PD ISO/TS 16751:2018

BSI Standards Publication

Soil quality — Environmental availability of non-polar organic compounds — Determination of the potential bioavailable fraction and the non-bioavailable fraction using a strong adsorbent or complexing agent

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National foreword

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Soil quality — Environmental availability of non-polar organic compounds — Determination of the potential bioavailable fraction and the non-bioavailable fraction using a strong adsorbent or complexing agent

Qualité du sol — Disponibilité environnementale des composés organiques non polaires — Détermination de la fraction potentiellement biodisponible et de la fraction non biodisponible en utilisant un agent adsorbant fort ou un agent complexant

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Foreword

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This document was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 7, *Soil and site assessment*.

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Introduction

The solubility of most non-polar organic contaminants is limited and they are sorbed to the soil matrix. They may desorb and become available for organisms, which may result in an effect (toxicity, degradation or bioaccumulation). Not all sorbed (adsorbed and absorbed) contaminants will desorb and become available.

Extractions used in chemical analysis to measure the total concentration, release more contaminants from the soil than are available. It is however also possible that contaminants are so strongly bounded by the soil that they will not be released by chemical extraction. This strong sorption may also be caused by incorporation of the contaminant (or a degradation or reaction product of the contaminant) in the organic soil structure. The distribution of contaminants over sorption sites of varying sorption strength is not constant in time and contaminants will shift, with increasing contact time, to the stronger sorption sites.

Figure 1 shows schematically the differentiation between:

— extractable residues that are also bioavailable (i.e. the potentially bioavailable fraction);

— residues that are extractable by harsher extraction methods but are non-bioavailable;

— residues that are neither extractable nor bioavailable.

If a degradable substance enters a soil, part of it will degrade over time (curve a). The area between curve a and c is extractable by exhaustive chemical procedures. For risk assessments, this part is considered as the “total concentration” for which values are defined in many regulations. However only a part of this amount is bioavailable. The area between curves a and b is the bioavailable fraction and the area between curves b and c is the non-bioavailable fraction. The method described in this document enables the measurement of the potential bioavailable and the non-bioavailable fraction of a contaminant in soil.

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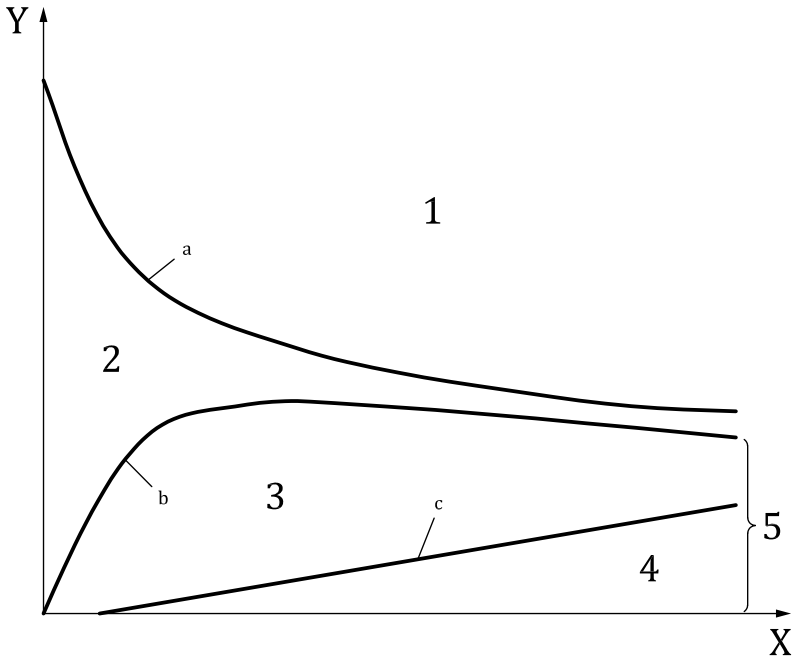

Key

X time

Y contaminant concentration

1 degradable

2 bioavailable

3 extractable, non-bioavailable

4 non-extractable: persistent residues

5 non-available fraction

NOTE For curves a, b and c see description in text above.

Figure 1 — Temporal changes in extractable/bioavailable fractions, extractable/non-bioavailable fractions and non-extractable/non-bioavailable fractions of a non-polar organic contaminant (modified from [1])

In the scientific research to bioavailability a large number of definitions and concepts are in use, which reflect the discussion in the scientific world. However, for regulatory purposes a more clear and simple approach is necessary. In regulation, organic contaminants are either bioavailable or non-bioavailable. To support decisions, both should be measurable. Therefore, this document follows the approach of Ortega-Calvo et al. (2015)[2] as illustrated in Figure 2. In this approach all defined fractions are measurable as further explained in Clause 4.

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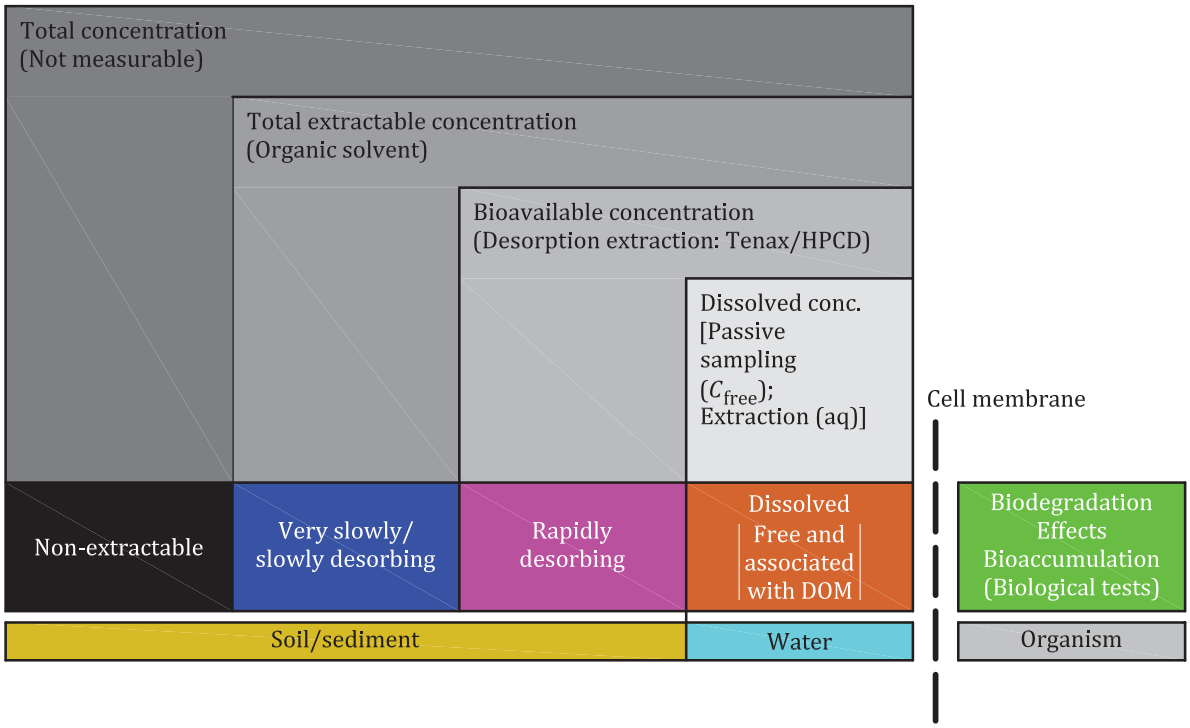

Figure 2 — Measurement of bioavailability of organic chemicals: a simplified scheme for use in regulation [Source: Ortega-Calvo et al. (2015)]

The colour boxes at the left of the biological membrane represent the distribution of pollutant molecules among four classes (non-extractable, very slowly/slowly desorbing, rapidly desorbing and water-dissolved) in soils and sediments. In the scheme in Figure 2, the bioavailable chemical is represented by the rapidly desorbing and dissolved concentrations. The chemical methods able to measure the pollutant present in each specific fraction are given in the grey boxes. The green box to the right of the cell membrane represents the processes that occur within the organism exposed to the pollutant. These biological processes can also serve as the basis for standard methods used for bioavailability measurements.

As presented in Figure 2, the bioavailable fraction can be measured using the method described in this document.

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