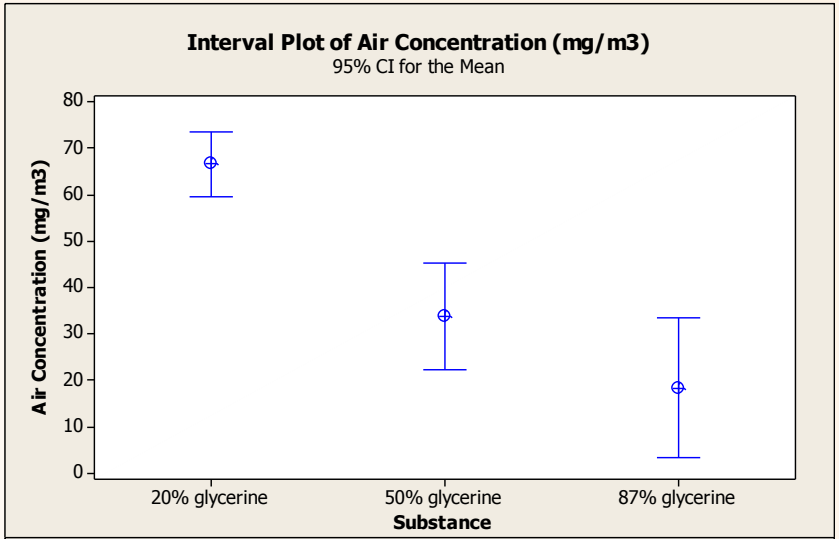
- **Stoffigheid**:
  - Concentratie in de lucht
  - Dermale belading

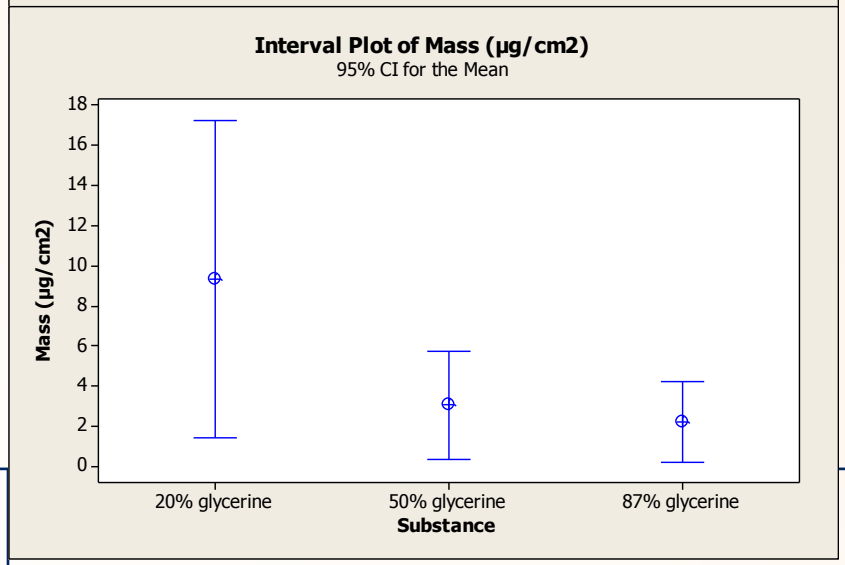


Stof	Techniek	**% Detecteerbaar**	Range (mg)
	Wassen	**100**	0.02 - 4.65
Calciumacetaat	Vegen	**50**	<0.03 - 1.24
	Wassen	**25**	<0.01 - 0.02
Zinkoxide	Vegen	**0**	<0.16
	Wassen	**25**	<0.01 - 0.07
Magnesiumsulfaat	Vegen	**0**	<0.1

Resultaten

- **Viscositeit**:
  - Concentratie in de lucht
  - Dermale belading

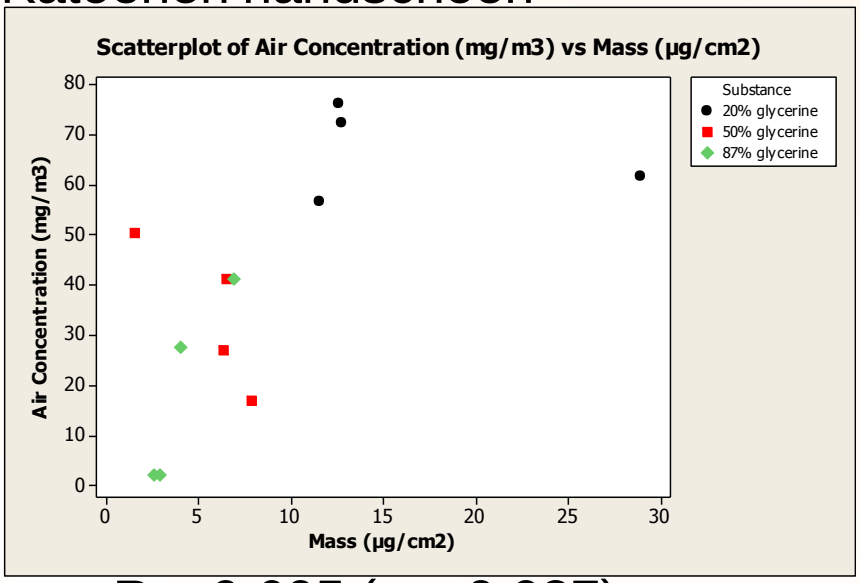




Resultaten

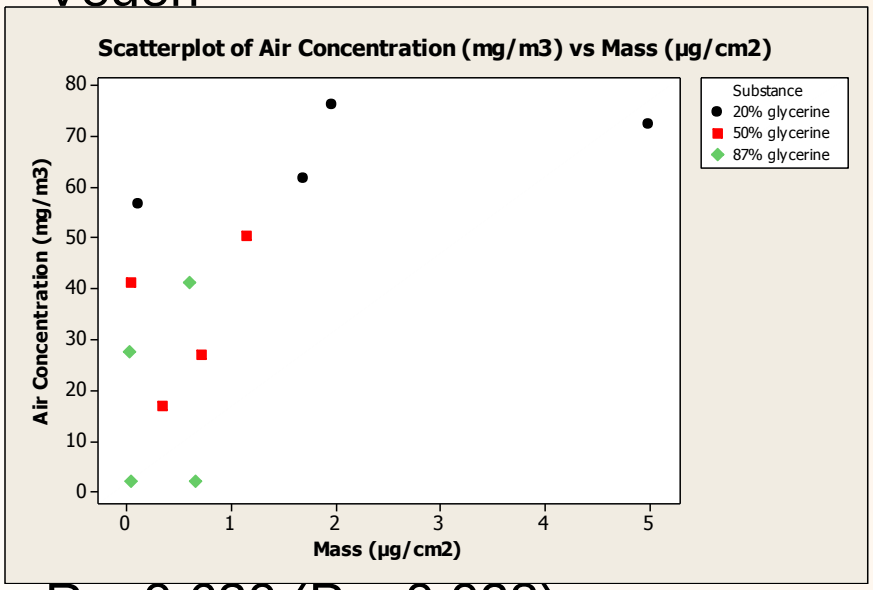
- **Viscositeit**:
  - Concentratie in de lucht *vs* dermale belading

Katoenen handschoen



R = 0.605 (p = 0.037)

Vegen



R = 0.630 (P = 0.028)

Discussie

- Conclusie:
  - Positieve relatie stoffigheid en concentratie in de lucht, waarschijnlijk ook met dermale belading
  - Negatieve relatie viscositeit en concentratie in de lucht, waarschijnlijk ook met dermale belading

- Kracht:
  - Systematische vergelijking van de dermale belading met:
    - Gestandardiseerde blootstelling
    - Gestandardiseerde meetmethoden
    - Gecontroleerde omgeving
  - Voorziet experimentele data voor Dermal ART

Discussie

- Beperkingen:
  - Stoffigheid
    - Drie verschillende materialen
    - Kwalitatief in plaats van kwantitatief

- Grootste doel werd ontwikkelen en standaardiseren van methode
  - Selecteren stoffen
  - Meten stoffigheid
  - Testen methodes

Discussie

- Stoffigheid *vs* viscositeit:
  - Meetbaarheid
  - Creëren van verschillende levels
  - Beïnvloedende factoren

- Subjectieve classificatie stoffigheid
  - Foute classificatie, foute evaluatie
  - Stoffigheid is meer dan alleen de grootte van de partikels

Subjectieve stoffigheid classificatie

Category	Description	Relative score
Firm granules, flakes, pellets or solid objects	Product does not result in dust emission without intentional breakage of products: e.g. firm polymer granules, granules covered with a layer of wax, a woodblock, a brick.	0.01
Granules, flakes or pellets	Granules or flakes may fall apart and crumble, resulting in only a very limited amount of fine particles. Handling the product does not result in a visible dust cloud; e.g. fertilizer, garden peat, animal pellets.	0.03
Coarse dust	A powdered product containing coarse particles. Handling the product in its dry form results in a dust cloud that settles quickly due to gravity: e.g. sand.	0.1
Fine dust	A powdered product containing fine particles. This category may also contain products with a mixture of fine particles and large particles or granules. Handling the product in its dry form results in a dust cloud that is clearly visible for some time: e.g. talcum powder, carbon black.	0.3
Extremely fine and light powder	A powdered product containing very fine, free flowing, light particles. This category may also contain products with a mixture of very fine particles and large particles or granules. Handling the product in its dry form results in a dust cloud that remains airborne for a long time. The product may be windswept: e.g. magnesium stearate.	1.0

- Gemiddelde relatieve score
  - $MgSO_4$: 0.025
  - ZnO: 0.39
  - $Ca(C_2H_3O_2)_2$: 0.58

(Fransman *et al* 2009)

Stan de Poot

Tel: 0642234601

e-mail: swdepoot@live.nl

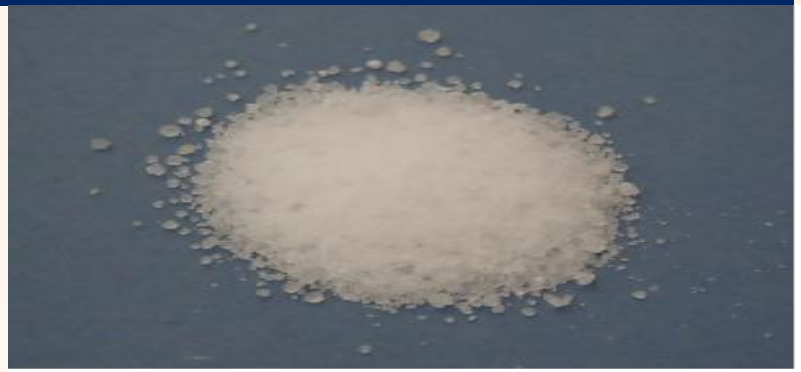
Dismissed substances

- Metals
  - Explosive
- Metal oxides
  - Oxidized status: nano
- Sugars
  - Explosive
- Salts (NaCl, KCl, MgCl)
  - High background, reaction with water

- Eventually: Combination of substances

Test substances (dustiness)

- $MgSO_4$
  - Coarse salt
- ZnO
  - Dense, compact
  - Coagulation
- $Ca(C_2H_3O_2)_2$
  - Light powder
  - Fluffy



Power calculation

- Scenario:

Body Part	Exposure (mg)				
	N	Range	AM	GM	GSD
Hands	5	0.000 - 0.06	0.036	0.042	1.605

- Assumed that amount is analysed on log scale;

Mean = -1.376 and SD= 0.2054

Sample size	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Standard error	0.145293	0.118631	**0.102738**	0.091891	0.083885	0.077662	0.072646

(Christopher *et al* 2008)

Standardizing spraying amounts

- To keep the amount of liquid sprayed constant, duration has to be adjusted:

	Duration	Amount sprayed
20% Gl.	2 sec	44 mg
50% Gl.	3 sec	43 mg
87% Gl.	27 sec	43 mg

Correction of data

- Data analysis:
  - Correction for:
    - Background/ blank error
    - Glycerine mass
    - Sampling efficiency
    - Hand surface
    - Skin moisture
  - Statistical testing:
    - Summary statistics
    - Scatter plots
    - ANOVA

Results(1)

- Particle Size Distribution
  - Aerosolised particles