Literature review on the current knowledge of the ecotoxicological testing of waste (including an overview on the current legislation of the classification of waste regarding their ecotoxicity (HP14))

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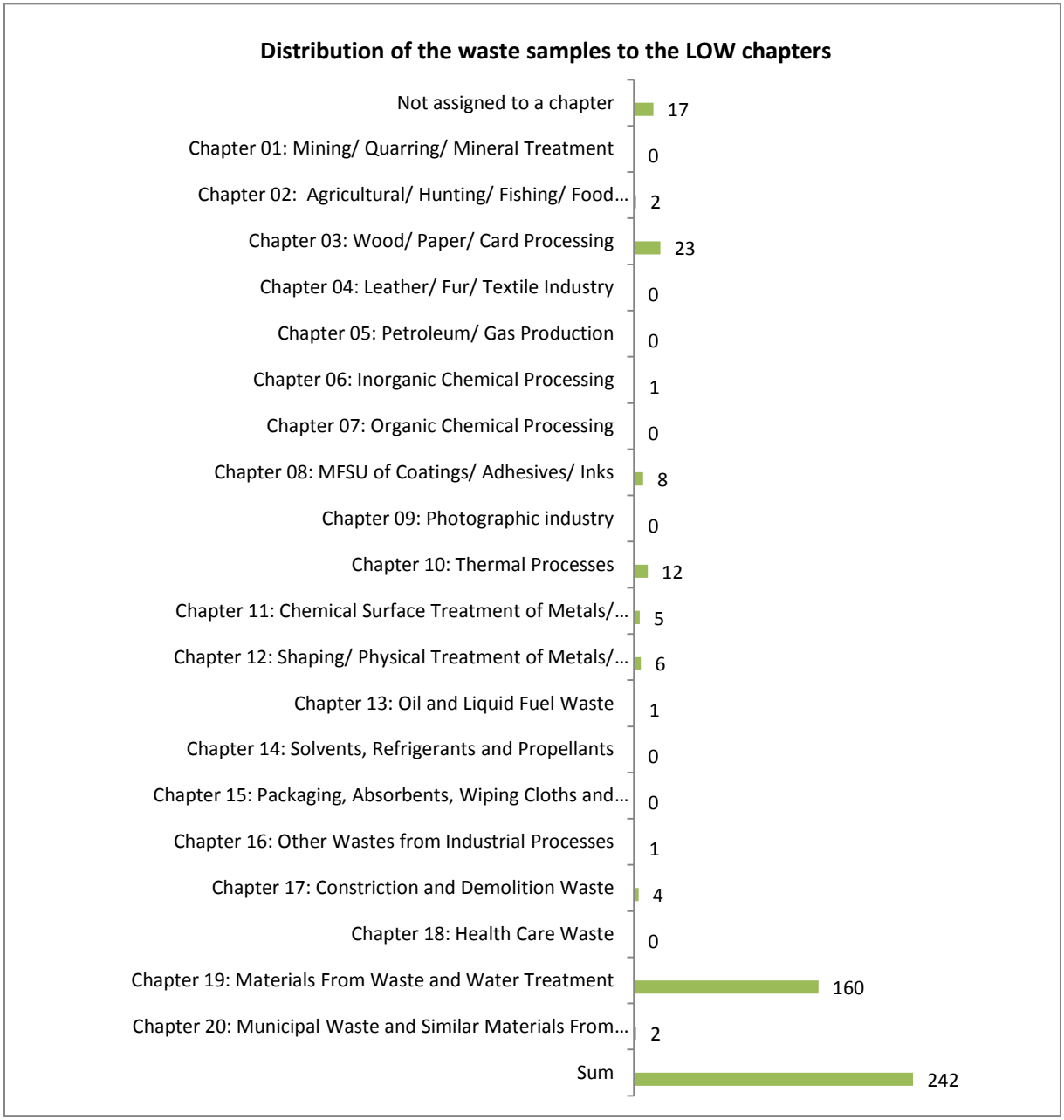
The aim of this work was to compile the current knowledge on the ecotoxicological hazard classification of wastes. In order to reach this goal a literature review was performed. Starting with some extended papers published in the last ten years (e.g. Kostka-Rick 2004; Pandard et al. 2006; Moser & Römbke 2009) individual reports, thesis and peer-reviewed papers covering ecotoxicological test data (including, if available, residue analysis) on different waste types and landfill leachates were evaluated. However, due to the clear dependency between the performance of ecotoxicological studies and legal requirements the review starts with an overview on existing directives of the European Union covering the classification of wastes (mainly the Waste Framework Directive and the European Waste List (EC 2000; EC 2008a)). So far, clear criteria for the assignment of the hazard class “HP14 ecotoxic" are lacking. Therefore, future legal requirements are discussed, arising partly due to the introduction of the CLP Regulation (originally defined for chemicals in the context of REACH). Some of the current proposals for revising the European Waste List and the Waste Framework Directive (OEKOPOL 2008), tend to focus only on the legislation on chemicals and recommend to apply the CLP rules for mixtures (Regulation (EC) No 1272/2008 (EC 2008b)) for classifying wastes as ecotoxic. Although this regulation excludes wastes from its scope, this approach can be regarded as relevant for mixtures with a limited number of constituents. For complex mixtures of only partly known composition (a common situation for wastes) it is much more difficult to implement. In this latter case, the performance of ecotoxicity tests on waste is generally considered as the most relevant approach because it allows integrating the effects of all contaminants including additive, synergistic and antagonistic effects. However, no further details about the status of the legislative progress are known to the authors.

Regarding ecotoxicological testing only 54 publications (peer-reviewed papers, agency reports or university thesis) were identified as being relevant for this review. After excluding some papers for reasons like doubled data sets, 29 publications covering 242 waste samples were chosen for a detailed analysis. They are very unevenly distributed among the 20 classes of the European List of Wastes (see next figure): 67% belong to Class 19 (Material from Waste and Water Treatments) while eight classes were never tested.



Unfortunately, in many of these studies no or insufficient descriptions on the sampling, storage or treatment of the wastes are given. This is especially evident when it comes to the documentation of the preparation and handling of eluates, a very crucial step. In addition, often data on the physico-chemical properties as well as the content of potential toxic substances of the waste samples is lacking. In detail, the literature was searched for:

- Information on the physical and chemical characterization of the waste samples;
- Test protocols, organism, endpoints, and test batteries; analysis are very general. Protocols: Out of 54 studies, 50% were perform ed to ISO and 20% present or were not reported).
- Effects on organisms, caused by waste properties (e.g. pH), or concentrations of chemicals, in particular heavy metals, and PAHs (other organic chemicals were either not.

Because of the extreme heterogeneity of the provided information the conclusions from this according to OECD guidelines (plus 10% Toxkits). Preparation of test solutions: Eluate preparation was rarely described in detail, but ca. 50% of all studies listed a guideline. Residue analysis (incl. physico-chemical properties): Often not reported; few data on salts or organic matter are available. Test species: Always listed, mostly standard species.

Regarding the toxicity of individual contaminants it can be stated that heavy metals are the best studied chemical group in waste testing. In particular, cadmium, copper, mercury (partly zinc) were most often reported as being toxic. Rarely, clear relationships between the observed toxicity and the concentrations of metals did occur; i.e. there was no correlation (e.g. Römbke et al. 2009). However, there are strong indications of the influence of abiotic conditions on the toxicity of (some) metals (e.g. pH). It became clear that information on other metals than Cd, Cu and Hg is lacking, as well as their interaction with other stressors. Among organic chemicals, PAHs are the best studied group. Unfortunately, while toxicity of all PAHs together is several times stated it is difficult to link these effects with single PAHs since many studies report only the total PAH content. Again, as in the case of metals, there is no direct correlation between effects and exposure (e.g. Baun et al. 2004). In all tests there is a clear tendency showing that acute endpoints are (much) less sensitive than chronic parameters (a good example is the SOI sample in the EU ringtest (Moser & Rombke 2009). One issue not addressed so far is the bioaccumulation of chemicals by organisms.

Conclusion:
With regard to the special conditions of waste, preferably the concentration, distribution and environmental fate of the substances contained in the waste, should be known. However, in (almost) all cases the chemical mixture of a waste sample is so complex that it is impossible to have this information quantitatively. Therefore, the performance of aquatic and terrestrial ecotoxicological tests following an ECx design is the appropriate approach for the hazard classification of wastes. When doing so, it is common sense, to choose species for ecotoxicological tests differing in their ecology, taxonomy, morphology and exposure. In addition, it is necessary to cover acute but mainly chronic endpoints. More emphasis should be given to robust guidance on sampling, storage and pre-treatment of waste samples used in ecotoxicological tests.