Examination Environmental Risk Assessment in Engineering, BOM060, 2015-03-17, 14.00-18.00
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Suggested solutions

Q1. Sensitivity analysis (5 p)

a.

With negative exponent (correct)

	L [m]	k [1/s]	v [m/s]
P_old	1000	8.88889E-07	0.01
V_old	0.084503782	0.084503782	0.084503782
P_new	1500	1.33333E-06	0.015
delta_P	500	4.44444E-07	0.005
delta_P/P_old	0.5	0.5	0.5
V_new	0.124038877	0.124038877	0.057160643
delta_V	0.039535095	0.039535095	-0.027343139
delta_V/V_old	0.467850004	0.467850004	-0.323572962
sp	0.935700009	0.935700009	-0.647145923

With positive exponent (incorrect)

	L [m]	k [1/s]	v [m/s]
P_old	1000	8.88889E-07	0.01
V_old	-0.092303803	-0.092303803	-0.092303803
P_new	1500	1.33333E-06	0.015
delta_P	500	4.44444E-07	0.005
delta_P/P_old	0.5	0.5	0.5
V_new	-0.141603177	-0.141603177	-0.060626068
delta_V	-0.049299374	-0.049299374	0.031677735
delta_V/V_old	0.534099051	0.534099051	-0.343189918
sp	1.068198102	1.068198102	-0.686379836

The parameters *L* and *k* are most sensitive.

b.

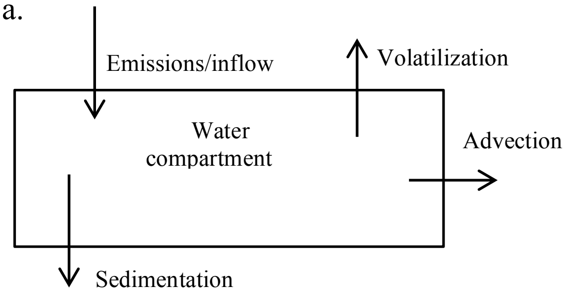
A scenario analysis strategy could be to define (1) a high removal scenario, with the possible values of the three input parameters that give the highest removal, and (2) a low removal scenario, with the possible values of the three input parameters that give the lowest removal. One could also add (3) a likely/baseline scenario to these two.

c.

The main difference would be that the input parameters would then be in the form of probability density functions, or probability distributions, and not as a fixed (scalar) value or set of fixed values (as in scenario analysis).

Q2. Exposure assessment (5 p)

a.



b.

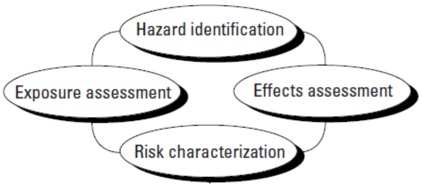
$$\text{PEC} = \frac{1}{V}\int_0^t \left(E - k_{\text{vol}} m - k_{\text{sed}} m - k_{\text{adv}} m\right) dt$$

PEC: predicted environmental concentration
V: water compartment volume
E: emissions
k: rate coefficients
m: mass of mercury in the water
t: time

c.
Air and soil.

Q3. Chemical risk assessment framework (5 p)

a.



Hazard identification: Determining which stressors that are relevant to study, and whether they have an inherent ability to cause harm (e.g. toxicity, persistence, emissions). Establish conceptual model

Exposure assessment: Assess exposure to relevant endpoint(s), which includes emission assessment and fate modelling. The PEC is determined.

Effect assessment: Assess effects from exposure to relevant endpoint(s) based on ecotoxicological test results. The PNEC is determined.

Risk characterization: Compare exposure in terms of PEC to effects in terms of PNEC by using risk quotients (RQ).

b.

$$RQ = \frac{PEC}{PNEC}$$

$$RQ = \frac{PDI}{ADI}$$

PEC: Predicted environmental concentration.

PNEC: Predicted no-effect concentration.

PDI: Predicted daily intake.

ADI: Acceptable daily intake.

RQ: Risk quotient.

Q4. Hazard identification and risk estimation (5 p)

a. Good hazard identification: (i) makes use of as many tools as possible; (ii) acknowledges the history and the different phases of past activities, and (iii) is based on a sound conceptual model. Examples of methods are: (i) checklists – used to make sure no common hazards (i.e. the lists are based on previous experience) are missed; (ii) structured brainstorming (e.g. What if?, HAZOP) – hazards are identified and discussed based on experience among people involved in the assessment; and (iii) conceptual models are often used together with guide words to go through the entire system and identify potential hazards.
b. Risk ranking is a typical and commonly applied qualitative (sometimes also called semi-qualitative method) risk estimation method. When performing a risk ranking, hazards (undesired events etc.) are identified and assign probabilities and consequences based on discretised scales. However, additional parameters may also be used to describe each hazard (in contaminate land application parameters such as contamination level, migration potential etc. may be used). The results are typically presented in a risk matrix or similar and illustrate the relative severity of the risks. The results can thus be used to rank/prioritise the risks and to decide where additional and more detailed analyses are required.

Q5. Contaminant migration (5 p)

a. To get a representative value of the concentrations in the groundwater discharging to the stream.
b. The mass flux should be based on the mean value of the concentrations or on a division into sections along the stream, where each sample represents one section.
c. 1326 kg/year.
d. 1.40 mg/l.

Q6. Effects assessment (5 p)

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Q7. Risk perception and professional duties of risk assessors (10 p)

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Q8. Risk assessment at contaminated sites (6 p)

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Q9. Soil sampling and data evaluation (4p)

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