International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
IJCSRR @ 2026
www.ijcsrr.org

European Classification and Labelling of Hazardous Products

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ABSTRACT: By adopting the CLP Regulation, the European Union has aligned its classification and labelling system for hazardous substances with a globally accepted standard based on the United Nations' Globally Harmonised System of Classification and Labelling of Chemicals (GHS). This article summarizes the key aspects of the current status of the CLP Regulation. It introduces the available labelling elements, such as hazard pictograms, signal words, hazard statements, and precautionary statements. This is followed by an overview of physical hazard classes, health hazards, environmental hazards, and an additional hazard class. The communication elements for each hazard class are presented in a tabular overview. Subsequently, general and specific criteria for the classification of mixtures are listed. The discussion section examines current legislative trends.

KEYWORDS: CLP Regulation, GHS, physical hazard classes, hazard pictograms, signal words, hazard statements, precautionary statements.

INTRODUCTION

To ensure the safe handling of products containing hazardous substances, the European Union enacted Regulation (EC) No 1272/2008 [1]. Commonly known as the CLP Regulation, it is binding in all member states [2]. It governs the classification and labelling of hazardous substances by assigning hazard potentials to defined hazard classes, for which specific testing requirements and labelling elements exist. The regulation covers four overarching areas of hazard potential: physicochemical hazards, health hazards, environmental hazards, and other hazards. Within these areas, there are currently 17 hazard classes for physical hazards in the European Union [3], 11 classes for health hazards, 4 classes for environmental hazards, and one class for other hazards [4]. For further specification, individual hazard classes are subdivided into hazard categories where necessary. These categories represent a gradation of hazard potential within each class. While a Category 1 substance poses a high level of hazard, the hazard level for a Category 2 substance is generally lower. Each category is assigned a shorthand code that clearly indicates both the hazard class and the hazard category.

Pictograms, signal words, and hazard statements are used to label hazardous substances and mixtures. Additionally, precautionary statements are provided to ensure the safe and proper handling of these chemicals. Detailed information regarding this hazard communication can be found in Articles 17 et seq. and in Annex I of the CLP Regulation. Substances and mixtures are classified based on the criteria specified in these sections of the Regulation. The outstanding advantage of the CLP Regulation over older European chemicals legislation lies in the application of standards developed by the United Nations and made available to all interested countries under the name Globally Harmonised System of Classification and Labelling of Chemicals (GHS) [5]. This regulatory framework was first published by the United Nations in 2003 and has been updated every two years since then. The 11th edition was released in 2025 [6].

MATERIALS AND METHODS

To identify the specific European classification and labelling criteria for hazardous substances, the CLP Regulation -in its original version and with relevant amendments - was reviewed and analyzed. Information and illustrative material from the Federal Institute for Occupational Safety and Health [7] proved to be a helpful resource.

RESULTS

A) Labelling elements

The Regulation provides several labelling elements for classification and labelling: signal words, hazard pictograms, hazard statements, and precautionary statements. These elements must be used depending on the outcome of the classification assessment and the intended use of the product.

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1. Signal words

According to Article 2 of the CLP Regulation, two signal words are available for an initial, broad classification of the hazard potential posed by a substance or mixture. The word DANGER warns of severe hazards; its code is Dgr. The word WARNING, with the code Wng, signals a lower hazard potential. The context in which these signal words are to be used is specified in Article 20 of the CLP Regulation and the tables in Annex I, Parts 2 to 5.

2. Hazard pictograms

In accordance with Annex V of the CLP Regulation, nine symbolic representations in the form of hazard pictograms are available for hazard communication to warn the user visually. They are to be used in compliance with the requirements of Article 19 of the Regulation. Each pictogram has a code consisting of the abbreviation GHS and a number and a symbol designation. The section references in parentheses in the following text refer to the listing of the respective classifications in the CLP Regulation.

GHS01  exploding bomb

This pictogram warns of the risk of explosion and is used to label unstable explosives and explosive mixtures; explosives, mixtures, and articles containing explosives of subclasses 1.1, 1.2, 1.3, and 1.4 (Section 2.1); self-reactive substances and mixtures of types A and B (Section 2.8); and organic peroxides of types A and B (Section 2.15).

GHS02  flame

The flame symbol warns of the risk of ignition or self-ignition. It is used for numerous hazard categories: flammable gases of hazard categories 1A and 1B (Section 2.2); aerosols of hazard categories 1 and 2 (Section 2.3); flammable liquids of hazard categories 1, 2, and 3 (Section 2.6); flammable solids of hazard categories 1 and 2 (Section 2.7); self-reactive substances and mixtures of types B, C, D, E, and F (Section 2.8); pyrophoric liquids of hazard category 1 (Section 2.9); pyrophoric solids of hazard category 1 (Section 2.10); self-heating substances and mixtures of hazard categories 1 and 2 (Section 2.11); substances and mixtures which, in contact with water, emit flammable gases (hazard categories 1, 2, and 3; Section 2.12); organic peroxides of types B, C, D, E, and F (Section 2.15); and desensitized explosives and explosive mixtures of hazard categories 1, 2, 3, and 4 (Section 2.17).

GHS03  flame over circle

This symbol indicates a risk of intensifying or causing a fire. It is found on oxidizing gases of hazard category 1 (Section 2.4), oxidizing liquids of hazard categories 1, 2, and 3 (Section 2.13), and oxidizing solids of hazard categories 1, 2, and 3 (Section 2.14).

GHS04  gas cylinder

The gas cylinder symbol warns of the risk of bursting or cold injuries. It identifies gases packaged under pressure: compressed gases, liquefied gases, refrigerated liquefied gases, or dissolved gases (Section 2.5).

GHS05  corrosion

The corrosion symbol warns of the destruction of metals (physical hazards) or the destruction of tissue (health hazards). It is associated with the following warnings: corrosive to metals, hazard category 1 (Section 2.16); skin corrosion, hazard categories 1, 1A, 1B, 1C (Section 3.2); or serious eye damage, hazard category 1 (Section 3.3).

GHS06  skull and crossbones

The skull and crossbones symbol warns of poisoning. It specifically indicates acute toxicity (oral, dermal, or inhalation) of hazard categories 1, 2, and 3 (Section 3.1).

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GHS07  exclamation mark

The exclamation mark is used for irritant effects, health damage, or damage to the ozone layer: acute toxicity (oral, dermal, inhalation) Hazard Category 4 (Section 3.1), skin irritation Hazard Category 2 (Section 3.2), eye irritation Hazard Category 2 (Section 3.3), skin sensitization Hazard Categories 1, 1A, 1B (Section 3.4), specific target organ toxicity (single exposure) Hazard Category 3 – respiratory tract irritation and narcotic effects (Section 3.8), and hazardous to the ozone layer, Hazard Category 1 (Section 5).

GHS08  health hazard

This symbol warns of very serious health damage: respiratory sensitization Hazard Categories 1, 1A, 1B (Section 3.4), germ cell mutagenicity Hazard Categories 1A, 1B, 2 (Section 3.5), carcinogenicity Hazard Categories 1A, 1B, 2 (Section 3.6), reproductive toxicity Hazard Categories 1A, 1B, 2 (Section 3.7), specific target organ toxicity (single exposure) Hazard Categories 1, 2 (Section 3.8), specific target organ toxicity (repeated exposure) Hazard Categories 1, 2 (Section 3.9), and aspiration hazard Hazard Category 1 (Section 3.10).

GHS09  environment

This symbol indicates toxicity to aquatic organisms or long-term damage to the ecosystem: acute aquatic hazard (Category Acute 1) and long-term aquatic hazard (Categories Chronic 1 and Chronic 2) (Section 4.1).
To prevent a label from bearing too many symbols - which could confuse rather than inform - Article 26 of the CLP Regulation establishes a rule of precedence. For instance, it states that if the hazard pictogram GHS05 is required, the hazard pictogram GHS07 (indicating skin or eye irritation) does not also need to be displayed.

3. Hazard and precautionary statements

Hazard communication is rounded out by the text of the hazard statements. These are set out in Annex III of the CLP Regulation in the relevant national languages of the Member States. For physical hazards, they begin with the letter H, followed by the digit 2 and two additional digits: H2xx. For health hazards, the digit 2 is replaced by the digit 3, while for environmental hazards, the digit 4 appears at the beginning of the numerical sequence. This aligns with UN GHS requirements. In addition, there are EU-specific hazard statements that begin with EUH rather than H. These serve as European supplements, warning of hazards not addressed in the UN system. Examples include EUH070 ("Toxic by eye contact") and EUH014 ("Reacts violently with water"). Article 25 and Annex II, Part 1 of the CLP Regulation establish legally binding requirements for the correct use of these hazard statements.
Following the identification of potential hazards via hazard statements, labels typically display instructions for the safe handling of the product. Precautionary statements use a coding system similar to that of hazard statements. Their codes begin with the letter P, followed by three digits. Statements coded P1xx provide general advice, such as "Keep out of reach of children." The P2xx code series covers preventive measures. A third group provides instructions on how to respond to accidents, a fourth group covers safe storage, and a fifth group addresses safe disposal. The precautionary statements are listed in Annex IV of the CLP Regulation in all required national languages. Article 22 outlines the applicable legal requirements.

B) Physical hazard classes according to Annex I of the CLP Regulation

Substances and mixtures undergo testing and are assigned to hazard classes and hazard categories based on the test results. The list of classes in the CLP Regulation begins in Section 2 with physical hazards.

1. Explosives

According to the CLP Regulation, this class comprises explosive substances, explosive mixtures, and articles containing explosives that present a mass explosion hazard; pose hazards from fragments, blast, or projection; generate fire, smoke, heat, or loud noise; or are manufactured to produce an explosion or a pyrotechnic effect. Classification criteria include explosive properties, handling sensitivity, and thermal stability. The Regulation defines seven hazard categories. Nitroglycerin and dynamite (see nitroglycerin

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with phlegmatizer up to a maximum of 40%) are classified in this hazard class with hazard statement H200. Black powder, TNT, and hydroxylammonium nitrate must be assigned hazard statement H201.

Table 1: Classification and labelling of explosives

Unst., Expl.	GHS01	Danger	H200	Unstable explosives
Expl. 1.1	GHS01	Danger	H201	Explosive; mass explosion hazard
Expl. 1.2	GHS01	Danger	H202	Explosive, severe projection hazard
Expl. 1.3	GHS01	Danger	H203	Explosive; fire, blast or projection hazard
Expl. 1.4	GHS01	Warning	H204	Fire or projection hazard
Expl. 1.5	-	Danger	H205	May mass explode in fire
Expl. 1.6	-	-	-	-

2. Flammable gases

The CLP Regulation distinguishes between two categories in this hazard class. Category 1 includes gases that, at 20°C and a standard pressure of 101.3 kPa, have a lower explosive limit of 13% or less, or whose explosive range (upper explosive limit minus lower explosive limit) is at least 12 percentage points. Gases with special reactivity also fall into this category. If a gas can spontaneously ignite in air at a temperature of 54°C or less, it is referred to as a self-igniting or pyrophoric gas. A chemically unstable gas, on the other hand, can react explosively even without air or oxygen. Category 2 includes all remaining gases that have an explosive range when mixed with air at 20°C and a standard pressure of 101.3 kPa.

Classification criteria are flammability and the explosive range when mixed with air. Flammable gases are classified into categories 1A, 1B, or 2. Flammable gases that are also pyrophoric (self-igniting) and/or chemically unstable are always classified in category 1A. Examples of extremely flammable and chemically unstable gases with hazard statements H220 and H230 are acetylene and ethylene oxide. Monosilane, on the other hand, is a representative of the pyrophoric gas category with hazard statements H220 and H232.

Table 2: Classification and labelling of flammable gases

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Flam. Gas 1A	GHS02	Danger	H220	Extremely flammable gas
Pyr. Gas	GHS02	Danger	H220 H232	Extremely flammable gas May ignite spontaneously if exposed to air
Chem. Unst. Gas A	GHS02	Danger	H220 H230	Extremely flammable gas May react explosively even in the absence of air
Chem. Unst. Gas B	GHS02	Danger	H220 H231	Extremely flammable gas May react explosively even in the absence of air at elevated pressure and/or temperature
Flam. Gas 1B	GHS02	Danger	H221	Flammable gas
Flam. Gas 2	-	Warning	H221	Flammable gas

3. Flammable aerosols

Under the CLP Regulation, aerosols are defined as non-refillable containers made of metal, glass, or plastic. They have a dispensing device, such as a spray nozzle, and contain liquid, paste-like, or powdered products. These products can be dispensed in various forms, such as foam, paste, or powder, using a propellant.

Classification criteria include the proportion of flammable substances, the heat of chemical combustion, and, for foam aerosols, the results of a foam test, or, for spray aerosols, the results of a flame jet test and a drum test. Classification is carried out in three categories. This class includes, for example, perfumery products and other household aerosols.

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Table 3: Classification and labelling of flammable aerosols

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Aerosol 1	GHS02	Danger	H222 H229	Extremely flammable aerosol Pressurised container: May burst if heated
Aerosol 2	GHS02	Warning	H223 H229	Flammable aerosol Pressurised container: May burst if heated
Aerosol 3	-	Warning	H229	Pressurised container: May burst if heated

4. Oxidizing gases

This class includes gases or gas mixtures that promote the oxidation of other substances more strongly than air. Many of these gases release oxygen. The classification criterion is their oxidizing power, which must be greater than 23.5% according to ISO 10156. Oxygen gas, chlorine gas, and fluorine gas meet this requirement.

Table 4: Classification and labelling of oxidizing gases

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Ox. Gas 1	GHS03	Danger	H270	May cause or intensify fire; oxidiser

5. Gases under pressure

This category includes gases that are either under pressure or packaged in liquefied or liquefied and cryogenically frozen form. Dissolved gases also belong to this class. The classification criterion is the state of matter in packaged form. Industrial gases in gas cylinders, such as helium or nitrogen, fall into the category Pressed Gas (Comp.). If they are transported in cryogenically frozen liquefied form, they belong to the category Pressed Gas (Ref. Liq.)

Table 5: Classification and labelling of gases under pressure

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Press. Gas (Comp.)	GHS04	Warning	H280	Contains gas under pressure; may explode if heated
Press. Gas (Liq.)	GHS04	Warning	H280	Contains gas under pressure; may explode if heated
Press. Gas (Diss.)	GHS04	Warning	H280	Contains gas under pressure; may explode if heated
Press. Gas (Ref. Liq.)	GHS04	Warning	H281	Contains refrigerated gas; may cause cryogenic burns or injury

6. Flammable liquids

This class includes all liquids with a flash point of 60°C or lower. According to the CLP Regulation, the flash point is defined as "the lowest temperature at which a flammable vapour-air mixture can form above a substance". An additional distinguishing feature for differentiation within this class is the boiling point. Classification is into three hazard categories: Category 1, if the flash point is below 23°C and the boiling point is less than or equal to 35°C; Category 2, if the flash point is below 23°C and the boiling point is above 35°C; and Category 3, if the flash point is in the range of 23°C to 60°C. Examples include diethyl ether (H224), ethanol (H225), and butanol (H226).

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Table 6: Classification and labelling of flammable liquids

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Flam. Liq. 1	GHS02	Danger	H224	Extremely flammable liquid and vapour
Flam. Liq. 2	GHS02	Danger	H225	Highly flammable liquid and vapour
Flam. Liq. 3	GHS02	Warning	H226	Flammable liquid and vapour

7. Flammable solids

Flammable solids are characterized by being either readily combustible or capable of causing or contributing to a fire through friction. Substances or mixtures are considered readily combustible if, for example, they can be easily ignited by a burning match and the flames spread within a specific time or at a defined rate.

Classification criteria are the burning rate and burning time. The following conditions must be met for classification in Category 1: In the case of non-metallic powders, a wetted zone must not stop the fire, and the burning time must be less than 45 seconds or the burning rate must exceed 2.2 mm/s. For metal powders, the burning time must not exceed 5 minutes.

Classification in Category 2 applies to metal powders if the burning time is between 5 and a maximum of 10 minutes. For all other substances, the criteria are that a wetted zone stops the fire for at least 4 minutes and the burning time is less than 45 seconds or the burning rate exceeds 2.2 mm/s. Examples include metal powders (found in both categories) and red phosphorus (Category 2).

Table 7: Classification and labelling of flammable solids

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Flam. Sol. 1	GHS02	Danger	H228	Flammable solid
Flam. Sol. 2	GHS02	Warning	H228	Flammable solid

8. Self-reactive substances and mixtures

Self-reactive substances or mixtures are thermally unstable. They can decompose strongly exothermically even without the presence of oxygen (air). In principle, all self-reactive solid and liquid substances or mixtures are potential candidates for this classification, unless they have already been classified as explosive substances/mixtures, organic peroxides, or oxidizing agents.

Classification criteria include detonation potential, explosive properties, and deflagration behavior (flame explosion). Examples of substances in this hazard class are hydrazine trinitromethane (H240) and 3-acidosulfonylbenzoic acid (H241).

Table 8: Classification and labelling of self-reactive substances and mixtures

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Self-react. A	GHS01	Danger	H240	Heating may cause an explosion
Self-react. B	GHS01 GHS02	Danger	H241	Heating may cause a fire or explosion
Self-react. CD	GHS02	Danger	H242	Heating may cause a fire
Self-react. EF	GHS02	Warning	H242	Heating may cause a fire
Self-react. G	-	-	-	-

9. Pyrophoric liquids

These substances ignite spontaneously upon contact with air, even in small quantities, within a short time. Classification criteria are spontaneous ignition upon contact with air within 5 minutes or ignition/charring of filter paper within 5 minutes. Trisilane, tetrasilane, liquid trialkylboranes, and magnesium alkyls meet these criteria.

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Table 9: Classification and labelling of pyrophoric liquids

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Pyr. Liq. 1	GHS02	Danger	H250	Catches fire spontaneously if exposed to air

10. Pyrophoric solids

Pyrophoric solids ignite spontaneously upon contact with air, even in small quantities. The classification criterion is spontaneous ignition upon contact with air within 5 minutes. Solid trialkylboranes, magnesium powder, and white phosphorus react according to this pattern.

Table 10: Classification and labelling of pyrophoric solids

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Pyr. Sol. 1	GHS02	Danger	H250	Catches fire spontaneously if exposed to air

11. Self-heating substances and mixtures

In contrast to pyrophoric liquids or solids, self-heating substances and mixtures require a significantly larger quantity (several kilograms) to ignite. Additionally, they take considerably longer (hours or days) to ignite. Classification criteria include the temperature rise or spontaneous ignition at predefined test temperatures between 100°C and 140°C, depending on the volume. Examples include sodium dithionite, magnesium powder, and zirconium powder.

Table 11: Classification and labelling of self-heating substances and mixtures

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Self-heat.1	GHS02	Danger	H251	Self-heating: may catch fire
Self-heat.2	GHS02	Warning	H252	Self-heating in large quantities; may catch fire

12. Substances and mixtures which emit flammable gases in contact with water

Solid or liquid substances or mixtures that spontaneously ignite or release flammable gases upon contact with water fall into this category. The classification criterion is the reaction rate with water. Category 1 includes, among others, the alkali metals sodium and potassium, lithium aluminum hydride, and numerous phosphides.

Table 12: Classification and labelling of substances and mixtures which emit flammable gases in contact with water

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Water-react. 1	GHS02	Danger	H260	In contact with water releases flammable gases which may ignite spontaneously
Water-react. 2	GHS02	Danger	H261	In contact with water releases flammable gases
Water-react. 3	GHS02	Warning	H261	In contact with water releases flammable gases

13. Oxidizing liquids

This product group can generally cause or promote fire in other materials through oxygen transfer. The classification criterion is the reactivity when mixed with cellulose. Classification is made into three categories. Nitric acid at a concentration of 65% is a representative of category Ox. Liq. 3, whereas hydrogen peroxide at a concentration of 35% is classified in category Ox. Liq. 1.

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Table 13: Classification and labelling of oxidizing liquids

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Ox. Liq. 1	GHS03	Danger	H271	May cause fire or explosion; strong oxidiser
Ox. Liq. 2	GHS03	Danger	H272	May intensify fire; oxidiser
Ox. Liq. 3	GHS03	Warning	H272	May intensify fire; oxidiser

14. Oxidizing solids

Oxidizing solids follow the same classification scheme as oxidizing liquids. They are categorized according to their reactivity when mixed with cellulose. Sodium peroxide is a representative of category Ox. Sol. 1, potassium nitrite meets the criteria of category Ox. Sol. 2, and sodium nitrite belongs to category Ox. Sol. 3.

Table 14: Classification and labelling of oxidizing solids

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Ox. Sol. 1	GHS03	Danger	H271	May cause fire or explosion; strong oxidiser
Ox. Sol. 2	GHS03	Danger	H272	May intensify fire; oxidiser
Ox. Sol. 3	GHS03	Warning	H272	May intensify fire; oxidiser

15. Organic peroxides

The CLP Regulation defines representatives of this hazard class as organic substances containing the bivalent -O-O- structure. They can be regarded as derivatives of hydrogen peroxide in which one or both hydrogen atoms have been replaced by organic radicals. This class also includes mixtures containing at least one organic peroxide. According to the regulation, these substances or mixtures are thermally unstable and can undergo exothermic, self-accelerating decomposition. Furthermore, they may decompose explosively, burn rapidly, be sensitive to impact or friction, and/or react dangerously with other substances. Classification criteria include, among others, detonation potential, explosive properties, and deflagration behavior (flame explosion). Classification is made into categories Type A to Type G. The disinfectant peroxyacetic acid typically belongs to category Org. Perox. CD, and the polymerization reaction initiator dibenzoyl peroxide falls into category Org. Perox. b.

Table 15: Classification and labeling of organic peroxides

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Org. Perox. A	GHS01	Danger	H240	Heating may cause an explosion
Org. Perox. B	GHS01 GHS02	Danger	H241	Heating may cause a fire or explosion
Org. Perox. CD	GHS02	Danger	H242	Heating may cause a fire
Org. Perox. EF	GHS02	Warning	H242	Heating may cause a fire
Org. Perox. G	-	-	-	-

16. Corrosive to metals

This product group can damage or destroy metals. Classification criteria are the corrosion rates on steel or aluminum surfaces. Strong acids and alkalis such as sulfuric acid or sodium hydroxide meet these criteria.

Table 16: Classification and labelling of products which are corrosive to metals

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Met. Corr. 1	GHS05	Warning	H290	May be corrosive to metals

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17. Desensitized explosives

This class includes all explosive substances that have been sufficiently phlegmatized. Classification criteria are thermal and mechanical sensitivity for verifying explosion behavior, as well as the burning rate. Dinitrophenylhydrazine moistened with at least 30% water is an exemplary representative of this class.

Table 17: Classification and labelling of desensitized explosives

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Desen. Expl. 1	GHS02	Danger	H206	Fire, blast or projection hazard; increased risk of explosion if desensitising agent is reduced
Desen. Expl. 2	GHS02	Danger	H207	Fire or projection hazard; increased risk of explosion if desensitising agent is reduced
Desen. Expl. 3	GHS02	Warning	H207	Fire or projection hazard; increased risk of explosion if desensitising agent is reduced
Desen. Expl. 4	GHS02	Warning	H208	Fire hazard; increased risk of explosion if desensitising agent is reduced

C) Health hazard classes according to Annex I of the CLP Regulation

The classification and labelling of health hazards are described in Section 3 of the CLP Regulation. For the assigned hazard statements, it is sometimes possible to provide supplementary information regarding routes of exposure—for example, for H-statement 340: "May cause genetic defects <state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard>." These extensions to the respective statements are not addressed in this article.

1. Acute toxicity

The CLP Regulation defines acute toxicity as "those adverse effects occurring following oral or dermal administration of a single dose of a substance or a mixture, or multiple doses given within 24 hours, or an inhalation exposure of 4 hours." [8]
Classification criteria are based on the lethal dose (LD50) or lethal concentration (LC50) - expressed in mg of substance per kg of body weight - at which 50% of the test animals die within a specific timeframe. An LD50 value applies to oral and dermal exposure, while an LC50 value applies to inhalation exposure. Additionally, the CLP Regulation introduced the concept of Acute Toxicity Estimates (ATE). If an LD50 or LC50 value is available, the estimate corresponds exactly to that empirically derived numerical value. Otherwise, it must be estimated. Annex I of the CLP Regulation provides two options for this: extracting the conversion value from Table 3.1.2 that relates to a dose range test, or extracting the conversion value that relates to a classification category. The ATE value of a mixture (ATEmix) can be calculated using the formula

$$\frac{100}{ATE_{mix}} = \sum_{i=1}^{n} \frac{c_i}{ATE_i} \qquad (1)$$

In this, the symbols denote:
ci - concentration of ingredient i (% w/w or % v/v);
ATEi - Acute Toxicity Estimate of ingredient i;
i - the individual ingredient from 1 to n;
n - the number of ingredients.
Depending on the route of exposure (oral, dermal, or inhalation) and the amount of the substance, it is assigned to one of four categories. In the case of inhalation, a further distinction is made as to whether the substance is present as a gas, vapor, or dust/mist.

Table 18: Definition of toxic product categories

	Cat. 1	Cat. 2	Cat.3	Cat. 4
Oral (mg/kg bodyweight.)	0-≤5	≤50	≤300	≤2000
Dermal (mg/kg bodyweight.)	0-≤50	≤200	≤1000	≤2000

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Inhalative				
Gases (ppm)	0-≤100	≤500	≤2500	≤20000
Vapours (mg/l)	0-≤0,5	≤2	≤10	≤20
Dusts and Mists (mg/l)	0-≤0,05	≤0,5	≤1	≤5

When communicating hazards, the hazard statement (H-statement) applicable to the route of exposure must be used. Category 1 includes highly toxic compounds such as potassium cyanide. Category 2 includes substances such as phosgene. Carbon monoxide is classified in Category 3, and trimethyl borate is a representative of Category 4.

Table 19: Classification and labelling of toxic substances

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Acute Tox. 1	GHS06	Danger	H300 H310 H330	Fatal if swallowed Fatal in contact with skin Fatal if inhaled
Acute Tox. 2	GHS06	Danger	H300 H310 H330	Fatal if swallowed Fatal in contact with skin Fatal if inhaled
Acute Tox. 3	GHS06	Danger	H301 H311 H331	Toxic if swallowed Toxic in contact with skin Toxic if inhaled
Acute Tox. 4	GHS07	Warning	H302 H312 H332	Harmful if swallowed Harmful in contact with skin Harmful if inhaled

2. Skin corrosion/irritation

Within the hazard class for skin corrosion/irritation, the CLP Regulation distinguishes between two categories. Category 1 includes substances and mixtures that caused corrosion in one to three out of a total of three test animals. Within this category, a further distinction is made based on severity. Classification in Category 1A applies if corrosion occurs after an exposure time of no more than three minutes and an observation period of up to one hour. For sub-category 1B, the exposure period ranges from three minutes to one hour, followed by an observation period of up to 14 days. Classification in sub-category 1C applies when the criteria of an exposure time between one and four hours and an observation period of up to 14 days are met. Substances and mixtures with less severe effects are classified in Category 2. The classification criteria for corrosion involve significant destruction of skin tissue following an exposure time of no more than four hours. Skin irritation is assessed based on redness, scab formation, edema, or inflammation. Examples include 95% sulfuric acid for Category 1A, concentrated hydrochloric acid (35–37%) for Category 1B, and isopropylamine for Category 2.

Table 20: Classification and labelling of skin-damaging products

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Skin. Corr. 1	GHS05	Danger	H314	Causes severe skin burns and eye damage
Skin. Corr. 1A	GHS05	Danger	H314	Causes severe skin burns and eye damage
Skin. Corr. 1B	GHS05	Danger	H314	Causes severe skin burns and eye damage
Skin. Corr. 1C	GHS05	Danger	H314	Causes severe skin burns and eye damage
Skin Irrit. 2	GHS07	Warning	H315	Causes skin irritation

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
IJCSRR @ 2026
www.ijcsrr.org

3. Serious eye damage/eye irritation

The Serious eye damage/eye irritation category identifies the hazards to the eye. Under the CLP Regulation, serious eye damage is defined as tissue damage to the eye or a severe impairment of vision that does not fully heal within 21 days of application. In contrast, eye irritation heals completely within this timeframe. The classification procedure takes into account all the facts gathered to date in order to avoid unnecessary animal testing. Classification is carried out in two categories. Irreversible effects on the eye are classified as Category 1 substances or mixtures. Reversible effects are classified as Category 2. All substances and mixtures classified as skin-corrosive meet the criteria for Category 1. However, chemicals such as the alcohol n-propanol also cause serious eye damage. The chemical sodium carbonate - better known as soda ash - falls into Category 2.

Table 21: Classification and labelling of eye-damaging products

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Eye Dam. 1	GHS05	Danger	H318	Causes serious eye damage
Eye Irrit. 2	GHS07	Warning	H319	Causes serious eye irritation

4. Respiratory or skin sensitisation

The class respiratory or skin sensitisation encompasses respiratory and skin allergens. Only Category 1 is available for classification; depending on the frequency of the allergic reaction, this is subdivided into Category 1A (causing allergies in many test subjects) and Category 1B (causing allergies in some test subjects). Under the CLP Regulation, respiratory allergens must be classified in Category 1 if specific respiratory hypersensitivity has been demonstrated in humans or if animal studies have yielded positive results. Skin allergens are classified in Category 1 based on similar criteria. Mixtures must be classified in one of these categories if a sensitising substance is present at or above a minimum concentration threshold - specifically ≥ 1% or ≥ 0.1%, depending on the physical state and the classification of the substance itself. The GHS08 pictogram and the signal word "Danger" are consistently used for the classification and labelling of inhalation allergens.

Table 22: Classification and labelling for respiratory sensitisation

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Resp. Sens. 1	GHS08	Danger	H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled
Resp. Sens. 1A	GHS08	Danger	H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled
Resp. Sens. 1B	GHS08	Danger	H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled

In contrast, the classification of skin sensitization uses a less severe warning. Here, the pictogram "Exclamation Mark" and the signal word "Warning" are used.

Table 23: Classification and labelling for skin sensitization

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Skin Sens. 1	GHS07	Warning	H317	May cause an allergic skin reaction
Skin Sens. 1A	GHS07	Warning	H317	May cause an allergic skin reaction
Skin Sens. 1B	GHS07	Warning	H317	May cause an allergic skin reaction

Hexachloroplatinic acid is a respiratory and skin sensitizer and is classified in Category 1 for both endpoints: Resp. Sens. 1 and Skin Sens. 1.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
IJCSRR @ 2026
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5. Germ cell mutagenicity

The germ cell mutagenicity class covers substances that cause, or may cause, permanent changes to genetic material. Classification is based on existing data and on in vivo and in vitro studies. Classification in Category 1 indicates established evidence. If the evidence comes from epidemiological studies in humans, the substance is classified in Category 1A. Classification in Category 1B is based on data from in vivo tests. Category 2 covers substances that may induce heritable changes in human germ cells. Mixtures must be classified in one of these categories if a germ cell mutagenic substance is present at a minimum concentration of ≥ 1% or ≥ 0.1%, depending on the substance's classification. Examples include diethyl sulfate and chromium trioxide (Category 1B) and cadmium sulfide (Category 2).

Table 24: Classification and labelling for germ cell mutagenicity

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Muta. 1A	GHS08	Danger	H340	May cause genetic defects
Muta. 1B	GHS08	Danger	H340	May cause genetic defects
Muta. 2	GHS08	Warning	H341	Suspected of causing genetic defects

6. Carcinogenicity

The carcinogenicity class encompasses all substances and mixtures that have the potential to cause cancer or increase the incidence of cancer. Classification is based on available data. Substances known to cause cancer in humans are assigned to Category 1A. Substances likely to cause cancer in humans - based on inferences from epidemiological studies, animal experiments, or other observations - are candidates for Category 1B. Category 2 includes suspected carcinogens for which the evidence is insufficient for a higher classification.

Mixtures must be classified into one of these categories if a carcinogenic substance is present at or above a specific threshold concentration - either ≥ 1% or ≥ 0.1%, depending on the substance's classification. Examples include asbestos (Category 1A), the plant product safrole (Category 1B), and pentachlorophenol (Category 2).

Table 25: Classification and labelling for carcinogenicity

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Carc. 1A	GHS08	Danger	H350 H350i	May cause cancer May cause cancer by inhalation
Carc. 1B	GHS08	Danger	H350 H350i	May cause cancer May cause cancer by inhalation
Carc. 2	GHS08	Warning	H351	Suspected of causing cancer

7. Reproductive toxicity

Substances toxic to reproduction impair sexual function and fertility in humans and adversely affect the development of offspring. They can also have negative effects on or via lactation. A substance is classified in Category 1A if it is known to be toxic to reproduction in humans. Category 1B includes substances known - primarily from animal studies - to significantly impair reproduction. Category 2 covers substances suspected of having such effects. There is also a hazard category for effects on or via lactation. This category includes substances that have been shown to be transferred to offspring via breast milk in humans or animals, causing harm to the offspring. Mixtures must be classified into one of these categories if a substance toxic to reproduction is present at or above a specific threshold concentration - either ≥ 3% or ≥ 0.3%, depending on the substance's classification.

The effects may be limited to male or female fertility or to the unborn child, or they may apply to both scenarios. Consequently, several H-statements are available, with the appropriate one selected based on the available data. Within the H-statements, further differentiation is made using uppercase and lowercase letters: uppercase letters are used for Categories 1A and 1B, while lowercase letters are used for Category 2. Impairment of sexual function and fertility is indicated by the letter F, while the letter D denotes

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
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impairment of development. Examples of substances assigned the H360D statement include the pesticide Etacelasil and the fungicide Flusilazole. Hazard statement H360FD applies to potassium dichromate and cadmium fluoride, while H361f is used to indicate the hazards associated with octamethylcyclotetrasiloxane.

Table 26: Classification and labelling for reproductive toxicity

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Repr. 1A	GHS08	Danger	H360	May damage fertility or the unborn child
			or	
			H360F	May damage fertility
			or	
Repr. 1B			H360D	May damage the unborn child
			or	
			H360FD	May damage fertility. May damage the unborn child
Repr. 2	GHS08	Warning	H361	Suspected of damaging fertility or the unborn child
			or	
			H361f	Suspected of damaging fertility
			or	
			H361d	Suspected of damaging the unborn child
			or	
			H361fd	Suspected of damaging fertility. Suspected of damaging the unborn child
Lact.	-	-	H362	May cause harm to breast-fed children

8. Specific target organ toxicity - single exposure

This class encompasses all substances capable of impairing human health following a single exposure. It is irrelevant whether the resulting damage is reversible or irreversible, or whether it manifests immediately or after a delay. Classification is divided into three categories. Category 1 includes substances that are clearly toxic to humans or for which such an effect can be inferred from animal studies. Category 2 comprises substances for which a harmful effect on humans is anticipated based on animal studies. Category 3 covers substances that cause reversible adverse health effects.

Classification criteria are based on immediate or delayed, as well as reversible or irreversible, effects on humans or test animals. Mixtures must be classified into one of these categories if a relevant substance is present at or above a minimum concentration threshold - specifically ≥ 10% or ≥ 1%, depending on the substance's classification. Examples of substances in this hazard class include o,o,o-tricresyl phosphate and the insecticide Cyanophenphos (Category 1), and the plant protection product Maneb and calcium sulfide (Category 3).

Table 27: Classification and labelling for specific target organ toxicity - single exposure

Hazard class and category code	Pictogram	Signal word	Hazard statement	
STOT SE 1	GHS08	Danger	H370	Causes damage to organs
STOT SE 2	GHS08	Warning	H371	May cause damage to organs
STOT SE 3	GHS07	Warning	H335	May cause respiratory irritation
			H336	May cause drowsiness or dizziness

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
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9. Specific target organ toxicity - repeated exposure

If two or more exposures to a substance are required before an adverse health effect occurs, the substance is a candidate for the hazard class Specific target organ toxicity (repeated exposure), unless it has already been classified in one of the other health hazard classes. Substances with toxic effects fall into Category 1, while substances with harmful effects on a target organ fall into Category 2. There are guidance values for distinguishing between the terms toxic and harmful, for example regarding the oral LD50 value. If this value is below 10 mg/kg body weight per day, the substance is a candidate for Category 1. For Category 2, an LD50 value between 10 and 100 mg/kg/day is sufficient.

Mixtures must be classified into one of these categories if a relevant substance is present at a minimum concentration of ≥ 10% or ≥ 1%, depending on the substance's classification. Examples of Category 1 substances include O-ethylhydroxylamine and (4-hydrazinophenyl)-N-methylmethanesulfonamide; examples of Category 2 substances include the herbicides Diuron and Linuron.

Table 28: Classification and labelling for specific target organ toxicity - repeated exposure

Hazard class and category code	Pictogram	Signal word	Hazard statement	
STOT RE 1	GHS08	Danger	H372	Causes damage to organs
STOT RE 2	GHS08	Warning	H373	May cause damage to organs

10. Aspiration hazard

The aspiration hazard class covers substances that can enter the trachea directly via the mouth and nose, or indirectly through vomiting, and cause severe health effects. There is a single classification category that includes substances proven to pose an aspiration hazard, as well as hydrocarbons with a kinematic viscosity of 20.5 mm²/s or less, measured at 40°C.

Mixtures must be classified in Category 1 if one or more relevant substances are present at a total concentration of at least 10% and the measured kinematic viscosity is 20.5 mm²/s or less. Substances posing an aspiration hazard include, among others, certain hydrocarbons, turpentine, and pine oil.

Table 29: Classification and labelling for aspiration hazard

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Asp. Tox. 1	GHS08	Danger	H304	May be fatal if swallowed and enters airways

11. Endocrine disruption regarding human health

This hazard class was subsequently added to the health hazard categories [9]. It targets adverse changes in the endocrine system. Such changes can lead to secondary conditions such as cancer, diabetes, or infertility. Classification is divided into two categories. Category 1 covers substances with proven harmful effects, while Category 2 includes suspected substances. Classification is primarily based on in vivo, in vitro, or other studies, on analogue data regarding structure-activity relationships, or by extrapolating data from chemically related substances.

Mixtures must be classified in Category 1 if one or more Category 1 endocrine disruptors are present at a total concentration of at least 0.1%. For classification in Category 2, the mixture must contain one or more Category 2 disruptors at a concentration of at least 1%. This class includes certain biocides, plant protection products, parabens, and phthalates.

Table 30: Classification and labelling for endocrine disruption regarding human health

Hazard class and category code	Pictogram	Signal word	Hazard statement	
ED HH 1	-	Danger	EUH380	May cause endocrine disruption in humans
ED HH 2	-	Warning	EUH381	Suspected of causing endocrine disruption in humans

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
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D) Environmental hazard classes according to Annex I of the CLP Regulation

Environmental hazards are set out in Section 4 of the Regulation. They warn of the short- and long-term harmful effects of chemicals on our natural environment.

1. Hazardous to the aquatic environment

A distinction is made between acute and long-term hazards to the aquatic environment. Classification as "acute aquatic hazard Category 1" is based exclusively on data regarding acute aquatic toxicity (EC50 or LC50). For long-term hazards - also referred to as chronic hazards - data on degradability and bioaccumulation are also taken into account. EC or LC values are obtained using fish, crustaceans, and algae or other aquatic plants: over a period of 96 hours for fish (resulting in an LC50 value), over a duration of 48 hours for crustaceans (resulting in an EC50 value), and/or within 72 or 96 hours for algae (yielding a final EC50 result).

The bioaccumulation potential of an organic substance can often be determined using the octanol-water partition coefficient. An experimentally determined bioconcentration factor (BCF) is preferable to this method. In the first case, the threshold value for bioaccumulation is ≥ 4; in the second case, it is ≥ 500.

For classification in Category 1 - whether for acute or long-term hazards - it is sufficient if one of the measured values for a population is less than or equal to 1 mg of substance per liter. For chronic hazards, poor degradability and/or bioaccumulation must also be present. On this basis, chronic hazard classification extends up to Category 3. The substrate threshold values increase by an order of magnitude in each case: ≤ 10 mg/L for Category 2 and ≤ 100 mg/L for Category 3. As a safeguard, there is a fourth category that applies when the following criteria are met simultaneously: the substance has a water solubility of ≤ 1 mg/L; it exhibits no acute toxicity within the range of its water solubility; and it is slowly degradable and potentially bioaccumulative (bioconcentration factor ≥ 500 or log KOW ≥ 4).

Another specific feature of this class is the use of multiplication factors for highly toxic substances in Category 1. The LC50 or EC50 value serves as the basis for acute toxicity. For chronic toxicity, the NOEC (No Observed Effect Concentration)—defined as the highest concentration of a substance at which no harmful or lethal effect is observed—is used. Furthermore, a distinction is made regarding chronic toxicity between rapidly degradable and non-rapidly degradable compounds. The classification steps are summarized in Table 31.

Table 31: Aquatic toxicity and M-factors

Acute Toxicity	M-Factor	Chronic Toxicity	M-Factor	
L(E)C50 (mg/l)		NOEC (mg/l)	Not rapidly biodegradable	rapidly biodegradable
0,1 < L(E)C50 ≤ 1	1	0,01 < NOEC ≤ 0,1	1	—
0,01 < L(E)C50 ≤ 0,1	10	0,001 < NOEC ≤ 0,01	10	1
0,001 < L(E)C50 ≤ 0,01	100	0,0001 < NOEC ≤ 0,001	100	10
0,0001 < L(E)C50 ≤ 0,001	1000	0,00001 < NOEC ≤ 0,0001	1000	100
0,00001 < L(E)C50 ≤ 0,0001	10000	0,000001 < NOEC ≤ 0,00001	10000	1000
(continuing in factor-of-10 intervals)		(continuing in factor-of-10 intervals)		

If toxicity data for the mixture components are available, calculations can be performed similarly to those for acute toxicity, whereby for highly toxic substances, the concentration of the respective substance increased by the M-factor is used. Examples of substances in category Acute 1 are the pesticide Thiram and hydrogen cyanide. Category Chronic 1 includes the pesticide Linuron and some cyanides.

Table 32: Classification and labelling for products which are hazardous to the aquatic environment

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Aquatic Acute 1	GHS09	Warning	H400	Very toxic to aquatic life
Aquatic Chronic 1	GHS09	Warning	H410	Very toxic to aquatic life with long lasting effects

International Journal of Current Science Research and Review
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Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
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Aquatic Chronic 2	GHS09	-	H411	Toxic to aquatic life with long lasting effects
Aquatic Chronic 3	-	-	H412	Harmful to aquatic life with long lasting effects
Aquatic Chronic 4	-	-	H413	May cause long lasting harmful effects to aquatic life

The following three hazard classes - along with the hazard class for endocrine disruption affecting human health - were introduced via CLP Regulation 2023/707 [3]. Substances in these new classes are of particular concern because they can irreversibly interfere with the hormonal systems of humans or animals, may be toxic, and/or may accumulate in the environment. Some candidates are already listed on the List of Substances of Very High Concern - also known as the Candidate List.

2. Endocrine disruption for the environment

The hazard class for endocrine disruption affecting the environment can lead to hormonal changes in the animal kingdom similar to those observed in humans. Two categories are available for classification: Category 1 for known or presumed endocrine disruptors, and Category 2 for suspected endocrine disruptors.

Mixtures must be classified as Category 1 if one or more Category 1 endocrine disruptors are present at a total concentration of at least 0.1%. For classification as Category 2, the mixture must contain one or more Category 2 disruptors at a concentration of at least 1%. Examples include 4-tert-octylphenol, p-isononylphenol, and dibutyl phthalate.

Table 33: Classification and labelling for endocrine disruption for the environment

Hazard class and category code	Pictogram	Signal word	Hazard statement	
ED ENV 1	-	Danger	EUH430	May cause endocrine disruption in the environment
ED ENV 2	-	Warning	EUH431	Suspected of causing endocrine disruption in the environment

3. Persistent, bioaccumulative and toxic or very persistent, very bioaccumulative properties

The substances and mixtures belonging to the class defined in Section 4.3 are resistant to biodegradation (persistent), accumulate in living organisms (bioaccumulative), and are toxic. They are therefore referred to by the abbreviation PBT substances. In the more extreme case, they are termed very persistent and very bioaccumulative (vPvB) substances. Classification is based on relevant test results. Mixtures must be classified as PBT or vPvB if they contain one or more classified constituents at a concentration of at least 0.1% by weight. Coal tar, decabromodiphenyl ether, and perfluorotridecanoic acid are classified in this hazard class.

Table 34: Classification and labelling for persistent, bioaccumulative and toxic or very persistent, very bioaccumulative properties

Hazard class and category code	Pictogram	Signal word	Hazard statement	
PBT	-	Danger	EUH440	Accumulates in the environment and living organisms including in humans
vPvB	-	Danger	EUH441	Strongly accumulates in the environment and living organisms including in humans

4. Persistent, mobile and toxic or very persistent, very mobile properties

The CLP Regulation defines substances in this hazard class as persistent, mobile and toxic (PMT) or very persistent and very mobile (vPvM). These are substances that are not retained by natural filters such as riverbank sediment and are eliminated from the environment only to a limited extent or not at all. Mobility has been introduced here as a new criterion. A substance meets this criterion if its partition coefficient log Koc (water–soil) is below 3. For classification as very mobile (vM), the log Koc must be less than 2. Classification within this hazard class is also based on relevant test results. Mixtures must be classified as PMT or vPvM if they contain one or more classified constituents at a concentration of at least 0.1% by weight. Examples include melamine, trifluoroacetic acid, and dioxane [10, 11].

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
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Table 35: Classification and labelling for persistent, mobile and toxic or very persistent, very mobile properties

Hazard class and category code	Pictogram	Signal word	Hazard statement	
PMT	-	Danger	EUH450	Can cause long-lasting and diffuse contamination of water resources
vPvM	-	Danger	EUH451	Can cause very long-lasting and diffuse contamination of water resources

E) Further hazards according to Annex I of the CLP Regulation

1. Hazardous to the ozone layer

To date, this is the only product group listed in Section 5 of the CLP Regulation. Experience has shown that it can negatively affect the structure or function of the stratospheric ozone layer. If a mixture contains at least 0.1% of such a substance, it must also be classified in this hazard class. Well-known examples of this hazard class are halogenated hydrocarbons such as methyl bromide, carbon tetrachloride, and dichlorofluoroethane.

Table 36: Classification and labelling for products which are hazardous to the ozone layer

Hazard class and category code	Pictogram	Signal word	Hazard statement	
Ozone 1	GHS07	Warning	H420	Harms public health and the environment by destroying ozone in the upper atmosphere

F) Classification of mixtures

Mixtures must always be classified by the manufacturer or supplier before being placed on the market. Some hazard classes explicitly require test results. In other classes, however, classification can be achieved in various ways; three options are available: test results, bridging principles, and consideration of the constituents.

If reliable test results for a mixture are available, they must be used as the primary basis for classification. If this is not the case, bridging principles may be applied - for example, in the case of the dilution of an already classified mixture or an analogous production batch. If no such data exist, classification is based on the constituents. This classification method is clearly defined in the CLP Regulation. The additivity principle applies to some hazard classes, while the individual substance approach applies to most.

Under the additivity principle, every hazardous substance present in the mixture is taken into account for classification within a hazard class in proportion to its potency and concentration. Under the individual substance approach, a classified substance reaching or exceeding a specified minimum concentration is sufficient to trigger the classification of the mixture.

Table 36: Classification of mixtures

Principle of additivity (additive)	Single-substance method (non-additive)
Acute Toxicity, Categories 1-4	Respiratory or skin sensitisation, Categories 1A, 1 or 1B
Skin corrosion/irritation	Germ cell mutagenicity, Categories 1A, 1B, 2
Serious eye damage/eye irritation	Carcinogenicity, Categories 1A, 1B, 2
Specific target organ toxicity — single exposure, Category 3	Reproductive toxicity, Categories 1A, 1B, 2 and Lact.
Aspiration hazard	Specific target organ toxicity — single exposure, Categories 1, 2
Hazardous to the aquatic environment, Categories Akute 1 and / or Chronic 1	Specific target organ toxicity — repeated exposure, Categories 1, 2
	Endocrine disruption for human health, Categories 1, 2

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
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	Endocrine disruption for the environment, Categories 1, 2
	PBT or vPvB properties
	PMT or vPvM properties
	Hazardous to the ozone layer

The approach taken can vary within a single hazard class - for example, in the case of specific target organ toxicity (single exposure). Classification into the first two categories follows the substance-based approach, whereas classification into the third category follows the additivity principle.
If the pH of a mixture is ≤2 or ≥11.5, the summation method is replaced by the substance-based approach.
Where the regulation's generic concentration limits are not applicable, they are superseded by specific concentration limits (SCLs). These specific limits may be higher or lower than the generic limit; this applies, for instance, to acids, alkalis, or substances toxic to reproduction.
Acute toxicity estimates (ATEs) are used to classify mixtures. A harmonized ATE value corresponds to the measured toxicity value (LD value). In the absence of a measured toxicity value, ATE values are assigned based on the substance's classification using Table 3.1.2 in Annex I, Part 3.1 of the CLP Regulation. When calculating the ATEmix value for a mixture, components with unknown toxicity are disregarded if their total concentration exceeds 10%. The calculation formula is then

$$\frac{100 - \sum C_{unknown}}{ATE_{Mix}} = \sum_{i=1}^{n} \frac{C_i}{ATE_i} \qquad (2)$$

and generally results in more restrictive classifications.

For certain hazard classes, there are minimum concentrations above which a substance must be taken into account when classifying a mixture. In the regulation, these are referred to as cut-off values.

Table 37: Minimum concentrations for the consideration of substances

Hazard classes	Cut-off values
Acute Toxicity	
-Categories 1 - 3	0,1 %
-Category 4	1 %
Skin corrosion/irritation	1 %
Serious eye damage/eye irritation	1 %
Hazardous to the aquatic environment	
- Aquatic Acute 1	0,1 %
- Aquatic Chronic 1	0,1 %
- Aquatic Chronic 2 - 4	1 %

DISCUSSION

In the field of chemical regulation, the CLP Regulation - alongside the REACH Regulation [12] - is one of the key instruments for managing product safety and ensuring consumer and environmental protection. It is a complex set of rules that governs the classification and labelling procedures for the vast majority of substances and mixtures, subject only to a few exceptions listed in Article 1 of the CLP Regulation.
The European Commission plays a leading role in the ongoing development of this regulation [13, 14]. It is supported by the European Chemicals Agency (ECHA), which provides comprehensive information on both general and specific aspects of the regulation via its website [15]. However, national contact points also offer targeted information regarding the CLP Regulation [16] - such as the REACH-CLP-Biocide Helpdesk operated by the Federal Institute for Occupational Safety and Health [17] - since

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
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market participants must also take national supplementary requirements into account alongside European mandates [18]. Without these authoritative information resources, companies would have struggled to manage the CLP amendments introduced in recent years.

A shift in the legislative course occurred in 2025. Prompted by the Draghi Report on EU competitiveness [19], the European Commission proposed slowing down the implementation timeline for the CLP updates introduced in 2024 [20]. Consequently, under the "Stop-the-Clock" regulation, the deadlines for implementing changes to labelling, advertising, and distance selling were postponed by significant periods [21].

Europe is currently in a phase of consolidation. The European Council and the European Parliament are negotiating key aspects of the Draghi Report. To this end, the European Commission has developed 12 proposal scenarios known as "Omnibus packages" [22]. The contents of these packages address, among other things, regulatory simplifications for businesses. Omnibus IV, for instance, addresses the task of easing the burden on small and medium-sized enterprises, which account for a significant portion of the European economy. Omnibus VI aims to reduce administrative costs associated with chemicals regulation. To this end, the parties involved agreed that the planned amendments to the CLP Regulation would not take effect until 2030 [23]. The final adoption of this provisional agreement is scheduled to take place in 2026.

CONCLUSION

With the introduction of the CLP Regulation and the incorporation of GHS standards into European law, the European Parliament and the Council of Europe aimed not only to simplify intra-European trade but also to achieve global harmonization of regulations governing the use and transport of hazardous products [1].

Numerous nations have since incorporated the GHS into their chemicals legislation regarding transport [24]. Regarding regional progress in implementing classification and labelling regulations, United Nations data from 2021 indicate that - when comparing the Andean Community, the European Union, the Eurasian Economic Union, and MERCOSUR - implementation was most advanced in Europe at that time [25]. By 2026, the situation had changed; other nations have followed suit [26], and the trend continues [27].

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International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-44, Impact Factor: 8.048
IJCSRR @ 2026
www.ijcsrr.org

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