ICCS INTERNATIONAL COLLABORATION ON COSMETICS SAFETY

Mobility Assessment of Difficult-to-Test Substances - Addressing instability in soil

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Introduction

- Assessing mobility (M/vM) of substances has recently been introduced as a requirement of PMT/vPvM assessments under the EU CLP regulation [1].
- M/vM assessment involves evaluating the sorption potential of substances, with criteria established based on the organic carbon-normalized soil-water partition coefficient (K_{OC}).
- Certain properties of substances can render them difficult to test and assess. Guidance for so-called "difficult-to-test" substances has previously been developed for aquatic toxicity, water solubility and biodegradation [2-5].
- Such challenges can lead to inaccurate data with regulatory consequences; ICCS is reviewing this area to support best-practice guidance.
- Charged and ionizable substances are one example that has received considerable attention due to their complex sorption interactions, and questions over the suitability of the K_{OC} criteria.
- Substances showing instability or reactivity in soils and under test conditions relevant for mobility assessment is another area of challenge.
- In addition to the difficulty of measuring adsorption of the parent substance, these substances can form numerous unknown transformation products. Clarifying the identity and potential relevance of these transformation products represents a significant additional challenge.
- This poster presents findings of a recent literature review into unstable/reactive substances and their implications for mobility assessment, including recommendations and further research needs.

Findings

Challenges and potential solutions with the OECD 106 test guideline

- Substances can present as unstable or reactive due to different processes, including **hydrolysis**, **biodegradation**, **photodegradation** or **oxidation**.
- Instability of test substances is recognized as an issue under OECD TG 106 (Adsorption-Desorption using a Batch Equilibrium Method).
- This can lead to reduced recovery of test substances, affecting the reliability of results. In extreme cases it can make the test unfeasible.
- Stability of substances under OECD 106 can be determined with preliminary testing. Substances recovered at < 90% are considered abiotically unstable.
- Unstable substances should be tested by analyzing both aqueous and soil phases (the '**direct method**'). However, the direct method is regarded as tedious and may not be feasible for highly unstable substances.
- The use of radiolabeled test materials and liquid scintillation counting (LSC) as a detection method should be avoided for unstable substances.
- For **biodegradable** substances, sterilized soils can be used. Autoclaving has been suggested as a preferred technique. Sodium azide should be avoided due to changes in soil pH [6].
- **Photodegradation** can be addressed by conducting tests in darkness.
- **Hydrolysis** could be mitigated by altering temperature and pH within permitted limits, and by using water-miscible solvents instead of water for applying the test substance.

Addressing the formation of transformation products

- Unstable substances can form various unknown transformation products during testing for mobility assessment. Identifying and testing these transformation products individually would represent a significant burden.
- Further research is needed to understand the processes, identity and relevance of transformation products for the assessment.

Specific reactivity in soils

- In addition to other transformation processes, reactivity with soil metal oxides is a potentially important transformation process.
- Metal oxides, in particular manganese oxides (Mn-oxides), are well recognized in geochemistry as playing an important role in the stabilization and destabilization of organic carbon, and in the carbon cycle (Figure 1).

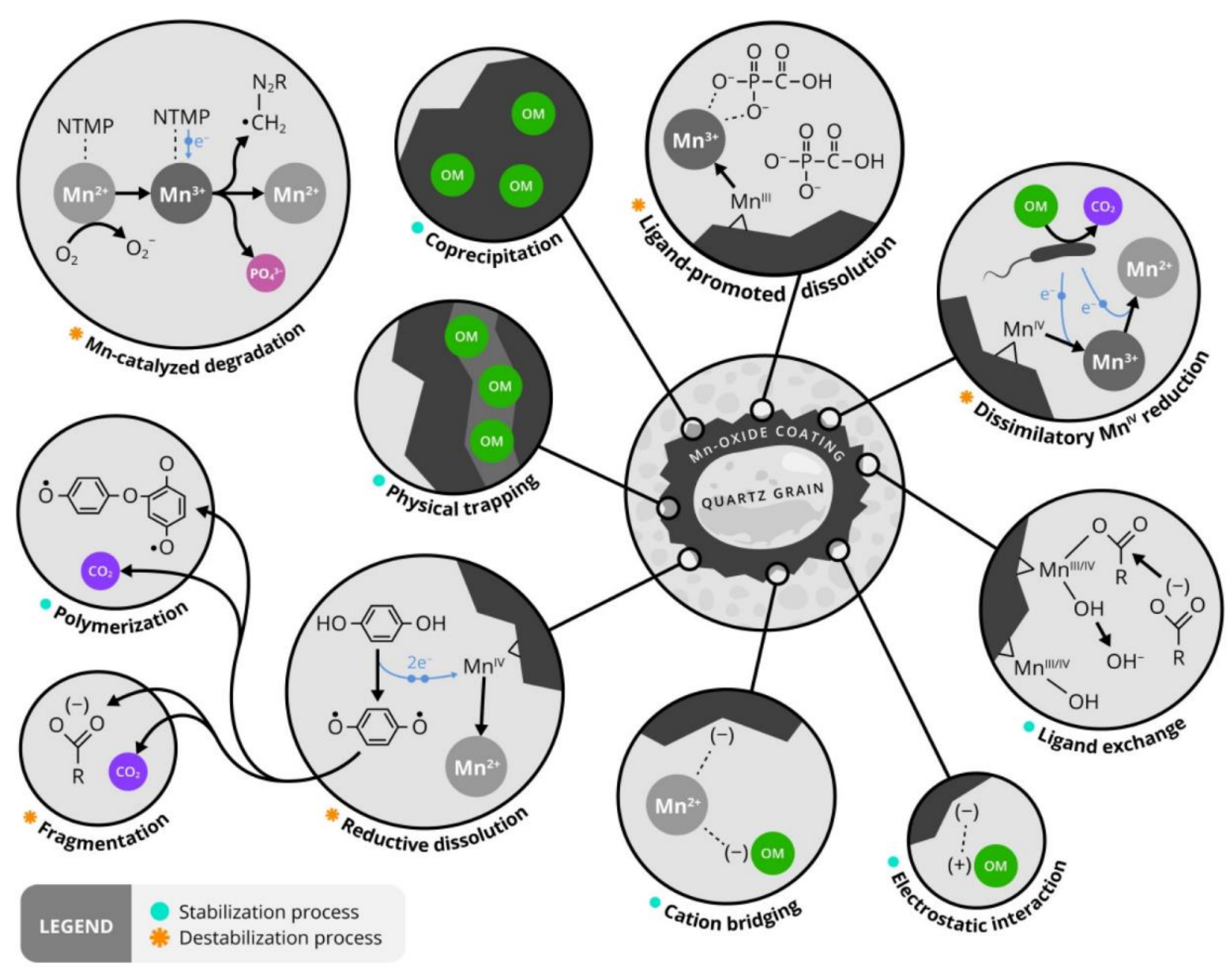

Figure 1. Examples of stabilizing and destabilizing interactions between Mn(III,IV)-oxides and organic compounds, from Li et al. (2021) [7].

- Substituted anilines and phenols are recognized as being particularly susceptible to oxidation by Mn-oxides.
- Substances with confirmed reactivity include antibacterial agents, chelating agents, dyes, known endocrine disruptors, flame retardants, pesticides, pharmaceuticals, and surfactants [8].

Recommendations

- The issue of test substance instability can present challenges for mobility assessments, but is not yet well recognized in regulatory guidance.
- Stability issues can be inferred based on knowledge of structure and properties of the substance, and confirmed through preliminary testing.
- Steps to test unstable substances according to OECD 106, and to mitigate biodegradation, hydrolysis and photodegradation, are described above.
- Certain substances (e.g. substituted anilines and phenols) can have specific reactivity in soils, which may make OECD 106 testing unfeasible.
- If OECD 106 testing is not feasible, other methods such as OECD 121 or 312 should be considered, or new analytical method development with low test concentrations in a Weight of Evidence approach. Ionizable substances present further complications for OECD 121 testing.
- Further research should be directed towards predicting the reactivity of substances under OECD 106 conditions, and in understanding pathways, identity, and relevance of transformation products for mobility assessment.
- There is a need for clear guidance to support safety assessors with the broad range of chemistries requiring mobility assessment.

References

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