

EVALUATION OF ECOTOXICITY (HP14) OF SOLID WASTE: CRITICAL ISSUES

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9a Edizione Giornate di Studio "Ricerca e Applicazione di Metodologie Ecotossicologiche"

L'ECOTOSSICOLOGIA AL TEMPO DEL COVID-19 *La ricerca, il controllo da parte delle Agenzie, il mondo dei privati*

24-25 Novembre 2020



The importance of waste classification

- ✓ In the framework of the new EU Circular Economy Action Plan¹ and the 7th Environment Action Programme² objectives, waste management should involve energy recovery and waste recycling, making it into secondary raw materials.
 - ✓ The waste classification as ecotoxic (HP₁₄) or not under the Waste Framework Directive (WFD, Dir. 2008/98/EC) is essential to make it suitable for recycling^{3,4}
 - ✓ Reg. 2017/997/UE defines the waste Hazardous Property HP 14 'Ecotoxic', which presents or may present immediate or delayed risks for ecosystems.
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- ✓ The most abundant **solid waste** are the municipal ones.
 - ✓ municipal solid waste incinerators (MSWI) reduce this waste in bottom ash (BA) and fly ash (FA).
 - ✓ BA and FA are classified as 'mirror entry' material under the WFD in the EU waste list (LoW) with specific entry codes: hazardous (BA: 19 01 11; FA: 19 01 13); not hazardous (BA 19 01 12; FA: 19 01 14).

Municipal solid waste (MSW)

About 500 kg/year/inhabitant of MSW production in Europe

Municipal incineration of solid waste

HP₁₄?

¹COM(2020) 98 final; ² Decision No. 1386/2013/EU; ³Pivato et al. 2019. doi: 10.1080/15275922.2019.1630517;

⁴Hennebert 2018. doi: 10.1016/j.wasman.2017.11.048



HP14 classification

is based on
chemical analysis of waste
(summation method of hazardous substances)

If the chemical composition is not fully known, they must be classified as ecotoxic (HP14) and ecotoxicological tests have to be performed.

Materials and methods

Several BA and FA samples from MSWI were evaluated according to CLP Reg. methods (samples preparation: OECD No. 29 2001; Aquatic Toxicity Tests: OECD 23 2019), as they are difficult samples to test (complex composition; low water solubility). A total of about 400 tests were performed.

The ecotoxicological tests performed, were: 
The effective concentrations (EC_{50}) were calculated statistically.

Ecotoxicological analysis

- Which appropriate ecotoxicological test battery has to be applied?
- How to treat wastes containing difficult substances and mixtures (e.g. sieving)?
- How to make extracts on which perform bioassays?



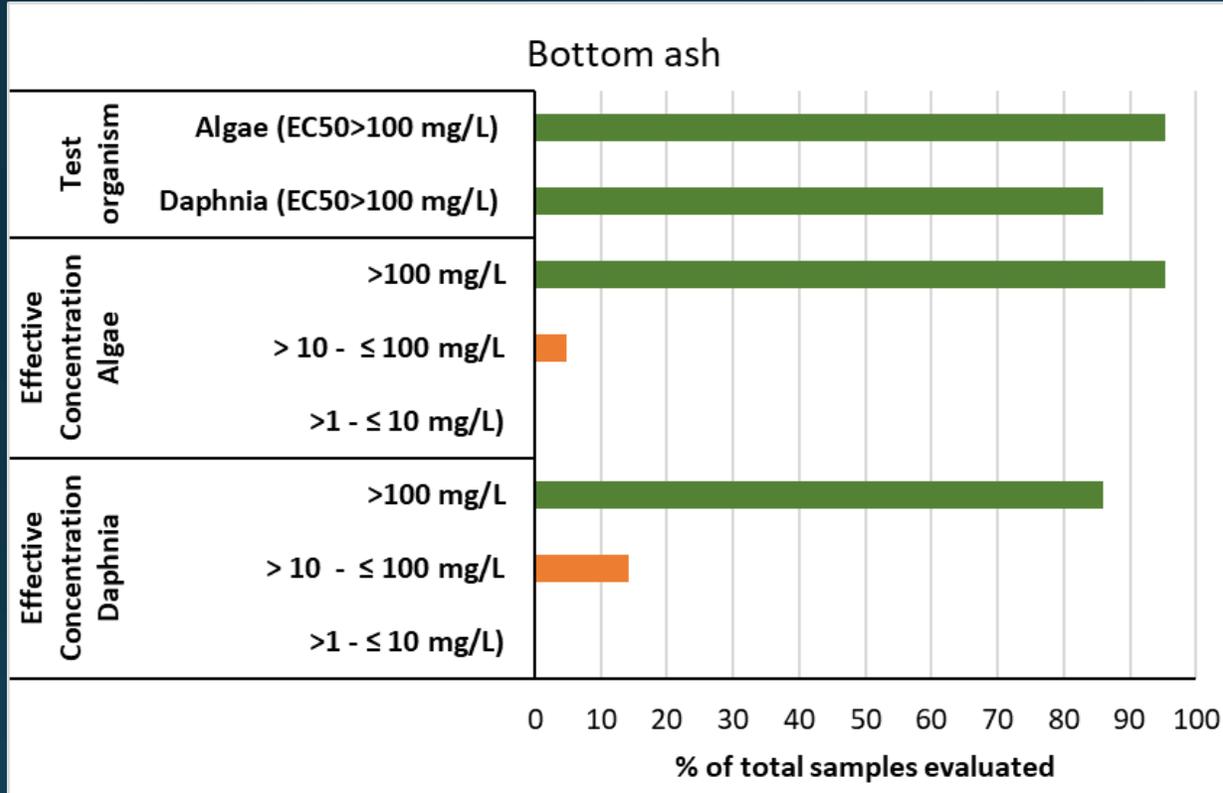
OECD No. 29: Guidance document on transformation/dissolution of metals and metal compounds in aqueous media.

OECD No. 23: Guidance document on aquatic toxicity testing of difficult substances and mixtures.

- Fish acute toxicity test (OECD TG 203);
- *Daphnia magna* acute toxicity test (OECD TG 202);
- Algal growth inhibition test (OECD TG 201).

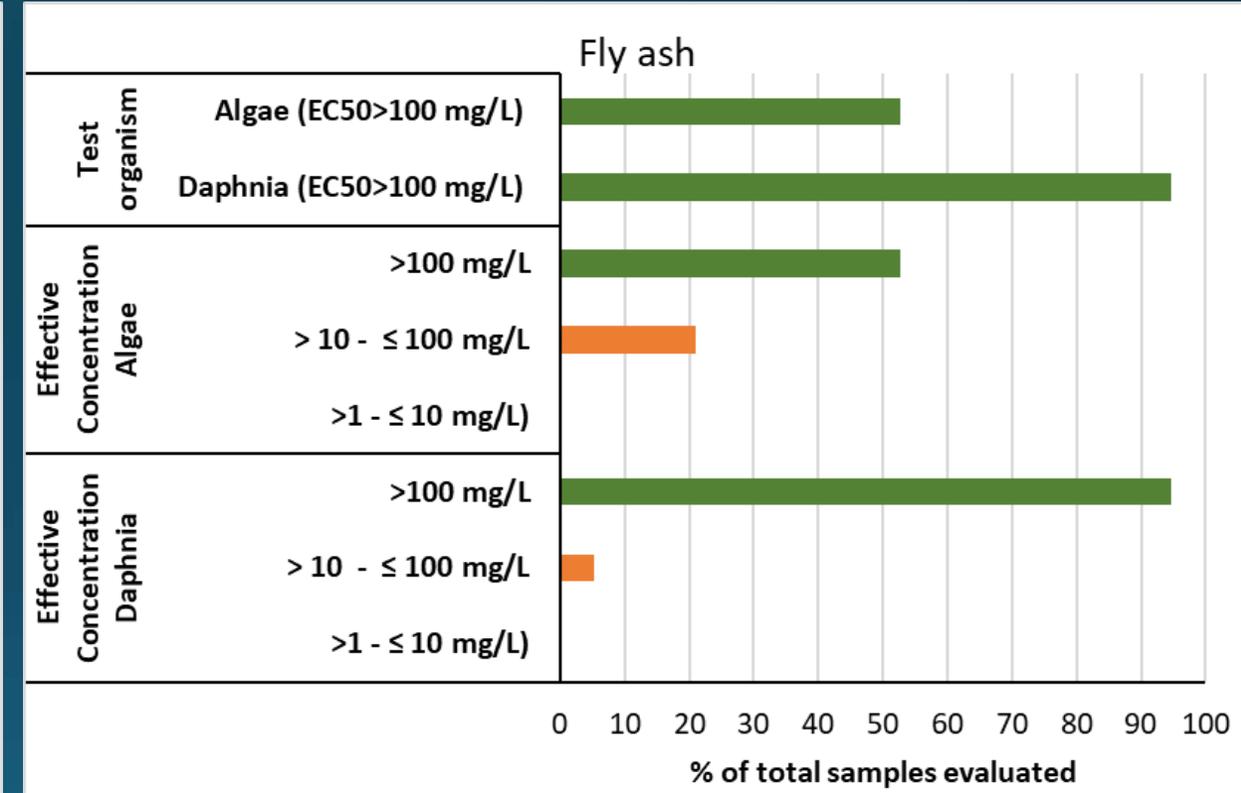
Main ecotoxicological results

- ✓ Most of the BA and FA samples were not classified as ecotoxic (EC_{50} values >100 mg/L for all tests)
- ✓ All the tests performed with fish* resulted with $EC_{50} > 100$ mg/L



Bottom ash:

- ✓ only 17% of samples resulted with EC_{50} values < 100 mg/L for 1 or 2 tested organisms
- ✓ *Daphnia* was more sensitive to this material



Fly ash:

- ✓ about 50% of samples resulted with EC_{50} values < 100 mg/L for 1 or 2 tested organisms
- ✓ Algae was more sensitive to this material

*Tests with fish were performed on samples with EC_{50} values > 100 mg/L for *Daphnia* and *Algae*

Concluding remarks

- ✓ The study showed that most of BA and FA samples can be used as a secondary raw material after its specific classification
- ✓ some critical problems for HP14 classification had arisen; different sample preparation procedures (e.g. sample grinding and homogenization, agitation speed, dissolution medium and period) can influence both chemical and ecotoxicological results and, consequently, lead to a waste classification variability.
- ✓ There is a need of specific recommendations and methodologies to be applied for HP14 classification for achieving an European harmonization and standardization of testing methods for waste classification in order to optimize waste classification, favoring its reuse
- ✓ Different waste classification has also consequences on ADR 2019 (European Agreement concerning the International Carriage of Dangerous Goods by Road)
- ✓ If it is decided to define new ecotoxicological criteria for HP14, they have to be compared with the CLP criteria to define an acceptable risk level

Work in progress:

Correlation between the ecotoxicological and chemical results with the type of MSWI.....