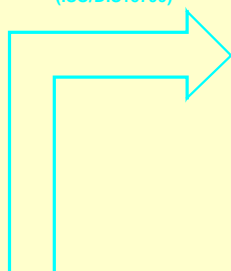


ESTIMATION OF SOIL TOXICITY WHICH TOXICITY TESTS ?

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Relevance according
to soil use
(ISO/DIS15799)



Soil use	Soil function		
	Retention	Habitat	
	Aquatic organisms	Plants	Soil biocenose
Sealed area	low*	low	low
Non sealed Shopping or industrial area	high	high	low
Filling, covering	high	high	low
Green spaces, parcs, recreation areas	high	high	high
Agriculture and horticulture	high	high	high

* in the non saturated part only

Area type	Nature (I)	Agriculture (II)	Habitat (III)	Recreation, Shopping, Habitat without garden (IV)	Industries (V)
Scope					
Ecotoxicity estimation	Highly relevant 5, 6, 7, 8 chronic tests Moderately relevant (1)*, 2*, 3*, 4*, 9	Highly relevant 5, 6, 7, 8 chronic tests Moderately relevant (1), 9	Highly relevant 5, 6, 7, 8, 9 chronic tests Moderately relevant (1), 9	Highly relevant 5, 6, 7 chronic tests Moderately relevant (1), 8, 9	Highly relevant 5 acute tests Moderately relevant (1), 2, 3, 6, 7, 8
Prioritisation for intervention	Highly relevant 5, 6, 7, 8 acute tests Moderately relevant (1)*, 2*, 3*, 4*	Highly relevant 5, 6, 7, 8 acute tests Moderately relevant (1), 2, 3	Highly relevant 5, 6, 7, 8 acute tests Moderately relevant (1), 2, 3	Highly relevant 5, 6, 7 acute tests Moderately relevant (1), 2, 3	Highly relevant 5 acute tests Moderately relevant (1), 2, 3, 6, 7, 8
Evolution in time	Highly relevant (1) + most sensitive test of the ecotoxicity evaluation				
Risk of Diffusion	Highly relevant 1, 2, 3 Moderately relevant 4**	Highly relevant Moderately relevant 1, 2, 3, 4*	Highly relevant Moderately relevant 1, 2, 3	Highly relevant Moderately relevant 1, 2, 3	Highly relevant Moderately relevant 1, 2, 3

*Relevant in forest/aquatic area

- (1) Systematic Microtox test
1 Bacteria (NVN 6516; ISO 11348-3)
2 Alga test (ISO 8692)
3 Crustacean test (ISO 6341; OECD 211)
4 Fish test

- 5 Bacteria and bacterial processes test
6 Soil organism test (ISO 11268-1; 2)
7 Higher plant test (ISO 11269-1; 2)
8 Field bioindicators
9 Genotoxicity test

Criteria for selecting
the battery of tests
(Life-sediments, 2001)

	CRITERIA						
	representativity of the terrestrial ecosystem	reproducibility	sensitivity	chronic vs acute	availability of data (tests, pollutants)	discriminative power	cost
Ecotoxicity estimation (area I to IV)	xx	x	x	xx	xx	-	-
Prioritisation	x	xx	xx	x	x	xx	xx
Evolution in time	-	xx	x	-	x	x	x
Risk of diffusion	-	x	x	xx	x	x	-

ESTIMATION OF SOIL TOXICITY WARNINGS AND QUESTIONS FOR A PRACTICAL IMPLEMENTATION

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Samples

Hypothesis : Sampling is significant, samples are relevant (ISO10381)

! Preservation: Soil samples are to be preserved in the dark, at 4°C, in clearly marked inert bottles. Aqueous extracts are to be prepared 24h before the test

? Reference soil: For an accurate interpretation of the results, they have to be compared to reference soils. Different reference soils may be defined : non contaminated soil from the same area, natural soil from reference area, artificial relevant soil, according to the scope of the study (small area, intercomparison, regional scale study)

Bioassays

Complementarity between bioassays and chemical analyses is evident. Only the habitat function is considered here. The global trend is to protect this functions through a "site specific" approach, according to the further uses of the soils. International normalised bioassays are recommended.

! Basic test battery of Chronic bioassays suggested:
 1) ISO 11268-2:1998
 Soil quality - Effects of pollutants on earthworms (*Eisenia fetida*) - Part 2: Determination of effects on reproduction
 2) ISO 11269-2:1995
 Soil quality - Effects of pollutants on soil flora - Part 2 : Effects of chemicals on the emergence and growth on higher plants
 3) ISO 14238:1997
 Soil quality - Biological methods - Determination of nitrogen mineralisation and nitrification in soils and the influence of chemical on these processes

? Which plant species?

In the framework of a sequential approach, the following tests may be added in order to decrease the environmental risk estimation uncertainty:

- ISO/DIS 11267: Effect on Collembola (*Folsomia candida*)
- ISO/CD 16387: Effect on Enchytraeidae

? Genotoxicity tests are to be included. Which ones ?

At the level of a preliminary study, acute tests may be used on non diluted samples on both matrices:

- ISO 11348-3: Effect on *V. fischeri* (Microtox®)
- ISO 6341: Effect on *Daphnia magna* Straus
- ISO 8692: Effect on *Sc. subspicatus* and *Ps. subcapitata*
- ISO 11268-1: Effect on earthworms (*Eisenia fetida*)
- ISO/DIS 11269-1: Effect on soil flora
- Biomet, Ames-test, Vitotox, UMU-C, Mutatox®

? Relevance of aquatic tests according to soil uses in non moist areas?

! Recommendations based on the actual science knowledge on the topic of measurement of soil ecotoxicity

? Inaccuracies or uncertainties to be raised for a robust application

Extraction method

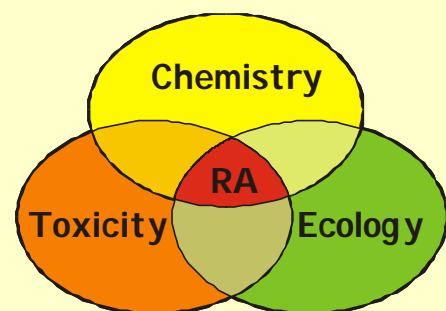
Tests on aquatic organisms and genotoxicity tests are performed on leachates or interstitial waters. Good extracts are those containing the bioavailable fraction of the pollutants and allowing toxicity tests

Leaching is the most adequate method for the classification and estimation of ecotoxicological hazard. Water must be used as extractant. For low Solid/Liquid ratios, the ionic power of the eluate may create interferences. Other extractants may be used : $\text{Ca}(\text{NO}_3)_2$ (best simulation), CaCl_2 (bioavailability estimation), NaNO_3 (does not modify the soil pH). Sedimentation, centrifugation and filtration may be required but can modify the toxic response

! Proposal : leaching using demineralised water; S/L=1/2

? Detailed leaching procedure?
 New extractants: $\text{Ca}(\text{NO}_3)_2$, organic solvent

Triad approach



The Triad approach has been developed in Flanders and in the Netherlands for the risk assessment of contaminated sites. Ecological data are added to chemistry and toxicity analyses.

? Detailed guidelines for the Triad implementation?

Further developments

Soil toxicology is an emerging science. New technical developments, normalisation and scientific publications will be very important in the new decades. Research and empirical programmes are sure to be supported.