

Key tasks for EU waste classification according to the new legislative framework

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Abstract

The EU's aim for circular economy has set clear targets towards the waste management, in order to secure access to the resources as well as to reinforce the ability to recover raw materials from waste. The EU waste classification is under the principles described in the Waste Framework Directive 2008/98/EC (WFD), which was directly affected by the Regulation (EC) 1272/2008 on the Classification Labelling and Packaging of substances and mixtures (CLP), by means of hazard classes and categories. This paper wishes to shed light on the procedure and the approaches to determine EU waste classification. The hazard assessment of a waste is based on 15 hazardous properties (HP1 to HP15) of the Annex to Regulation (EU) 1357/2014, which must be separately examined. (In the new regulation the hazardous properties H1 to H15, as defined in Annex III to Directive (EC) 2008/98, were renamed as HP1 to HP15). The assessment starts with the investigation and identification of hazardous ingredients, which may be contained in the waste and compare their content based on the limit values defined in Regulation 1357/2014/EU. If necessary, the risk assessment may require of specific tests per hazardous property for the waste. Concluding the analysis provide useful insights on critical parameters, which affect the waste classification.

Keywords: waste classification, hazardous properties, LoW, EU legislation

1. INTRODUCTION

The EU's vision of a circular economy aims to secure access to resources, reinvent the economy by means of competitiveness and sustainability, as well as to bring benefits for both the human health and the environment. The Circular Economy covers the whole life cycle of a material: from the design phase and production processes to waste management and the market for secondary raw materials. Since 1975, when the European Union first introduced its waste hierarchy, described as a "ladder" to be climbed step-by step from bottom (landfill) to top (waste prevention) several amendments have been made to address the issue of waste [1].

Currently, a review of key targets in EU waste legislation has been conducted, in order to reinforce and simplify the existing procedures of waste classification. The last Waste Directive 2008/98/EC (Waste Framework Directive - WFD) [2] sets the basic concepts and definitions related to waste management, as well as defines the basic obligations of different relevant actors. The assessment of the hazardousness of wastes within the European Union was done based on the Annex III to Directive 2008/98/EC, which defines the properties that may render a waste as hazardous and Decision 200/532/EC on the list of waste (LoW) [3,4]. Both pieces of legislation have been affected by the Regulation (EC) 1272/2008 on the Classification Labeling and Packaging of substances and mixtures [5]. In particular, the properties that render waste hazardous have been updated by the Commission Regulation (EU) 1357/2014 [6], which replace the Annex III to Directive 2008/98/EC. The scope of this replacement was to implement the rules of classification of mixtures as hazardous and to set strict limit values concentration. Furthermore, Commission Decision (EC) 2000/532 (European List of Waste) has been revised by EU Decision (EU) 2014/955[4].

This paper is structured according to the steps of waste classification highlighting the basic concepts, as it is given in the Fig1. The procedure of the evaluation whether the waste is hazardous or not is a decision-making process that typically begins with the European Waste Catalogue, in which both the hazardous and the non-hazardous

wastes are included. The identification of the most appropriate entry for any given waste stream in the LoW is the first step on EU waste classification. The hazard assessment of a waste is based on 15 hazardous properties (HP1 to HP15) of the Annex to Regulation (EU) 1357/2014, which must be separately examined. The assessment starts with the investigation and identification of hazardous ingredients, which may be contained in the waste and compare their content based on the limit values defined in Regulation 1357/2014/EU. If necessary, the paper provides some basic concepts regarding waste sampling and chemical analysis of waste.

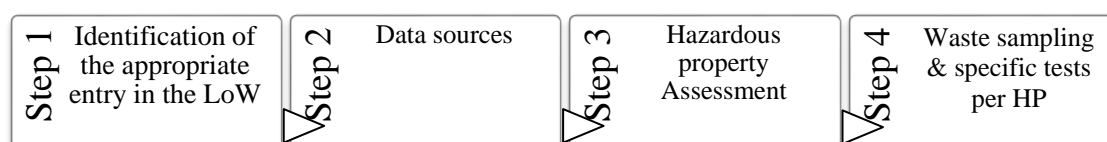


Fig. 1 Key tasks for EU waste classification according to the new legislative framework

2. LEGISLATIVE FRAMEWORK

2.1 Waste Framework Directive 2008/98/EC

The Waste Framework Directive sets the basic concepts and definitions related to waste management, such as definitions, principles and obligations. The directive determines when a substance or object fulfills the criteria for being waste and unless it is excluded from the scope of WFD, the substance or the object is subject to the waste legislation and waste classification.

According to article 3 of the WFD a hazardous waste defined as a waste which displays one or more of the hazardous properties listed in Annex III. The Commission Regulation 1357/2014 replaces the Annex III to Directive 2008/98/EC, in order to adapt the methodology and the scientific progress of the chemical legislation.

2.2 European List of Waste (LoW)

Commission Decision 2000/532/EC establish the European List of Waste (LoW). The last amendment to the LoW, has been conducted by the EU Decision 2014/955/EU, in order to adapt the scientific progress that have been set by chemicals legislation. Legally, the LoW should have been applied since 1 June 2015. The procedure of the evaluation whether the waste is hazardous or not is a decision-making process that typically begins with the European Waste Catalogue, in which both the hazardous and the non-hazardous wastes are included [7].

The different types of waste in the list are fully defined by the six-digit code. The LoW contains 20 chapters (two digit codes), further divided into sub-chapters (four digit codes) and entries (six digit codes). The six-digit codes that are marked by an asterisk (*) shall be consider as hazardous. On the other hand all the other entries are considered as non- hazardous.

The methodology for the selection of the appropriate code for every waste stream is based on the identification of the source generating the waste, by choosing the first 2 digits from the Chapters 01 to 12 or 17 to 20. If no appropriate waste code can be found in Chapters 01 to 12 or 17 to 20, the Chapters 13, 14 and 15 must be examined

to identify the waste. As last choice the waste must be identified according to Chapter 16. If the waste is not in Chapter 16 either, the 99 code (wastes not otherwise specified) must be used in the section of the list corresponding to the activity identified in step one.

The identification of the most appropriate entry, between the 842 entries in the LoW, is a key tool in the classification of waste and requires objectiveness

3. The assessment and classification of waste

3.1 Identification of the appropriate entry in the LoW

The assessment and classification of waste is applied to each distinct waste stream generated by a producer. Unless the waste stream is specifically excluded from the scope of WFD, it is subject to the waste legislation including waste classification. As a second step, the waste evaluator should identify the most appropriate entry for any given waste stream in the LoW, as it is given in the Fig. 2. In many cases more than one code will need to be considered at this stage [8].

The question that arises is in which entry the waste stream shall be assigned (a) absolute hazardous entry, (b) absolute non-hazardous entry or (c) Mirror entry

- **Absolute hazardous entry:** The waste stream is marked with an asterisk and must not be allocated in a non-hazardous entry. It will still be necessary to proceed in the evaluation of the 15 hazardous properties of the Annex to Regulation 1357/2014/EU, in order to fulfill the provisions laid down in Article 19 of the WFD on correct labeling of hazardous waste (e.g. for filling a consignment note for waste movements).
- **Absolute non-hazardous entry:** In case a waste stream is non-hazardous shall be classified as non-hazardous without any further assessment
- **Mirror entry:** Some wastes are not automatically hazardous or non-hazardous - they are called mirror entry wastes [6]. Mirror entries are a group of at least two alternative entries. It is necessary to proceed in the evaluation of the 15 hazardous properties of the Annex to Regulation.

3.2 Data sources

The risk assessment of a waste stream is based on the investigation and identification of hazardous ingredients, which are being contained in the waste. Chemical analysis (particularly for inorganic substances) does not always identify the specific components but usually provides information on the individual anions and cations. In such cases, the waste holder/ evaluator may need to determine what precise substances are likely to be present either by further analysis or by applying knowledge of the process / activity that produced the waste. If there is any doubt, the worst case substance should be considered to be present [8]. Another way is to derive mineralogical forms of the elements from leachate composition at different pH and geochemical modeling [9].

Once the composition of the waste stream is determined, the next step is to collect all the available data for the classification of each compound. The major data sources are (a) Tables 3.1 and 3.2 of Annex VI to the CLP Regulation, (b) technical dossier from registered substances according to REACH Regulation and if the composition of the waste has not change the SDS provided by the suppliers. A useful tool in order to find

all the available information on hazardous substances is the research tool of C&L inventory.

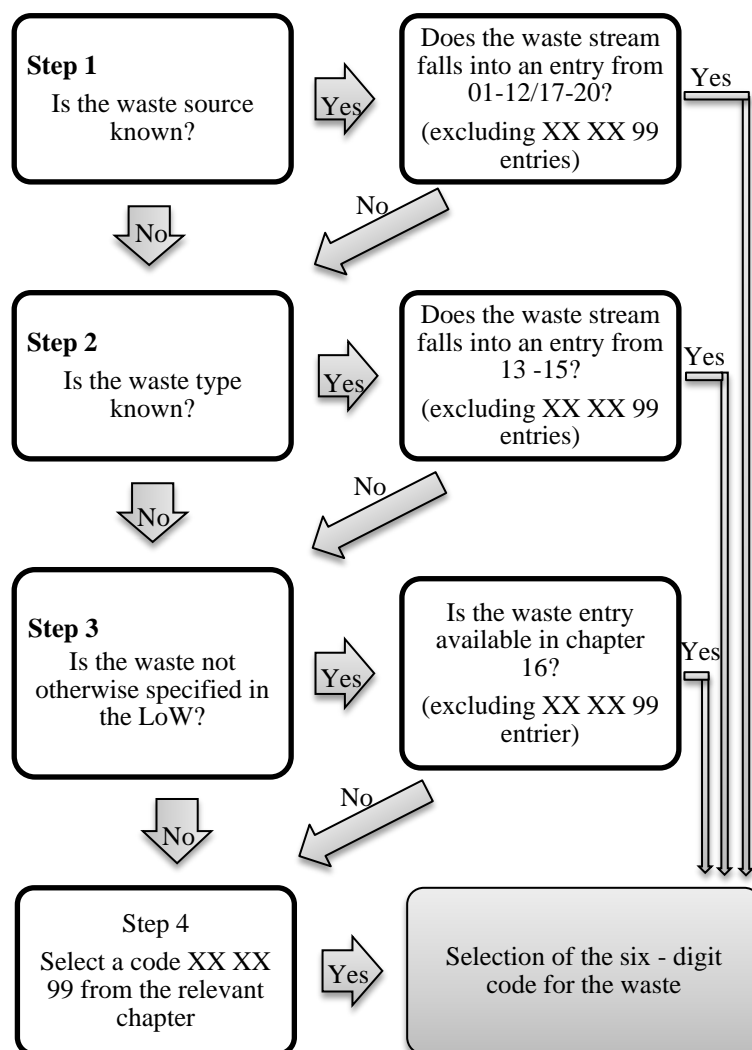


Fig.2 The assessment for the identification of the proper six–digit code from the LoW

3.3 Hazardous property assessment

The risk assessment, of a waste stream in order to determine where it belongs in an absolute hazardous or in an absolute non-hazardous entry, is based the Hazardous Property-criteria and related thresholds that are present in Regulation 1357/2014. Obtaining sufficient information about the composition of the waste stream, the waste evaluator should separately examine the 15 hazardous properties (HP1 to HP15), in order to determine if the waste might display any of the hazard categories listed in the Regulation 1357/2014/EU. The Table 1 provides an overview of the 15 hazardous properties.

Regarding the calculation method, it should be noted that hazardous substance content values in waste as they have been determined, e.g. by sampling and chemical analysis of the waste under consideration, have to be compared against the concentration limits listed in Regulation 1357/2014/EU.

Table 1 Hazardous properties of the Annex to Regulation 1357/2014/EU

HP1	“Explosive” : It refers to the waste which is capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic waste, explosive organic peroxide waste and explosive self-reactive waste is included.
HP2	“Oxidising” : It refers to the waste which may, generally by providing oxygen, cause or contribute to the combustion of other materials.
HP3	“Flammable” : It refers to the waste which applies to at least one of the following : — flammable liquid waste: liquid waste having a flash point below 60 °C or waste gas oil, diesel and light heating oils having a flash point > 55 °C and ≤75 °C; — flammable pyrophoric liquid and solid waste: solid or liquid waste which, even in small quantities, is liable to ignite within five minutes after coming into contact with air; — flammable solid waste: solid waste which is readily combustible or may cause or contribute to fire through friction; — flammable gaseous waste: gaseous waste which is flammable in air at 20 °C and a standard pressure of 101.3 kPa; — water reactive waste: waste which, in contact with water, emits flammable gases in dangerous quantities; — other flammable waste: flammable aerosols, flammable self-heating waste, flammable organic peroxides and flammable self-reactive waste.
HP4	“Irritant —skin irritation and eye damage” : Waste which on application can cause skin irritation or damage to the eye.
HP5	“Specific Target Organ Toxicity (STOT)/Aspiration Toxicity” : waste which can cause specific target organ toxicity either from a single or repeated exposure, or which cause acute toxic effects following aspiration.
HP6	“Acute Toxicity” : waste which can cause acute toxic effects following oral or dermal administration, or inhalation exposure.
HP7	“Carcinogenic” : waste which induces cancer or increases its incidence.
HP8	“Corrosive” : waste which on application can cause skin corrosion.
HP9	“Infectious” : waste containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms.
HP10	“Toxic for reproduction” : waste which has adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in the offspring.
HP11	“Mutagenic” : waste which may cause a mutation, that is a permanent change in the amount or structure of the genetic material in a cell.
HP12	“Release of an acute toxic gas” : waste which releases acute toxic gases (Acute Tox. 1, 2 or 3) in contact with water or an acid.
HP13	“Sensitising” : waste which contains one or more substances known to cause sensitising effects to the skin or the respiratory organs.
HP14	“Ecotoxic” : waste which presents or may present immediate or delayed risks for one or more sectors of the environment.
HP15	“Waste capable of exhibiting a hazardous property listed above not directly displayed by the original waste” .

However the definition of the 15 hazard properties of waste has not been completed, since the attribution of the hazardous property HP 14 is made on the basis of the criteria laid down in Annex VI to Council Directive 67/548/EEC. The assessment of HP 14 has not been changed to allow time for Directorate General of the Environment of European Commission to complete a study that is examining the impacts of four different calculation methods. The legislation limited the first two levels of chronic ecotoxicity, but including extended M-factors [5].

3.4 Waste sampling & specific tests per HP

In some cases the realistic risk coming from a waste is possibly lower than the predicted risk. In such cases if a testing of the waste in accordance with the Regulation (EC) 440/2008 reveals that the waste in question does not display the hazard property, the results of the test shall prevail [11]. It should be noted that proceeding to testing for toxicological and eco-toxicological hazard properties may be rather costly and time consuming. Furthermore, the aforementioned tests are in contrast with Article 7 of CLP Regulation that tests on animals shall be undertaken only where no other alternatives exist.

Additionally testing of a specific hazard property is preferable in cases when a waste stream is associated with a specific hazard property. For example, if a waste producer knows that according to the production line the waste is composed with a substance with harmonized classification as H226 Flammable liquid 3, even in low concentrations, it is advisable to test the waste stream for the hazardous property HP3-Flammable. The test results are considered as the most accurate and realistic assessment, since it was conducted in the original waste stream. If the test method verifies that the waste has flammable properties the waste holder must classify it as hazardous. However, it will still be necessary to proceed in the evaluation of all the other hazardous properties of the Annex to Regulation 1357/2014/EU, as it is mentioned before.

The Table 2 provides some examples for the test methods per hazardous property according to the previous mentioned Regulation.

Table 2 Examples of testing methods per hazardous property

HP1	<ul style="list-style-type: none"> • A.14. Explosive Properties • Tests according to the CLP Criteria [12] for: <ul style="list-style-type: none"> ➤ Organic peroxides ➤ self-reactive substances and mixtures ➤ explosives
HP2	<ul style="list-style-type: none"> • A.17. Oxidising Properties (Solids) • A.21. Oxidising Properties (Liquids) • Tests according to the CLP Criteria [12] for: <ul style="list-style-type: none"> ➤ Oxidising gases ➤ Oxidising liquids ➤ Oxidising solids
HP3	<ul style="list-style-type: none"> • A.10. Flammability (Solids) • A.11. Flammability (Gases) • A.12. Flammability (Contact with water) • Tests according to the CLP Criteria [12] for: <ul style="list-style-type: none"> ➤ flammable gases ➤ aerosols ➤ flammable liquids ➤ flammable solids ➤ self-reactive substances and mixtures ➤ pyrophoric liquids ➤ pyrophoric solids ➤ self-heating substances and mixtures ➤ water reactive substances ➤ organic peroxides
HP4	<ul style="list-style-type: none"> • Test No. 122: Determination of pH, Acidity and Alkalinity [13]

	<ul style="list-style-type: none"> • B.46 In Vitro Skin Irritation: Reconstructed Human Epidermis Test Method <p>The Regulation (EC) 440/2008 presents test methods that are in contrast with Article 7 of CLP Regulation, that tests on animals shall be undertaken only where no other alternatives exist.</p>
HP5	<ul style="list-style-type: none"> • Tests for specific target organ toxicity and aspiration toxicity properties according to the CLP Criteria [12] <p>The Regulation (EC) 440/2008 presents test methods that are in contrast with Article 7 of CLP Regulation, that tests on animals shall be undertaken only where no other alternatives exist.</p>
HP6	<ul style="list-style-type: none"> • Tests for acute toxicity properties according to the CLP Criteria [12] <p>The Regulation (EC) 440/2008 presents test methods that are in contrast with Article 7 of CLP Regulation, that tests on animals shall be undertaken only where no other alternatives exist.</p>
HP7	<ul style="list-style-type: none"> • Tests for carcinogenic properties according to the CLP Criteria [12] • The Regulation (EC) 440/2008 presents test methods that are in contrast with Article 7 of CLP Regulation, that tests on animals shall be undertaken only where no other alternatives exist.
HP8	<ul style="list-style-type: none"> • B.40. In Vitro Skin Corrosion: Transcutaneous Electrical Resistance Test (TER) • B.40 BIS. In Vitro Skin Corrosion: Human Skin Model Test • Tests for corrosive properties according to the CLP Criteria [12]
HP9	There are no test methods given in the Test Methods Regulation.
HP10	<ul style="list-style-type: none"> • Tests for reproductive toxicity according to the CLP Criteria [12] • OECD 473 Test / B10. Cytogenicity, in vitro in mammalian cells [14]
HP11	<ul style="list-style-type: none"> • B.10. Mutagenicity – In Vitro Mammalian Chromosome Aberration Test • B.13/14. Mutagenicity: Reverse Mutation Test Using Bacteria • B.15. Mutagenicity Testing and Screening for Carcinogenicity Gene Mutation – Saccharomyces Cerevisiae • B.17. Mutagenicity – In Vitro Mammalian Cell Gene Mutation Test
HP12	There are no direct test methods for HP 12.
HP13	<ul style="list-style-type: none"> • Tests for sensitising properties according to the CLP Criteria [12]
HP14	The Regulation (EC) 440/2008 presents test methods that are in contrast with Article 7 of CLP Regulation, that tests on animals shall be undertaken only where no other alternatives exist.
HP15	<ul style="list-style-type: none"> • Tests for explosive properties (EUH001, EUH044 and H205) according to the CLP Criteria [12]

4. Conclusions

Nowadays, the recognition if a waste is hazardous or nonhazardous is a key tool in the entire chain of waste management and of life – cycle of an operation. The proper waste classification includes the waste evaluation and its hazard properties, which is a key task that affects waste producers, waste holders, and competent authorities.

The EU waste law has raised the concern on the impact of the waste management for health and the environment. The revision of the legislation has been conducted, in order to reinforce and simplify the existing procedures of waste classification and takes into consideration the Regulation (EC) 1272/2008 on the Classification Labelling and Packaging of substances and mixtures.

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