

Eksponeringsvurdering og risikohåndtering ved brug af *control banding* og kvantitativ modellering

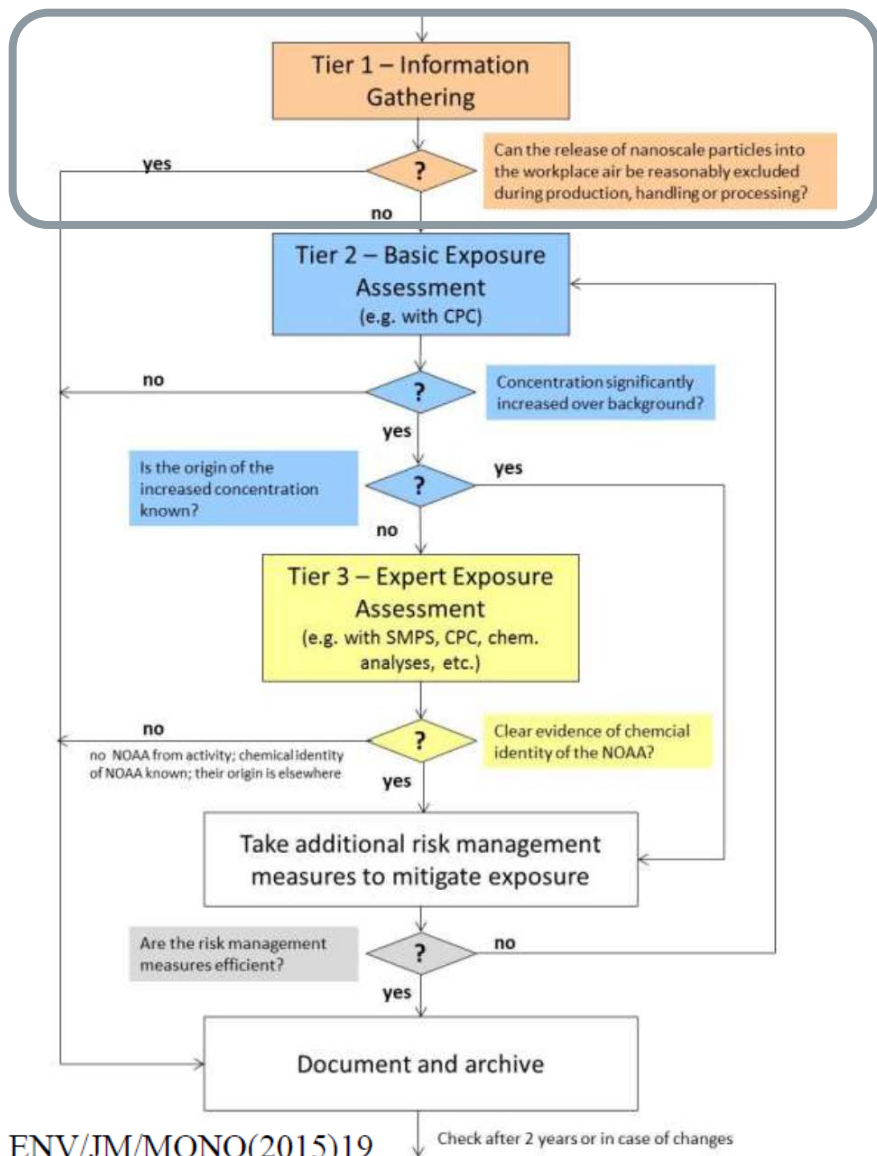
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DET NATIONALE
FORSKNINGSCENTER FOR ARBEJDSMILJØ

Eksponeringsvurdering (OECDs Trinvis tilgang)



Kan involvere control banding
eller beregninger vha. kvantitativ
modellering



Forside » Regler » At-vejledninger mv. » At-vejledning om arbejde med nanomaterialer

AtVEJLEDNING

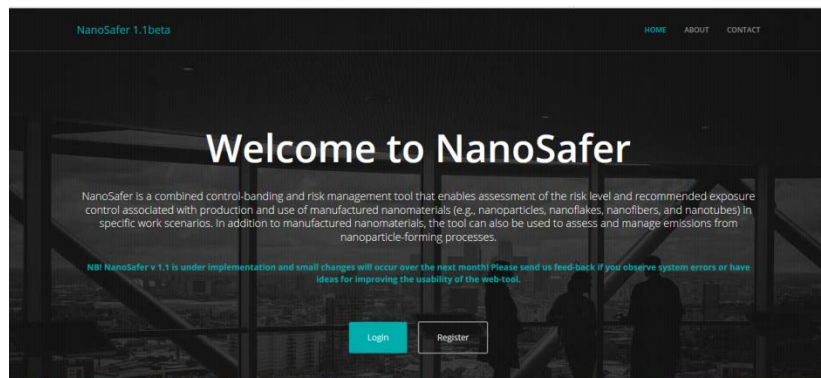
Arbejde med nanomaterialer

At-vejledning 9.3.1
November 2014

De vigtigste regler om forebyggelse af sundhedsfarlige påvirkninger ved arbejde med fremstillede nanomaterialer.

Vejledningen handler om en række af de krav, der stilles til forebyggelse af påvirkning fra arbejdet med fremstillede nanopartikler og nanomaterialer (herefter kaldet nanomaterialer), der kan udgøre en risiko for de ansattes sikkerhed og sundhed.

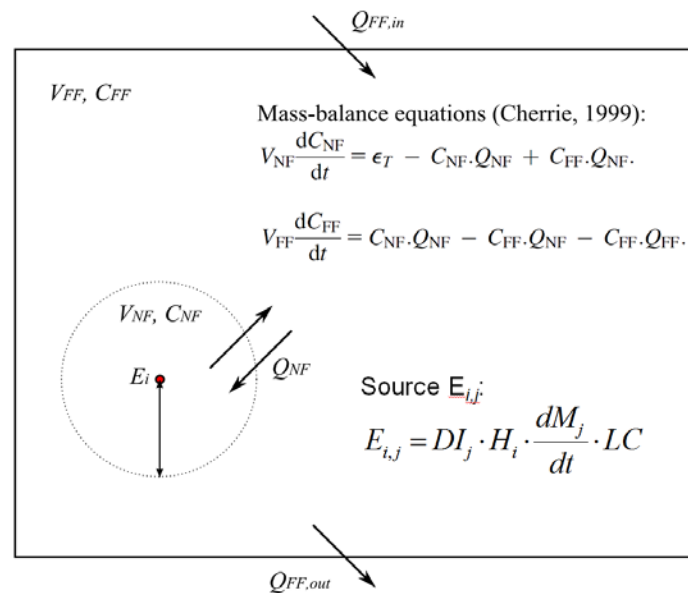
To eksempler på modellering og anvendelse af viden om værnemidlers effektivitet



Eksp. Score	Hazard = 0,75-1.0	Hazard 0.5 - 0.75	Hazard 0,25 - 0,5	Hazard < 0,25
$R^* > 1.0$				
$0.50 < R^* < 1.0$				
$0.25 < R^* < 0.50$				
$0.1 < R^* < 0.25$				
$R^* < 0.1$				

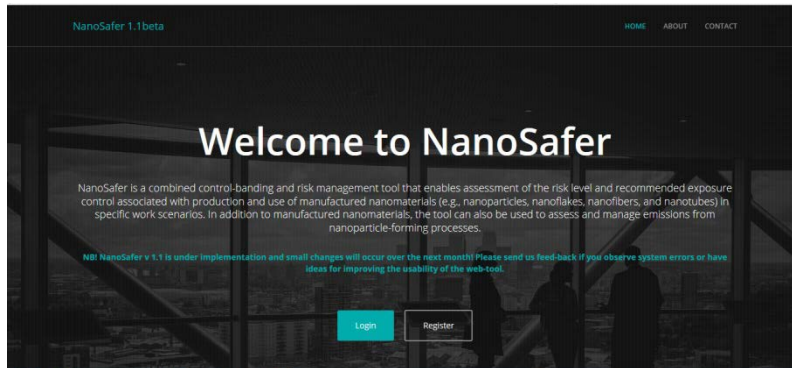


Risk Management Efficacy Library



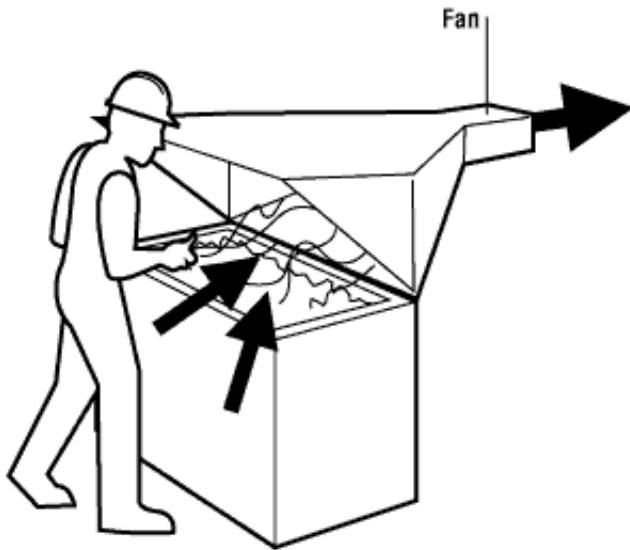
	C(NF)	C(FF)
min	0.0000	0.0000 mg/m3
max	0.2890	0.0876 mg/m3
15 min Peak	0.1564	0.0829 mg/m3
8-timers middel	0.1061	0.0618 mg/m3

Arbejdsscenario

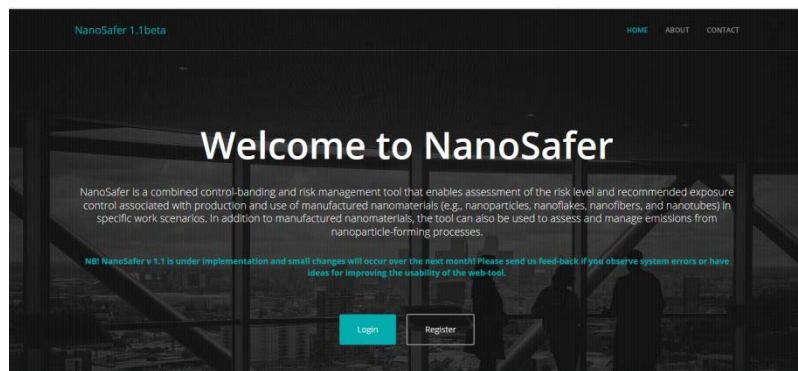


Process

- Iblanding 19 sække med nanoler á 10 kg
- 5 min per ihældning
- Åbent pulverfald (< 5 cm)
- 15 min mellem hver sæk
- Pause: 2 x 20 min, 1 x 30 min
- Arbejders NF område 2.3^3 m^3
- Rum er $2.3 \times 10 \times 10 \text{ m}^3$
- Støvtransport via 3 sider af NF box
- General ventilation 2 per time
- Støvfang som lokal udsug

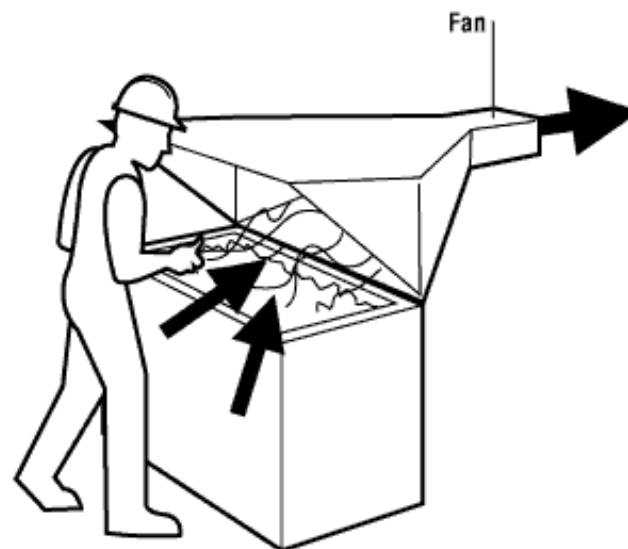


Materiale-information



Organoclay (Nanofil®5)

- Specific surface area: $20 \text{ m}^2/\text{g}$
- Relative density: 2.1 g/cm^3
- Flake ($2 \text{ nm} \times 0.5 \text{ }\mu\text{m} \times 1 \text{ }\mu\text{m}$)
- Coated: ja
- Nano OEL: Nej
- OEL bulk: 5 mg/m^3
- Ingen R sætninger
- Dustiness: 187.5 g/kg



Vurdering med NanoSafer CB v. 1.1

(www.nanosafer.org)

Tox

Score: 0.56

It is recommended to apply an engineered protection equipment with a protection factor of **19.79 (94.9%)** or higher [Go to the ECEL Library for possible solutions](#)

Near-field

Acute: 1.37066

RL5: Very high toxicity suspected and/or moderate to very high exposure. The work should be conducted under strict dust release control, such as in a fume-hood, separate enclosure etc. Air-supplied respirators or highly efficient filter masks (PP3 or higher quality) may be used as a supplement and must be readily available in case of accidents. Expert advice is recommended.

Near-field

Daily: 1.97886

RL5: Very high toxicity suspected and/or moderate to very high exposure. The work should be conducted under strict dust release control, such as in a fume-hood, separate enclosure etc. Air-supplied respirators or highly efficient filter masks (PP3 or higher quality) may be used as a supplement and must be readily available in case of accidents. Expert advice is recommended.

Far-field

Acute: 0.69938

RL5: Very high toxicity suspected and/or moderate to very high exposure. The work should be conducted under strict dust release control, such as in a fume-hood, separate enclosure etc. Air-supplied respirators or highly efficient filter masks (PP3 or higher quality) may be used as a supplement and must be readily available in case of accidents. Expert advice is recommended.

Far-field

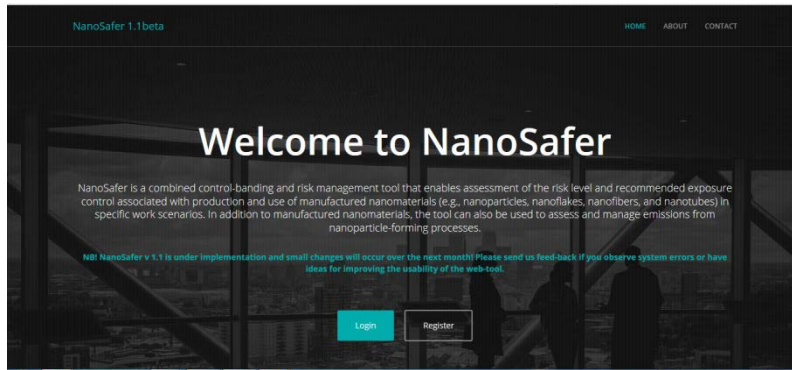
Daily: 1.16703

RL5: Very high toxicity suspected and/or moderate to very high exposure. The work should be conducted under strict dust release control, such as in a fume-hood, separate enclosure etc. Air-supplied respirators or highly efficient filter masks (PP3 or higher quality) may be used as a supplement and must be readily available in case of accidents. Expert advice is recommended.

Foreslåede typer af tekniske foranstaltninger med fuldt ud anbefalet beskyttelsesniveau

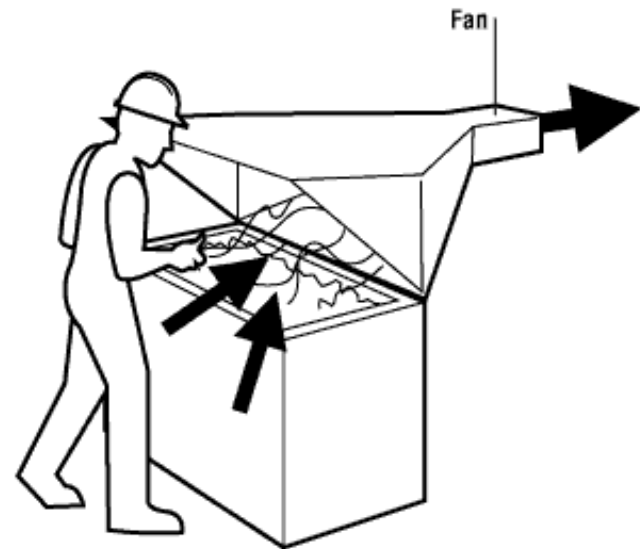
Control sub-class*	ART value	ECEL ^		Nano data analysis&		Proposed value		
		%	95% CI (%)	AvEffect %	Min-Max	%	Lower	Upper
Containment - no extraction	-	-	-	-	-	-	-	-
- Medium	99	(86)	(30 – 97)	(99.89)	(99.3 – 99.999)	95	70	99
- High	99.9	(86)	(30 – 97)	(99.89)	(99.3 – 99.999)	99.9	90	99.99
Glove bag	-	-	-	-	-	-	-	-
- Glove bag (non-ventilated)	99	-	-	-	-	99	90	99.9
- Glove bag (ventilated or kept under negative pressure)	99.9	-	-	-	-	99.9	95	99.99
Glove box	-	-	-	-	-	-	-	-
- Low specification glove box	99.9	-	-	97	(n=2)	99.9	95	99.95
- Medium specification glove box	99.97	-	-	-	-	99.97	98	99.99
- High specification glove box	99.99	-	-	-	-	99.99	99	9 100
Downward laminar flow booth); dusts/mists	-	-	-	-	-	-	-	-
- Downward laminar flow booth, full screen with glove ports	99	-	-	-	-	99	85	99.9
Downward laminar flow booth); vapours/gases/fumes	-	-	-	-	-	-	-	-
- Downward laminar flow booth; full screen with glove ports	98.5	-	-	-	-	98.5	85	99.9

Kvantitativ vurdering med 2-boks model

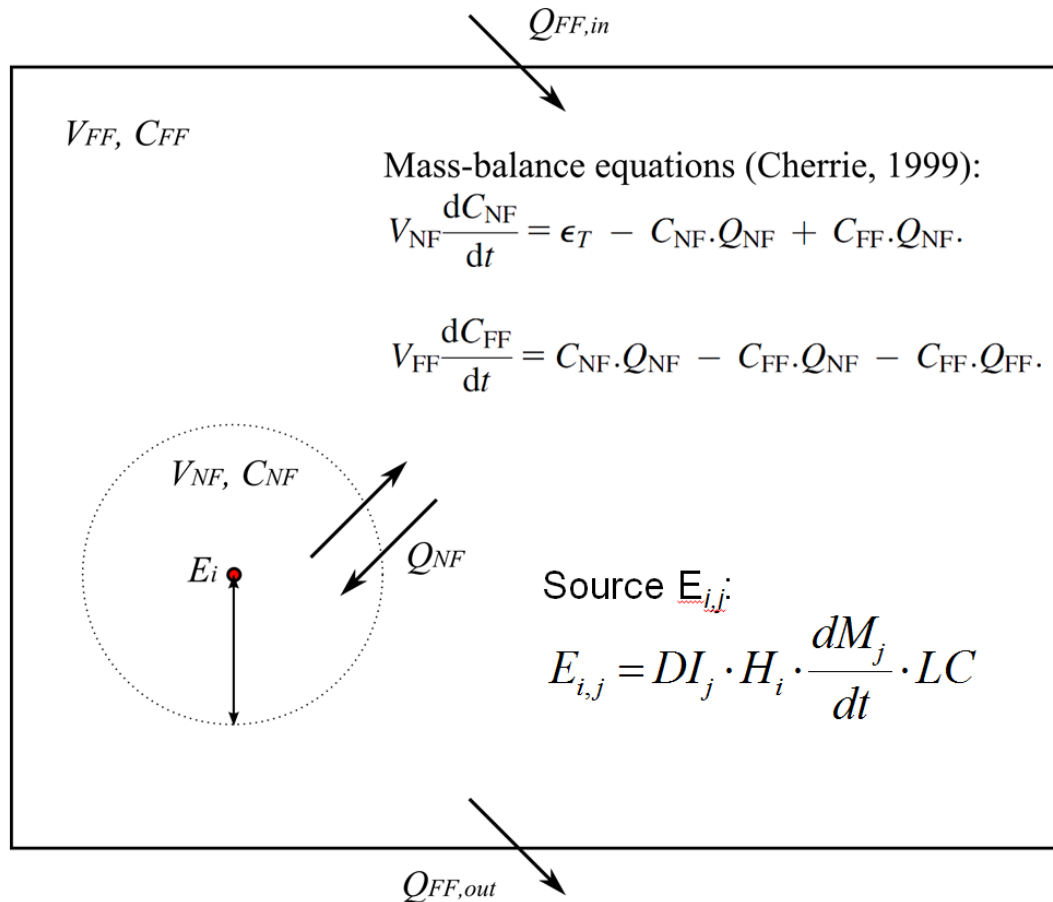


Organoclay (Nanofil®5)

- Specific surface area: 20 m^3
- Relative density: 2.1 g/cm^3
- Flake ($2 \text{ nm} \times 0.5 \text{ }\mu\text{m} \times 1 \text{ }\mu\text{m}$)
- Coated: ja
- **Target nanoOEL: 0.35 mg/m^3**
- OEL bulk: 5 mg/m^3
- Ingen R sætninger
- Dustiness: 187.5 g/kg



“Two-box” Model med Teknisk Foranstaltning



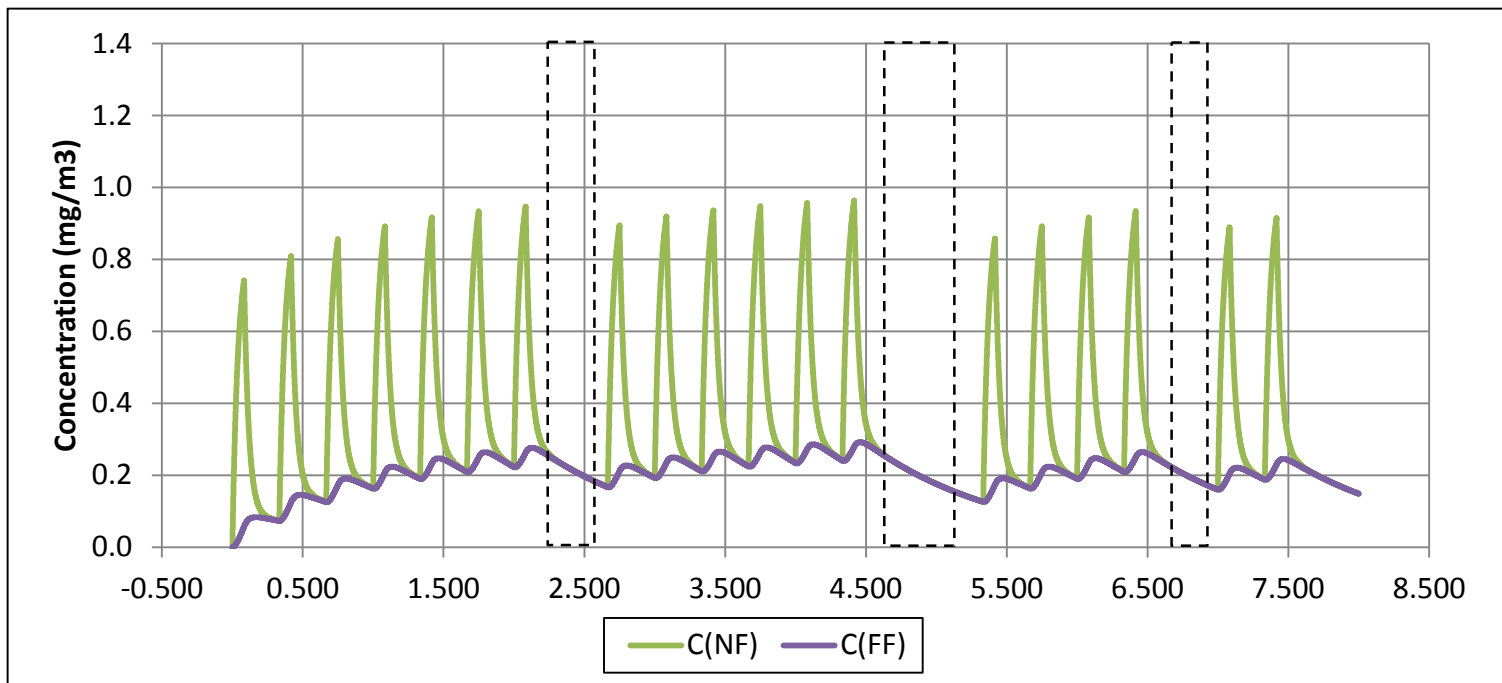
Parameters:

$Q_{FF,in}$ = Incoming ventilation air flow
 $Q_{FF,out}$ = Exhaust ventilation air flow
 V_{NF} = Near field volume
 V_{FF} = Far field volume
 C_{NF} = Near field concentration
 C_{FF} = Far field concentration
 t = Time
 E_i (or ϵ_T) = Emission source

Emission source parameters:

DI_j = Dustiness of material j
 H_i = Handling energy factor of process i
 M_j = Mass of material j
 LC = Localized controls

Estimeret luftkoncentration uden emfang

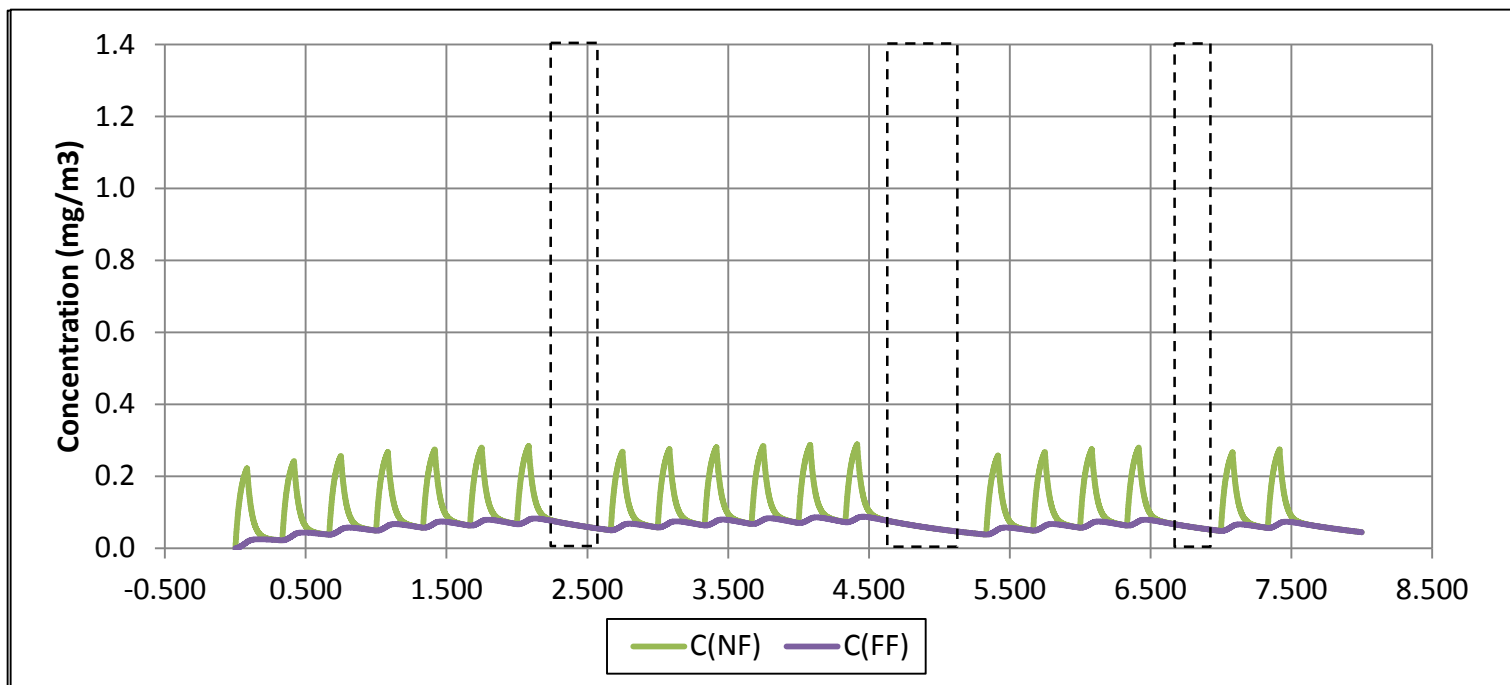


	C(NF)	C(FF)
min	0.0000	0.0000 mg/m3
max	0.9633	0.2921 mg/m3
15 min Peak	0.5213	0.2765 mg/m3
8-timers middel	0.3536	0.2060 mg/m3

Effektivitet af tekniske foranstaltninger

Control sub-class*	ART value	ECEL [^]		Nano data analysis ^{&}		Proposed value		
		%	95% CI (%)	AvEffect%	Min-Max	%	Lower	Upper
No localized controls	0	0	-	-	-	0	-	-
Containment - no extraction	-	50	4 – 74	96	50 – 99.999	-	-	-
- Low level	90	23	-103 – 70	92	50 – 99.998	85	30	90
- Medium	99	(86)	(30 – 97)	(99.89)	(99.3 – 99.999)	95	70	99
- High	99.9	(86)	(30 – 97)	(99.89)	(99.3 – 99.999)	99.9	90	99.99
LEV - Receiving hoods	0 80	81~	75 – 86	-	-	-	-	-
- Canopy hoods		-	-	-	-	50	0	70
- Other receiving hoods		-	-	-	-	80	50	90
LEV - Capturing hoods	90	81~	75 – 86	-	-	-	-	-
- Fixed capturing hoods		-	-	94	75 – 100	90	70	98
- Flexible capturing hoods		82	75 – 88	81	75 – 94	88	80	98
- On-tool extraction	90	87	84 – 90	-	-	90	80	99
LEV - Enclosing hoods	99 90 90	86	69 – 94	-	-	-	-	-
- Fume cupboard		-	-	81	57 – 95	90	50	99
- Horizontal/downward laminar flow booth		94	37 – 99	-	-	90	40	95
- Other enclosing hoods		-	-	75	(n=1)	90	40	95

Estimeret luftkoncentration med emfang



	C(NF)	C(FF)
min	0.0000	0.0000 mg/m3
max	0.2890	0.0876 mg/m3
15 min Peak	0.1564	0.0829 mg/m3
8-timers middel	0.1061	0.0618 mg/m3

