*nanomaterials*

MDPI

# Supplementary Material 1

# Quantifying Emission Factors and Setting Conditions of Use According to ECHA Chapter R.14 for a Spray Process Designed for Nanocoatings—A Case Study

**Antti Joonas Koivisto [1,2,3,*], Benedetta Del Secco [4], Sara Trabucco [4], Alessia Nicosia [4], Fabrizio Ravegnani [4], Marko Altin [5], Joan Cabellos [6], Irini Furxhi [7,8], Magda Blosi [9], Anna Costa [9], Jesús Lopez de Ipiña [10] and Franco Belosi [4]**

1 Air Pollution Management APM, Mattilanmäki 38, 33610 Tampere, Finland
2 Institute for Atmospheric and Earth System Research (INAR), University of Helsinki, PL 64, FI-00014 Helsinki, Finland
3 ARCHE Consulting, Liefkensstraat 35D, B-9032 Wondelgem, Belgium
4 CNR-ISAC, Institute of Atmospheric Sciences and Climate, National Research Council of Italy, Via Gobetti, 101, 40129 Bologna, Italy; b.delsecco@isac.cnr.it (B.D.S.); s.trabucco@isac.cnr.it (S.T.); a.nicosia@isac.cnr.it (A.N.); f.ravegnani@isac.cnr.it (F.R.); f.belosi@isac.cnr.it (F.B.)
5 Witek srl, Via Siena 47, 50142 Firenze, Italy; marko.altin@witekgroup.com
6 Leitat Technological Center, c/de la Innovació 2, Terrassa, 08225 Barcelona, Spain; jcabellos@leitat.org
7 Transgero Limited, Cullinagh, Newcastle West, Co. Limerick, V42 V384 Limerick, Ireland; irini.furxhi@transgero.eu
8 Department of Accounting and Finance, Kemmy Business School, University of Limerick, V94 T9PX Limerick, Ireland
9 ISTEC-CNR, Institute of Science and Technology for Ceramics, CNR, National Research Council, Via Granarolo 64, 48018 Faenza, Italy; magda.blosi@istec.cnr.it (M.B), anna.costa@istec.cnr.it (A.C.)
10 Basque Research and Technology Alliance (BRTA), Consiglio Nazionale delle Ricerche, Parque Tecnológico de Alava, Leonardo Da Vinci 11, 01510 Miñano, Spain; jesus.lopezdeipina@tecnalia.com (J.L.d.I.)
* Correspondence: joonas.apm@gmail.com; Tel: +358-407-222-029

## TEXT S1: Near-field volume

Version: TEAS 2019 (Version 1.0)
Date: 5/5/2021 11:22:04 AM

Prediction Model: Near Field Volume

| Variable | Units | Variable Model |
|---|---|---|
| Side Length | m | ~ Triangular (1.5, 1, 2 ) |

Near Field Shape: Cube (square box)

STATISTICS

Simulation N: 50000

Non-parametric Statistics

| | |
|---|---|
| Min: | 1.009 |
| Max: | 7.982 |
| Median: | 3.373 |
| Mode: | 3.171 |
| X0.05: | 1.564 |
| X0.95: | 6.243 |

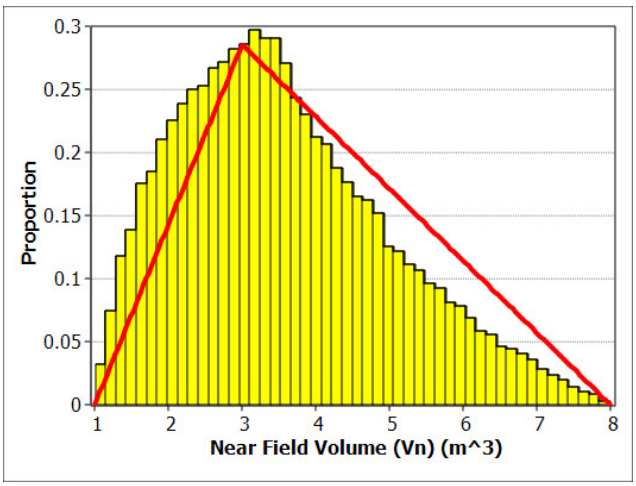
Normal Distribution Statistics

| | |
|---|---|
| Mean: | 3.563 |
| SD: | 1.414 |
| X0.05: | 1.237 |
| X0.95: | 5.889 |

Lognormal Distribution Statistics

| | |
|---|---|
| GM: | 3.282 |
| GSD: | 1.514 |
| Mode: | 2.763 |
| X0.05: | 1.659 |
| X0.95: | 6.492 |

GRAPHS




APPROXIMATE STATISTICAL MODEL

V_N ~ Triangular( 3.0, 1.00, 8) m^3

NOTES

SOURCE:
-Nicas (2009): Chapter 6 - The Near Field/Far Field (Two Box) Model with a Constant Contaminant Emission Rate. in Mathematical Models for Estimating Occupational Exposure to Chemical, 2nd Edition. AIHA.

NOTES:
1. Box - the worker is assumed to be standing at the front.

2. Beta = 1/2 * (Free Surface Area) * S

3. Free Surface Area does not include the blocked surfaces.

## TEXT S2: Near-field flowrate

Version: TEAS 2019 (Version 1.0)
Date: 5/5/2021 11:45:19 AM

Prediction Model: Near Field Flowrate (ß)

| Variable | Units | Variable Model |
|---|---|---|
| Side Length | m | ~ Triangular (1.5, 1, 2 ) |
| Air Velocity | m/min | ~ Triangular (0.9, 0.45, 1.8 ) |

Near Field Shape: Cube (square box)
Blocked Sides: Side

STATISTICS

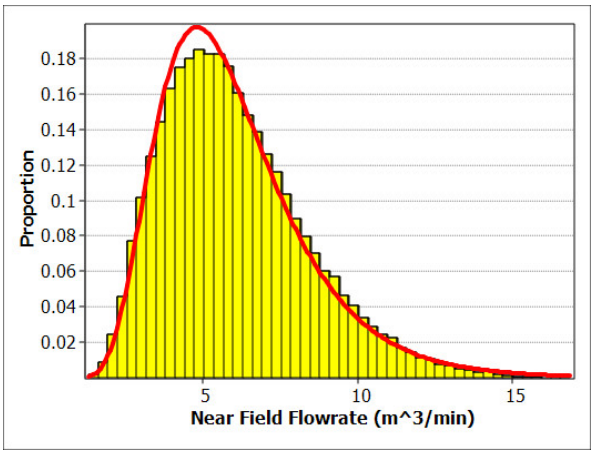
Simulation N: 50000

Non-parametric Statistics
Min: 1.293
Max: 16.874
Median: 5.666
Mode: 4.876
X0.05: 2.858
X0.95: 10.383

Normal Distribution Statistics
Mean: 6.017
SD: 2.318
X0.05: 2.203
X0.95: 9.831

Lognormal Distribution Statistics
GM: 5.588
GSD: 1.477
Mode: 4.800
X0.05: 2.943
X0.95: 10.612

GRAPHS




APPROXIMATE STATISTICAL MODEL

Beta ~ Lognormal( 5.588, 1.477) m^3/min

NOTES

SOURCE:
-Nicas (2009): Chapter 6 - The Near Field/Far Field (Two Box) Model with a Constant Contaminant Emission Rate. in Mathematical Models for Estimating Occupational Exposure to Chemical, 2nd Edition. AIHA.

NOTES:
1. Box - the worker is assumed to be standing at the front.

2. Beta = 1/2 * (Free Surface Area) * S

3. Free Surface Area does not include the blocked surfaces.

## TEXT S3: $TiO_2$-N Near-Field

Version: TEAS 2019 (Version 1.0)
Date: 6/24/2021 3:17:45 PM

SUBSTANCE INFORMATION

$TiO_2$-N particles dispersed in EtOH (1% w/w). $TiO_2$ content of aerosol particles at NF was 44% according to the ICP-MS analysis of collected particles.

EXPOSURE LIMITS

| Limit value | Type | Source | Notes |
|---|---|---|---|
| REL: 0.3 mg/m3 | TWA | NIOSH REL | Here concentrations are for total dust (44% is $TiO_2$ from the total dust) |

TASK INFORMATION

TASK 1 - Break
Description:
Model: M201
Model Name: 2Box.CE.Gv
Comments:

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |

| | | |
|---|---|---|
| 7: ß | ~ Lognormal (5.588, 1.477, ) | m³/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 2 - T1

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (1.3, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | m³ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | m³ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | m³/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (9, , ) | min |

TASK 3 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | m³ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | m³ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | m³/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 4 - T2

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (2, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (9, , ) | min |

TASK 5 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 6 - T3

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (5.9, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Uniform (2, 3, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (9, , ) | min |

TASK 7 - Break

Description:
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 8 - T4
Description:
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (0.9, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (9, , ) | min |

TASK 9 - Break
Description:
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |

| | | |
|---|---|---|
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 10 - T5

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (1.6, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (9, , ) | min |

TASK 11 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 12 - T6

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |

| | | |
|---|---|---|
| 3: G | ~ Constant (4.5, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Uniform (2, 3, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 13 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

## TWA CALCULATION (TASK OR FULL SHIFT)

Task TWA - the TWA is calculated for the duration of the task(s).

Comments:

## SIMULATION OPTIONS

Unless noted below, for all variables modeled with a statistical distribution a random value was generated for each repeat of a task.

Room Variables:
- For each TWA, the room ventilation rate Q generated for the first Box model task was used for all of the following Box model tasks.
- For each TWA, the room volume V generated for the first Box model task was used for all of the following Box model tasks.

Options for 2Box variables t1, t2, and tg:
- If a random t1, t2 or tg > 0, apply following rules:
  1. if tg > Duration, let tg = Duration
  2. if t2 > Duration, let t2 = Duration
  3. if t1 > t2, let t1=1/2 t2

Options for 2Box Constant Emission Model variables t2 and tg:
- tg is not linked to task Duration (DEFAULT)
- t2 is always equal to task Duration (DEFAULT)

STATISTICS

Output Units: mg/m3
Simulation N: 10000

Non-parametric Statistics

| | |
|---|---|
| Min: | 0.064 |
| Max: | 0.145 |
| Median: | 0.093 |
| Mode: | 0.095 |
| X0.05: | 0.079 |
| X0.50: | 0.093 |
| X0.60: | 0.096 |
| X0.70: | 0.099 |
| X0.75: | 0.100 |
| X0.80: | 0.102 |
| X0.90: | 0.107 |
| X0.95: | 0.111 |
| X0.99: | 0.120 |
| X0.999: | 0.131 |

Normal Distribution Statistics

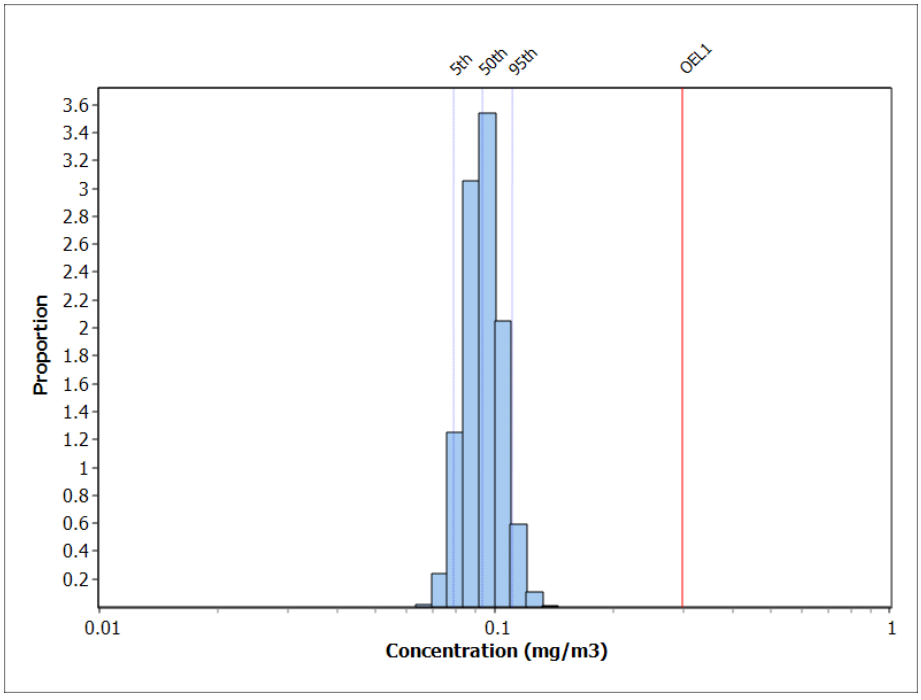
| | |
|---|---|
| Mean: | 0.094 |
| SD: | 0.010 |

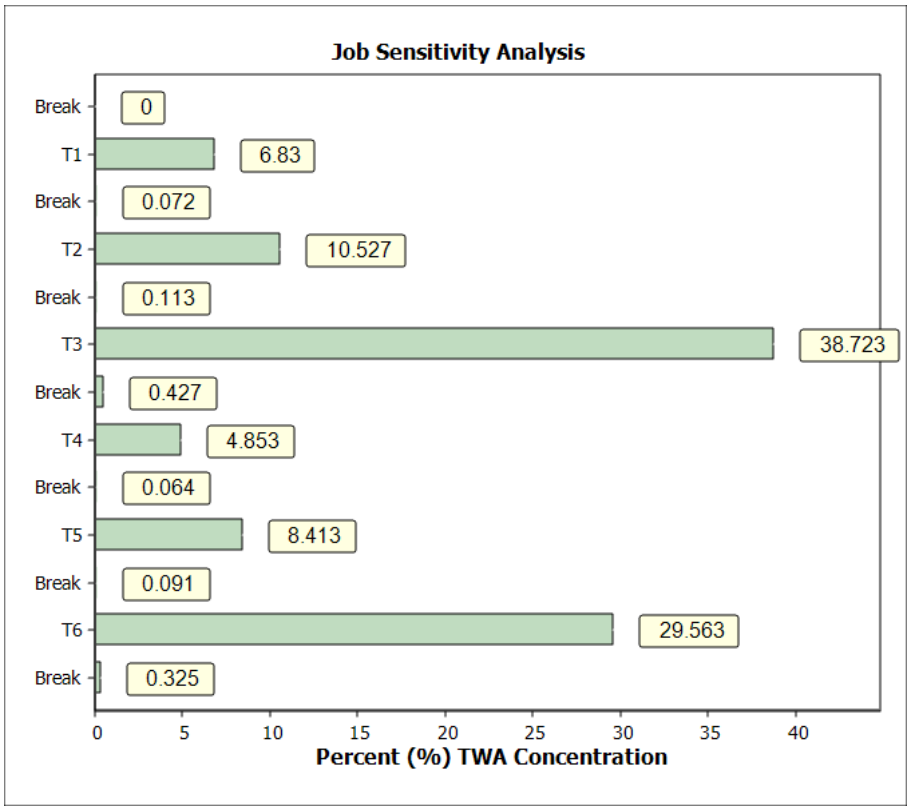
Lognormal Distribution Statistics

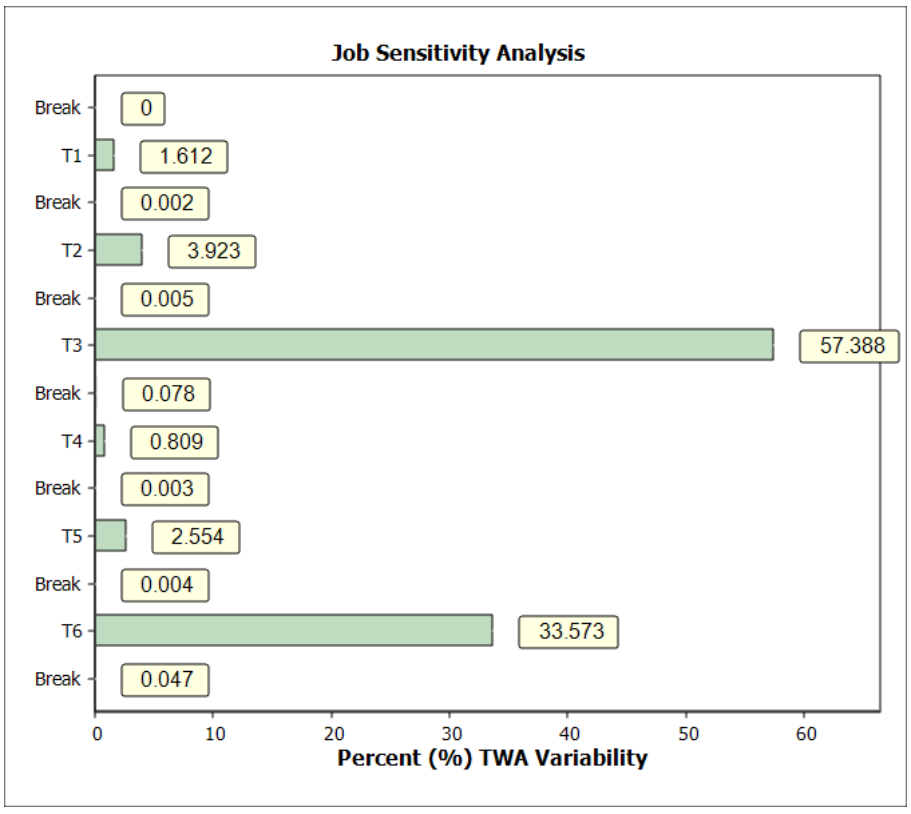
| | |
|---|---|
| GM: | 0.093 |
| GSD: | 1.111 |

| | |
|---|---|
| X0.95: | 0.111 |
| X0.99: | 0.119 |

GRAPHS




Job Sensitivity Analysis
Break
0
T1
6.83
Break
0.072
T2
10.527
Break
0.113
T3
38.723
Break
0.427
T4
4.853
Break
0.064
T5
8.413
Break
0.091
T6
29.563
Break
0.325
0
5
10
15
20
25
30
35
40
Percent (%) TWA Concentration


Job Sensitivity Analysis
Break
0
T1
1.612
Break
0.002
T2
3.923
Break
0.005
T3
57.388
Break
0.078
T4
0.809
Break
0.003
T5
2.554
Break
0.004
T6
33.573
Break
0.047
0
10
20
30
40
50
60
Percent (%) TWA Variability

## TEXT S4: $TiO_2$ Far-Field

Version: TEAS 2019 (Version 1.0)
Date: 6/24/2021 3:20:14 PM

SUBSTANCE INFORMATION

$TiO_2$-N particles dispersed in EtOH (1% w/w). $TiO_2$ content of aerosol particles at NF was 44% according to the ICP-MS analysis of collected particles.

EXPOSURE LIMITS

| Limit value | Type | Source | Notes |
|---|---|---|---|
| REL: 0.3 mg/m3 | TWA | NIOSH REL | Here concentrations are for total dust (44% is $TiO_2$ from the total dust) |

EXPOSURE LIMITS

| | Type | Source | Notes |
|---|---|---|---|
| OEL1: 0.3 ug/m3 | TWA | NIOSH REL | |

TASK INFORMATION

TASK 1 - T1
Description:
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (1.3, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 2 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 3 - T2

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (2, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 4 - Break

Description:
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 5 - T3
Description:
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (5.9, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Uniform (2, 3, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 6 - Break
Description:
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |

| | | |
|---|---|---|
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 7 - T4

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (0.9, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 8 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 9 - T5

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |

| | | |
|---|---|---|
| 3: G | ~ Constant (1.6, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 10 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 11 - T6

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (4.5, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Uniform (2, 3, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 12 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ UniformInt (18, 19, ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TWA CALCULATION (TASK OR FULL SHIFT)

Task TWA - the TWA is calculated for the duration of the task(s).

SIMULATION OPTIONS

Unless noted below, for all variables modeled with a statistical distribution a random value was generated for each repeat of a task.

Room Variables:
- For each TWA, the room ventilation rate Q generated for the first Box model task was used for all of the following Box model tasks.
- For each TWA, the room volume V generated for the first Box model task was used for all of the following Box model tasks.

Options for 2Box variables t1, t2, and tg:
- If a random t1, t2 or tg > 0, apply following rules:
  1. if tg > Duration, let tg = Duration
  2. if t2 > Duration, let t2 = Duration
  3. if t1 > t2, let t1=1/2 t2

Options for 2Box Constant Emission Model variables t2 and tg:
- tg is not linked to task Duration (DEFAULT)
- t2 is always equal to task Duration (DEFAULT)

STATISTICS

Output Units: mg/m3

| | |
|---|---|
| Simulation N: | 10000 |

Non-parametric Statistics

| | |
|---|---|
| Min: | 0.002 |
| Max: | 0.010 |
| Median: | 0.004 |
| Mode: | 0.003 |
| X0.05: | 0.002 |
| X0.50: | 0.004 |
| X0.60: | 0.004 |
| X0.70: | 0.005 |
| X0.75: | 0.005 |
| X0.80: | 0.005 |
| X0.90: | 0.007 |
| X0.95: | 0.007 |
| X0.99: | 0.008 |
| X0.999: | 0.009 |

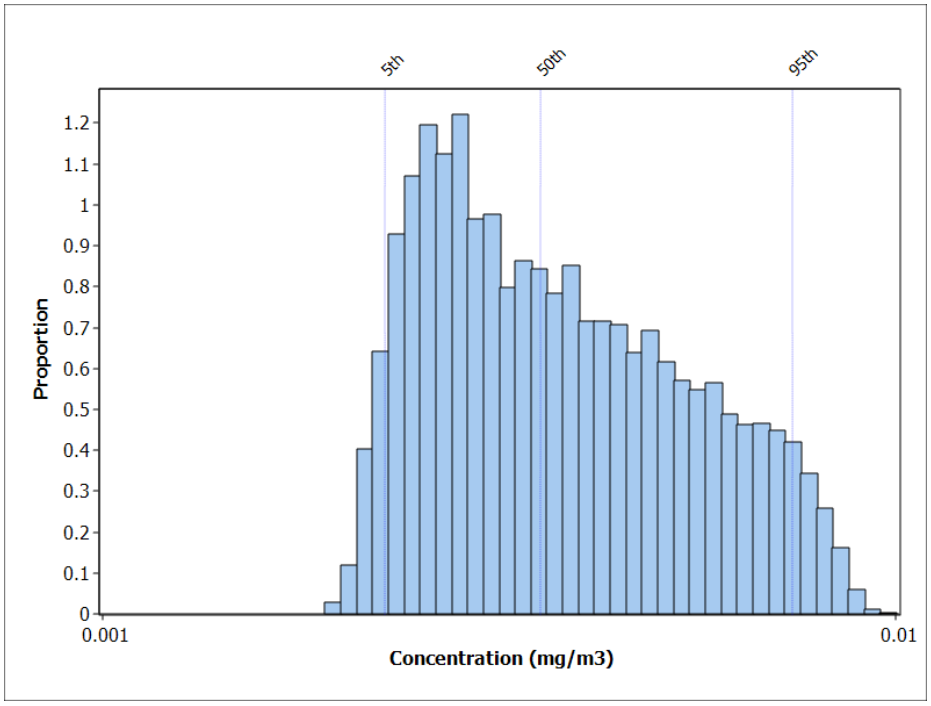
Normal Distribution Statistics

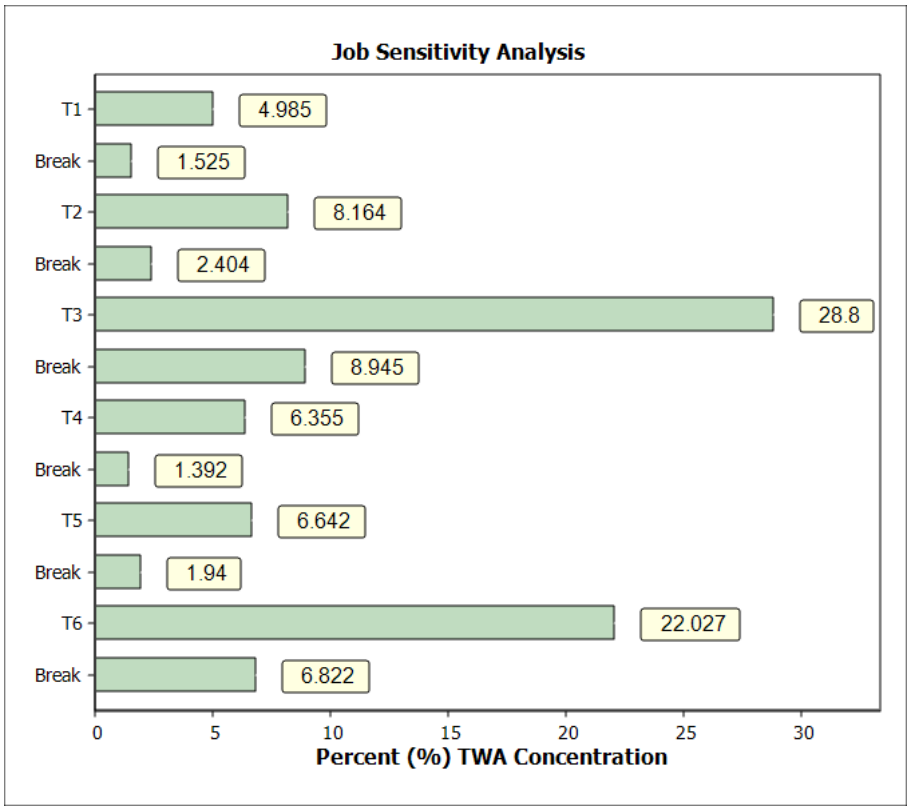
| | |
|---|---|
| Mean: | 0.004 |
| SD: | 0.002 |

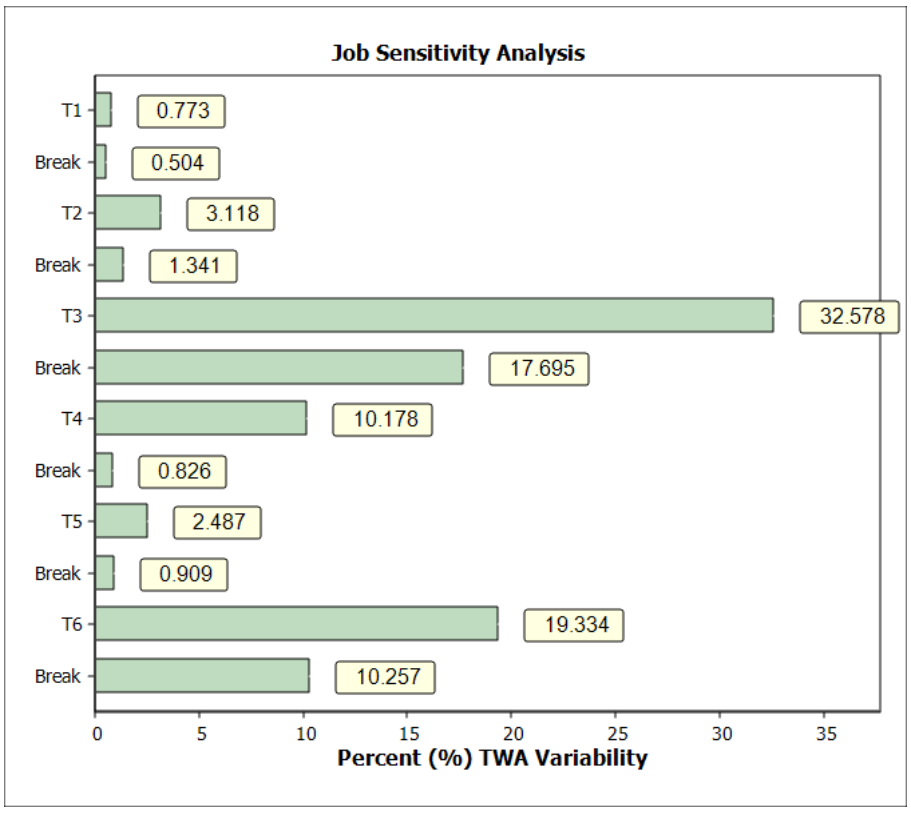
Lognormal Distribution Statistics

| | |
|---|---|
| GM: | 0.004 |
| GSD: | 1.452 |
| X0.95: | 0.007 |
| X0.99: | 0.009 |

GRAPHS


5th
50th
95th
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Proportion
0.001
0.01
Concentration (mg/m3)


Job Sensitivity Analysis
T1
4.985
Break
1.525
T2
8.164
Break
2.404
T3
28.8
Break
8.945
T4
6.355
Break
1.392
T5
6.642
Break
1.94
T6
22.027
Break
6.822
0
5
10
15
20
25
30
Percent (%) TWA Concentration


Job Sensitivity Analysis
T1
0.773
Break
0.504
T2
3.118
Break
1.341
T3
32.578
Break
17.695
T4
10.178
Break
0.826
T5
2.487
Break
0.909
T6
19.334
Break
10.257
0
5
10
15
20
25
30
35
Percent (%) TWA Variability

## TEXT S5: Ag-HEC Near-Field

Version: TEAS 2019 (Version 1.0)
Date: 6/24/2021 3:26:46 PM

SUBSTANCE INFORMATION

Ag-HEC particles dispersed in water. Ag content of aerosol particles at NF was 1.1% according to the ICP-MS analysis of collected particles.

EXPOSURE LIMITS

| Limit value | Type | Source | Notes |
|---|---|---|---|
| REL: 0.9 ug/m3 | TWA | NIOSH REL | Here concentrations are for total dust (1.1% is Ag from the total dust) |

TASK INFORMATION

TASK 1 - T7
Description:
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ ConstantInt (11, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (11, , ) | min |

TASK 2 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 3 - T8

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (0.8, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Uniform (1, 2, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (9, , ) | min |

TASK 4 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |

| | | |
|---|---|---|
| 7: ß | ~ Lognormal (5.588, 1.477, ) | m³/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 5 - T9

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (1.3, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | m³ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | m³ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | m³/min |
| 8: tg | ~ Uniform (1, 2, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (9, , ) | min |

TASK 6 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | m³ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | m³ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | m³/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 7 - T10

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (1.9, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 8 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 9 - T11

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (2.2, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Uniform (1, 2, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (9, , ) | min |

TASK 10 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 11 - T12

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (2.6, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TASK 12 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |

| | | |
|---|---|---|
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (19, , ) | min |

TWA CALCULATION (TASK OR FULL SHIFT)

Task TWA - the TWA is calculated for the duration of the task(s).

SIMULATION OPTIONS

Unless noted below, for all variables modeled with a statistical distribution a random value was generated for each repeat of a task.

Room Variables:
- For each TWA, the room ventilation rate Q generated for the first Box model task was used for all of the following Box model tasks.
- For each TWA, the room volume V generated for the first Box model task was used for all of the following Box model tasks.

Options for 2Box variables t1, t2, and tg:
- If a random t1, t2 or tg > 0, apply following rules:
  1. if tg > Duration, let tg = Duration
  2. if t2 > Duration, let t2 = Duration
  3. if t1 > t2, let t1=1/2 t2

Options for 2Box Constant Emission Model variables t2 and tg:
- tg is not linked to task Duration (DEFAULT)
- t2 is always equal to task Duration (DEFAULT)

STATISTICS

Output Units: mg/m3
Simulation N: 10000

Non-parametric Statistics

| | |
|---|---|
| Min: | 0.027 |
| Max: | 0.060 |
| Median: | 0.039 |
| Mode: | 0.039 |
| X0.05: | 0.033 |
| X0.50: | 0.039 |
| X0.60: | 0.040 |

| | |
|---|---|
| X0.70: | 0.041 |
| X0.75: | 0.042 |
| X0.80: | 0.042 |
| X0.90: | 0.044 |
| X0.95: | 0.046 |
| X0.99: | 0.049 |
| X0.999: | 0.053 |

Normal Distribution Statistics

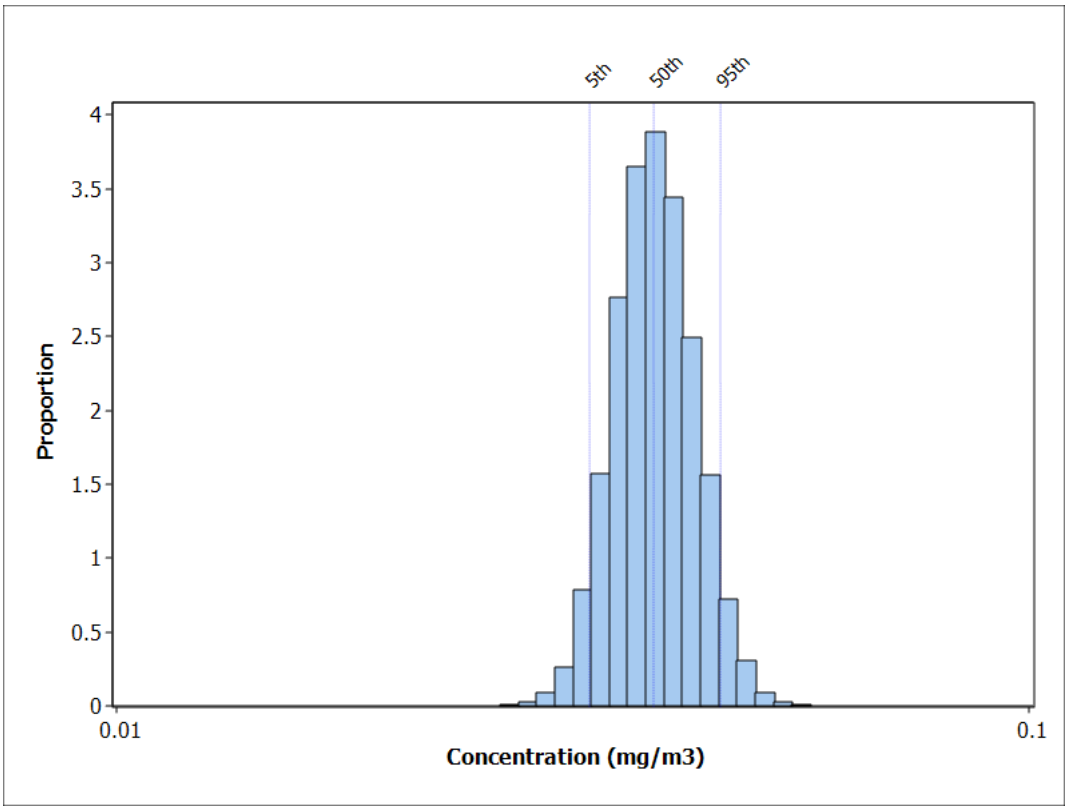
| | |
|---|---|
| Mean: | 0.039 |
| SD: | 0.004 |

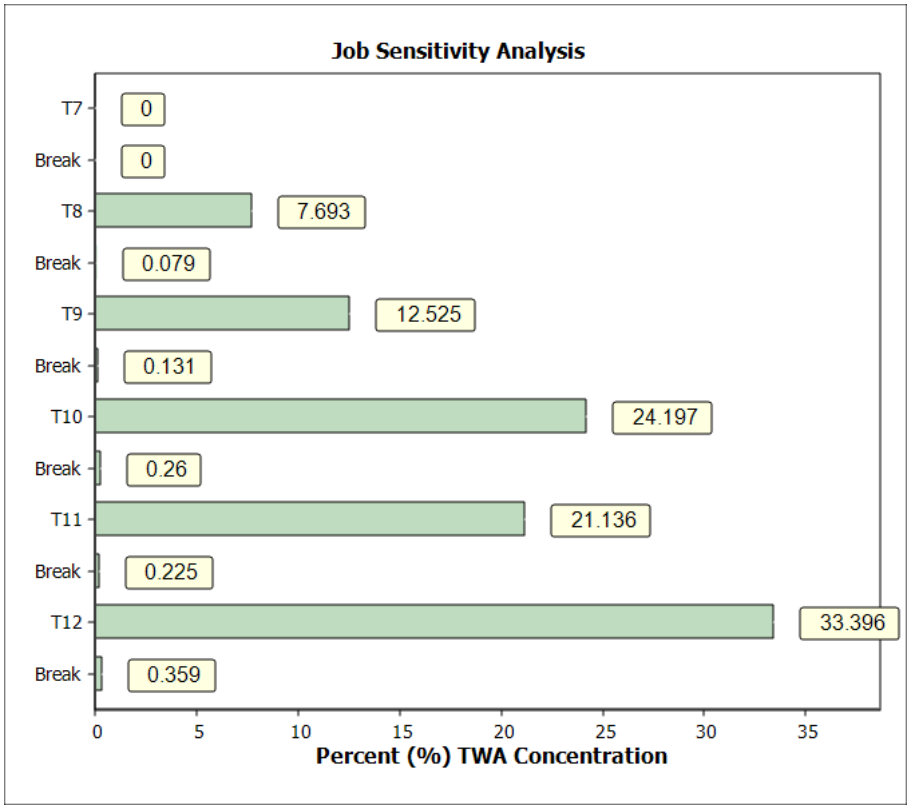
Lognormal Distribution Statistics

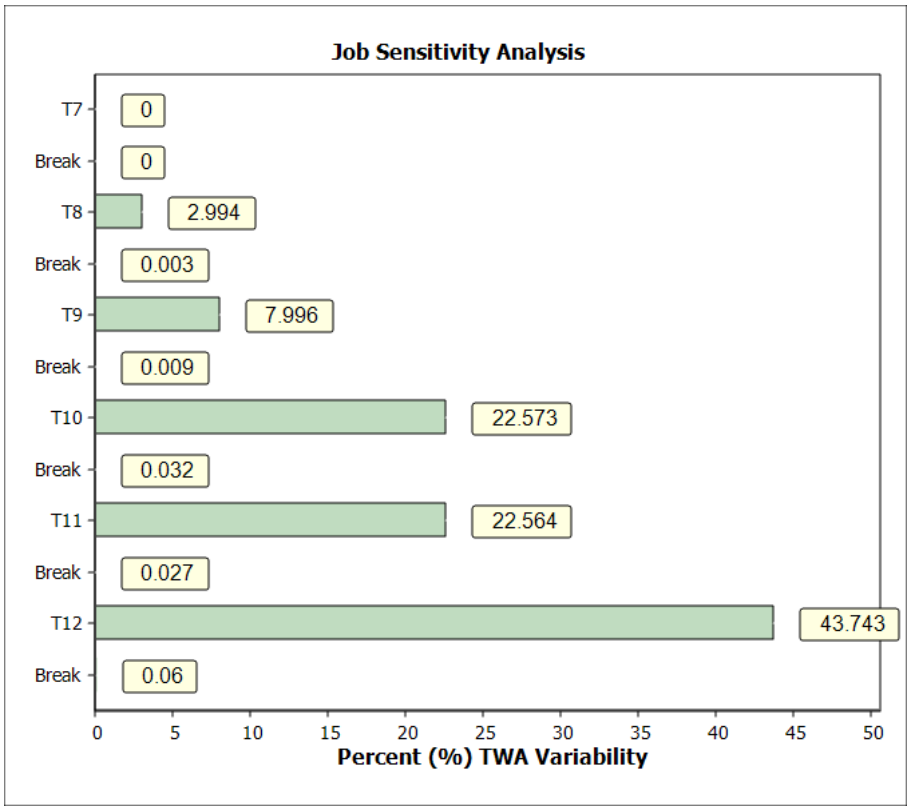
| | |
|---|---|
| GM: | 0.039 |
| GSD: | 1.106 |

| | |
|---|---|
| X0.95: | 0.046 |
| X0.99: | 0.049 |

GRAPHS


5th
50th
95th
Proportion
4
3.5
3
2.5
2
1.5
1
0.5
0
0.01
0.1
Concentration (mg/m3)


Job Sensitivity Analysis
T7
0
Break
0
T8
7.693
Break
0.079
T9
12.525
Break
0.131
T10
24.197
Break
0.26
T11
21.136
Break
0.225
T12
33.396
Break
0.359
0
5
10
15
20
25
30
35
Percent (%) TWA Concentration


Job Sensitivity Analysis
T7
0
Break
0
T8
2.994
Break
0.003
T9
7.996
Break
0.009
T10
22.573
Break
0.032
T11
22.564
Break
0.027
T12
43.743
Break
0.06
0
5
10
15
20
25
30
35
40
45
50
Percent (%) TWA Variability

## TEXT S6: Ag-HEC Far-Field

Version: TEAS 2019 (Version 1.0)
Date: 6/24/2021 3:29:27 PM

SUBSTANCE INFORMATION

Ag-HEC particles dispersed in water. Ag content of aerosol particles at NF was 1.1% according to the ICP-MS analysis of collected particles.

EXPOSURE LIMITS

| Limit value | Type | Source | Notes |
|---|---|---|---|
| REL: 0.9 ug/m3 | TWA | NIOSH REL | Here concentrations are for total dust (1.1% is Ag from the total dust) |

TASK INFORMATION

TASK 1 - T7
Description:
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ ConstantInt (11, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 2 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 3 - T8

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (0.8, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Uniform (1, 2, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 4 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |

| | | |
|---|---|---|
| 7: ß | ~ Lognormal (5.588, 1.477, ) | m³/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 5 - T9

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (1.3, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | m³ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | m³ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | m³/min |
| 8: tg | ~ Uniform (1, 2, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 6 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | m³ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | m³ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | m³/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 7 - T10

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (1.9, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 8 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 9 - T11

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (2.2, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Uniform (1, 2, ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 10 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 11 - T12

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (4, , ) | /shift |
| 2: Duration | ~ UniformInt (7, 9, ) | min |
| 3: G | ~ Constant (2.6, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (2, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TASK 12 - Break

Description:

Model: M201

Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (19, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (2.5, 10, ) | ACH |
| 5: V | ~ Uniform (1200, 1470, ) | $m^3$ |
| 6: Vn | ~ Triangular (3, 1, 8 ) | $m^3$ |

| | | |
|---|---|---|
| 7: ß | ~ Lognormal (5.588, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (0, , ) | min |

TWA CALCULATION (TASK OR FULL SHIFT)

Task TWA - the TWA is calculated for the duration of the task(s).

SIMULATION OPTIONS

Unless noted below, for all variables modeled with a statistical distribution a random value was generated for each repeat of a task.

Room Variables:
- For each TWA, the room ventilation rate Q generated for the first Box model task was used for all of the following Box model tasks.
- For each TWA, the room volume V generated for the first Box model task was used for all of the following Box model tasks.

Options for 2Box variables t1, t2, and tg:
- If a random t1, t2 or tg > 0, apply following rules:
  1. if tg > Duration, let tg = Duration
  2. if t2 > Duration, let t2 = Duration
  3. if t1 > t2, let t1=1/2 t2

Options for 2Box Constant Emission Model variables t2 and tg:
- tg is not linked to task Duration (DEFAULT)
- t2 is always equal to task Duration (DEFAULT)

STATISTICS

| | |
|---|---|
| Output Units: | μg/m3 |
| Simulation N: | 10000 |

Non-parametric Statistics

| | |
|---|---|
| Min: | 0.749 |
| Max: | 3.609 |
| Median: | 1.403 |
| Mode: | 0.955 |

| | |
|---|---|
| X0.05: | 0.891 |
| X0.50: | 1.403 |
| X0.60: | 1.587 |
| X0.70: | 1.825 |
| X0.75: | 1.961 |
| X0.80: | 2.130 |
| X0.90: | 2.563 |
| X0.95: | 2.847 |
| X0.99: | 3.224 |
| X0.999: | 3.480 |

Normal Distribution Statistics

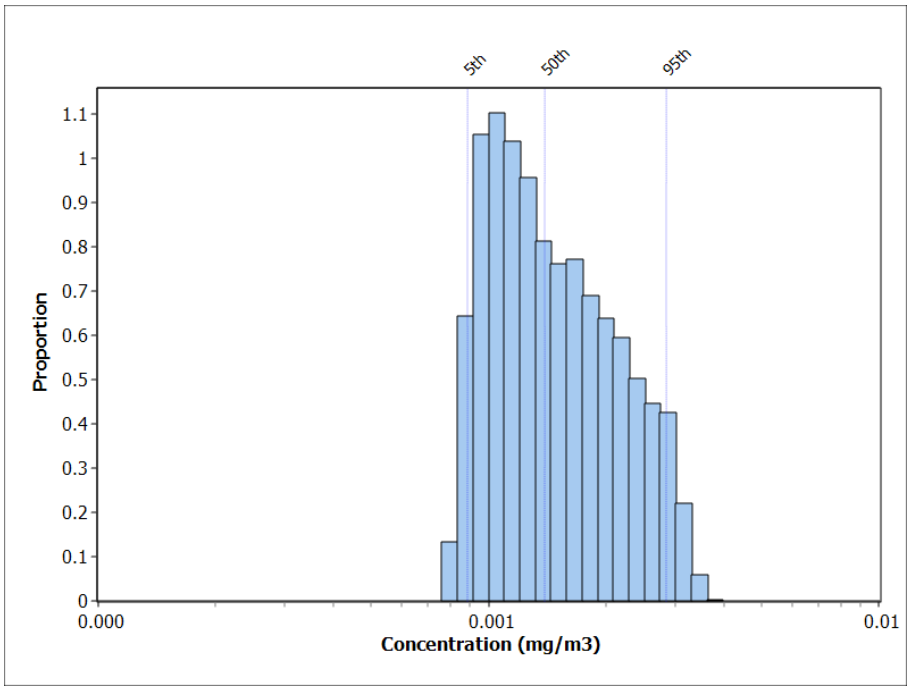
| | |
|---|---|
| Mean: | 1.585 |
| SD: | 0.622 |

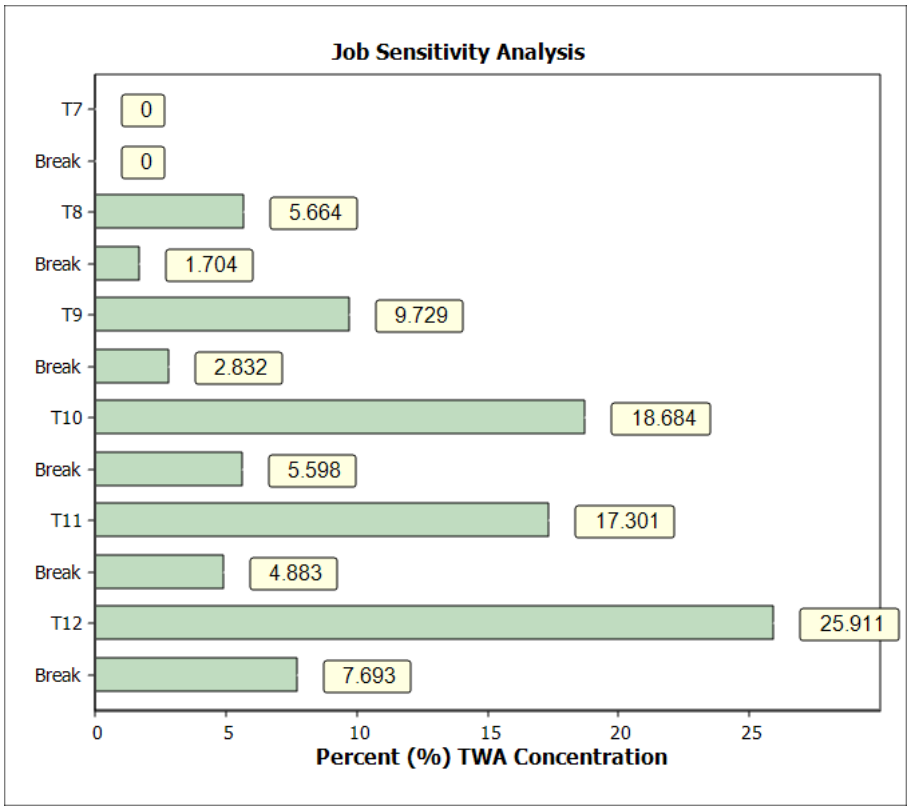
Lognormal Distribution Statistics

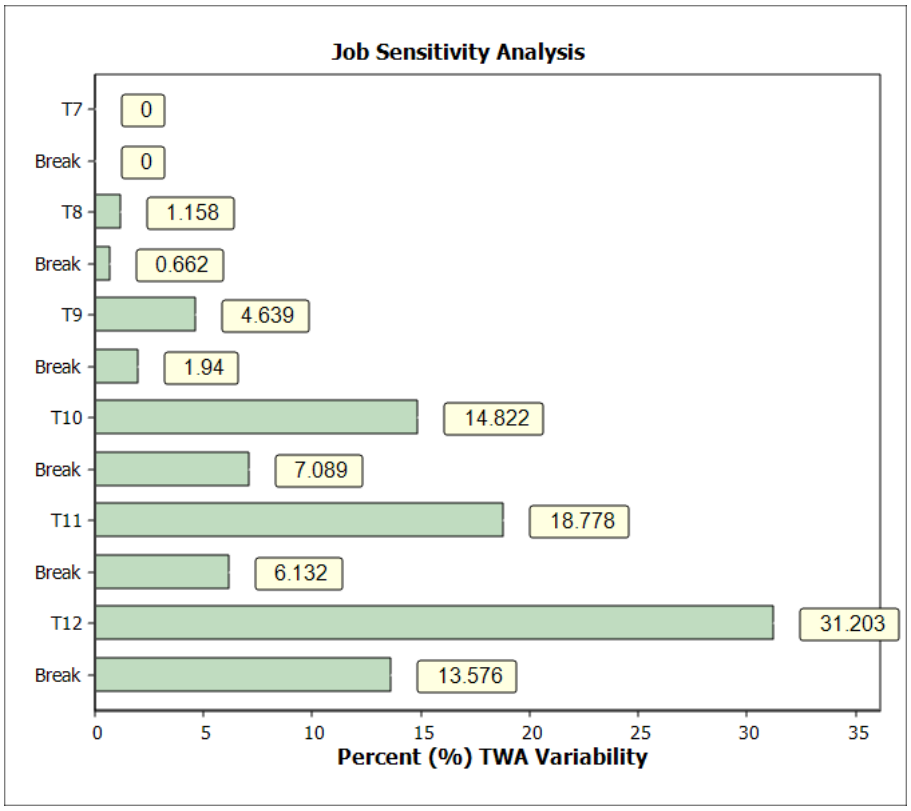
| | |
|---|---|
| GM: | 1.477 |
| GSD: | 1.447 |

| | |
|---|---|
| X0.95: | 2.712 |
| X0.99: | 3.487 |

GRAPHS


5th
50th
95th
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Proportion
0.000
0.001
0.01
Concentration (mg/m3)


Job Sensitivity Analysis
T7
0
Break
0
T8
5.664
Break
1.704
T9
9.729
Break
2.832
T10
18.684
Break
5.598
T11
17.301
Break
4.883
T12
25.911
Break
7.693
0
5
10
15
20
25
Percent (%) TWA Concentration


Job Sensitivity Analysis
T7
0
Break
0
T8
1.158
Break
0.662
T9
4.639
Break
1.94
T10
14.822
Break
7.089
T11
18.778
Break
6.132
T12
31.203
Break
13.576
0
5
10
15
20
25
30
35
Percent (%) TWA Variability

## TEXT S7: Ag-HEC Near-Field RWC

Version: TEAS 2019 (Version 1.0)
Date: 11/25/2021 8:54:22 AM

SUBSTANCE INFORMATION

Ag-HEC particles dispersed in water. Ag content of aerosol particles at NF was 1.1% according to the ICP-MS analysis of collected particles. The fraction of Ag in the NF was used to calculate emission rate of Ag.

EXPOSURE LIMITS

| Limit value | Type | Source | Notes |
|---|---|---|---|
| REL: 0.9 ug/m3 | TWA | NIOSH REL | |

TASK INFORMATION

RWC conditions: Room volume 600 to 735 $m^3$; General ventilation 1.25 to 5 ACH; NF volume min 0.5 $m^3$, mode 1.5 $m^3$, max 4 $m^3$; $\beta$ = 2.8 $m^3$/min (GSD = 1.477).

TASK 1 - T1.1
Description: 1 nozzle
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (180, , ) | min |
| 3: G (Ag) | ~ Uniform (0.0286, 0.0572, ) | mg/min |
| 4: Q | ~ Uniform (1.25, 5, ) | ACH |
| 5: V | ~ Uniform (600, 735, ) | $m^3$ |
| 6: Vn | ~ Triangular (1.5, 0.5, 4 ) | $m^3$ |
| 7: ß | ~ Lognormal (2.8, 1.477, ) | $m^3$/min |

| | | |
|---|---|---|
| 8: tg | ~ Constant (180, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (180, , ) | min |

TASK 2 - Break
Description: 1 nozzle
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (60, , ) | min |
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (1.25, 5, ) | ACH |
| 5: V | ~ Uniform (600, 735, ) | $m^3$ |
| 6: Vn | ~ Triangular (1.5, 0.5, 4 ) | $m^3$ |
| 7: ß | ~ Lognormal (2.8, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (60, , ) | min |

TASK 3 - T1.2
Description: 1 nozzle
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (180, , ) | min |
| 3: G (Ag) | ~ Uniform (0.0286, 0.0572, ) | mg/min |
| 4: Q | ~ Uniform (1.25, 5, ) | ACH |
| 5: V | ~ Uniform (600, 735, ) | $m^3$ |
| 6: Vn | ~ Triangular (1.5, 0.5, 4 ) | $m^3$ |
| 7: ß | ~ Lognormal (2.8, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (180, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (180, , ) | min |

TASK 4 - Break
Description: 1 nozzle
Model: M201
Model Name: 2Box.CE.Gv

| Variable | Variable Model | Units |
|---|---|---|
| 1: Frequency | ~ ConstantInt (1, , ) | /shift |
| 2: Duration | ~ ConstantInt (60, , ) | min |

| | | |
|---|---|---|
| 3: G | ~ Constant (0, , ) | mg/min |
| 4: Q | ~ Uniform (1.25, 5, ) | ACH |
| 5: V | ~ Uniform (600, 735, ) | $m^3$ |
| 6: Vn | ~ Triangular (1.5, 0.5, 4 ) | $m^3$ |
| 7: ß | ~ Lognormal (2.8, 1.477, ) | $m^3$/min |
| 8: tg | ~ Constant (0, , ) | min |
| 9: t1 | ~ Constant (0, , ) | min |
| 10: t2 | ~ Constant (60, , ) | min |

TWA CALCULATION (TASK OR FULL SHIFT)

Task TWA - the TWA is calculated for the duration of the task(s).

SIMULATION OPTIONS

Unless noted below, for all variables modeled with a statistical distribution a random value was generated for each repeat of a task.

Room Variables:
- For each TWA, the room ventilation rate Q generated for the first Box model task was used for all of the following Box model tasks.
- For each TWA, the room volume V generated for the first Box model task was used for all of the following Box model tasks.

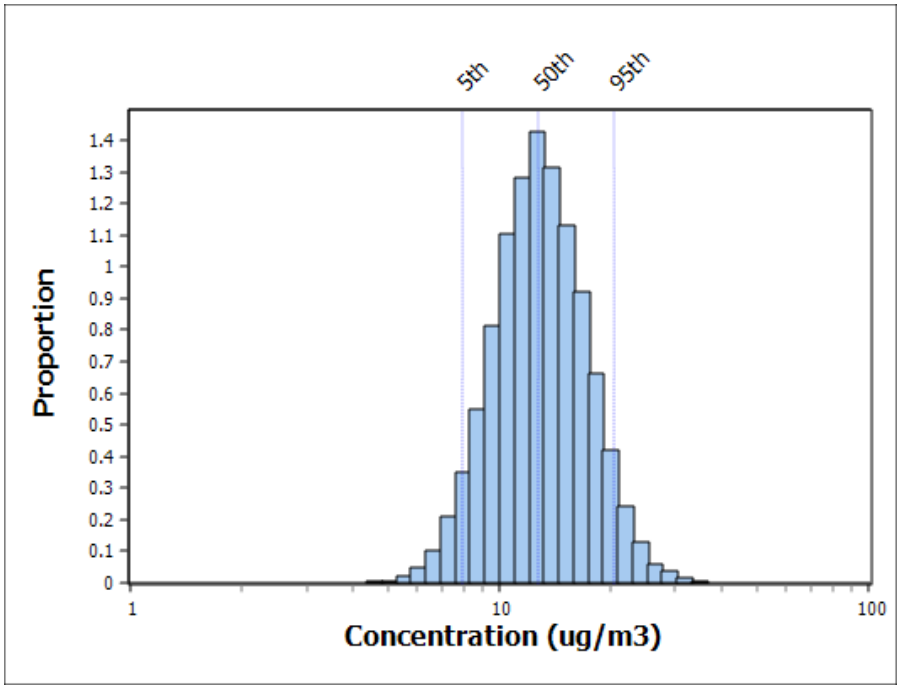
Options for 2Box variables t1, t2, and tg:
- If a random t1, t2 or tg > 0, apply following rules:
  1. if tg > Duration, let tg = Duration
  2. if t2 > Duration, let t2 = Duration
  3. if t1 > t2, let t1=1/2 t2

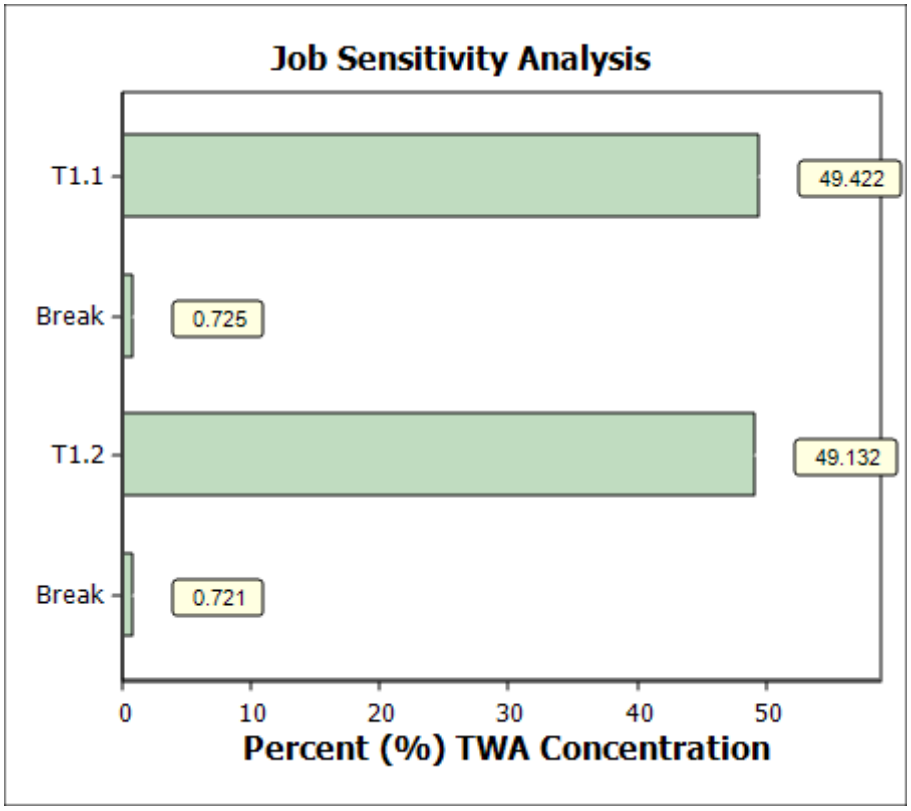
Options for 2Box Constant Emission Model variables t2 and tg:
- tg is not linked to task Duration (DEFAULT)
- t2 is always equal to task Duration (DEFAULT)

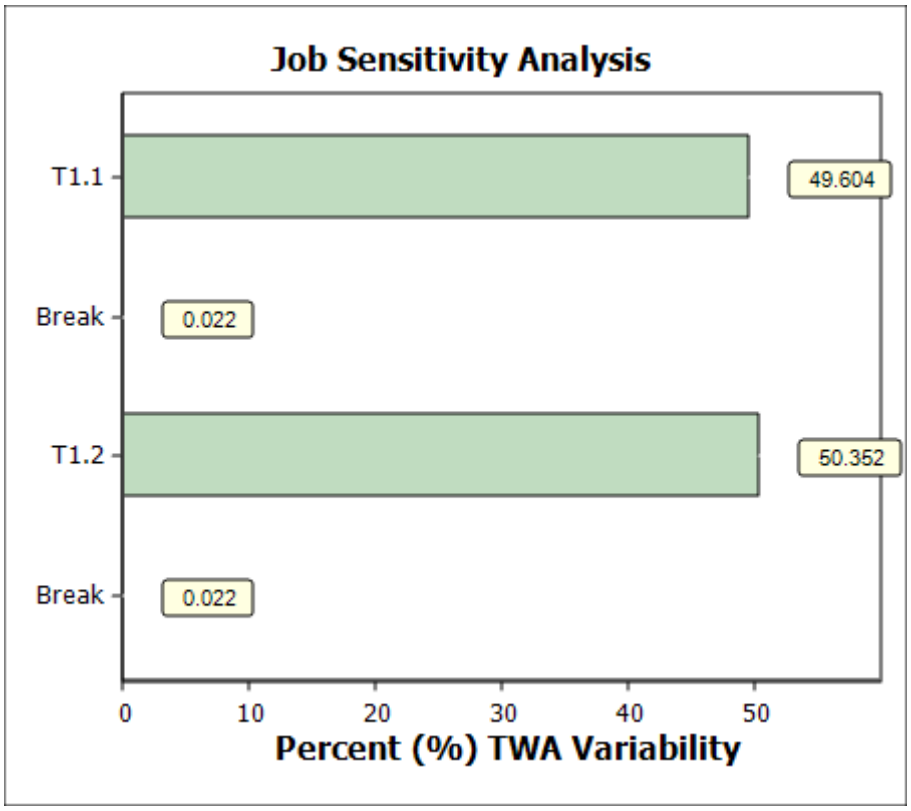
STATISTICS

| | |
|---|---|
| Output Units: | μg/m3 |
| Simulation N: | 10000 |
| Non-parametric Statistics | |
| Min: | 4.456 |
| Max: | 40.410 |
| Median: | 12.765 |
| Mode: | 12.589 |
| Fraction>REL: | 100.000% |
| X0.05: | 7.912 |
| X0.50: | 12.762 |
| X0.60: | 13.761 |
| X0.70: | 14.877 |
| X0.75: | 15.548 |
| X0.80: | 16.312 |
| X0.90: | 18.501 |
| X0.95: | 20.529 |
| X0.99: | 25.515 |
| X0.999: | 32.235 |
| Normal Distribution Statistics | |
| Mean: | 13.348 |
| SD: | 3.979 |
| Lognormal Distribution Statistics | |
| GM: | 12.797 |
| GSD: | 1.337 |
| X0.95: | 20.624 |
| X0.99: | 25.129 |
| Fraction>REL: | 100.000% |

GRAPHS


5th
50th
95th
Proportion
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
10
100
Concentration (ug/m3)


Job Sensitivity Analysis
T1.1
49.422
Break
0.725
T1.2
49.132
Break
0.721
0
10
20
30
40
50
Percent (%) TWA Concentration


Job Sensitivity Analysis
T1.1
49.604
Break
0.022
T1.2
50.352
Break
0.022
0
10
20
30
40
50
Percent (%) TWA Variability