Solid Waste: Assessment, Monitoring and Remediation
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I.1
Solid waste: what is it?

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I.1.1. Introduction

The activities of human society are always accompanied by waste generation. The fundamental environmental issue in industrial and developing countries throughout the world is how to best identify and manage waste streams. Surprisingly enough, mankind at the beginning of the 21st century still has problems with the development of a precise legal definition of a waste, as well as with international harmonization of national standards on waste terminology. This evokes serious problems with waste management and statistics at the global and even at the regional level. To start solving these problems, some apparently simple basic questions are thus to be unanimously answered:

- What is a waste?
- What is solid waste?
- What is hazardous waste?
- What is inert waste?
- What is a waste, which is not hazardous and not inert?

The legal definitions of waste exert a profound impact on the waste management system, resulting in serious consequences to environmental safety and sustainability. Despite increasing environmental awareness, the waste management practice in the world shows clearly that it generally follows the path of least cost and least regulatory control unless restrained by appropriate laws and regulations supported by adequately implemented enforcement procedures. Legal terms and definitions are an essential part of these procedures. Consequently, it is also a matter-of-course that definitions must not become a barrier to an optimum management of waste, environmental protection and economic development. At present, still many different national concepts of "waste", "solid waste", "hazardous waste" and related policies exist in the world.

The intention of this introductory chapter is to present and discuss the state of the art concerning basic terminology and legal definitions related to waste, in particular solid waste, in the USA and the European Union, with some references to national and international definitions.

I.1.2. Definitions of waste in the USA legislation

In the United States, waste identification is a generator responsibility. It is regulated within the framework of the two major federal laws: Resource Conservation and Recovery Act (RCRA) enacted in 1976 replacing the Solid Waste Act of 1965, and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, commonly known as Superfund, with appendices and amendments. The most important latter ones include the Hazardous and Solid Waste Amendments of RCRA (HSWA, 1984) and the Superfund Amendments and Reauthorization Act (SARA, 1986). Other U.S. environmental laws related to solid waste among different sources of environmental pollution are: the Toxic Substances Control Act of 1976, Provisions of the Asbestos Hazard Emergency Response Act of 1988 and Asbestos Information Act of 1988, as well as the Pollution Prevention Act of 1990. Besides federal laws, also states may develop their own state regulations that have to comply with or exceed the stringency of the federal law.

RCRA provides several basic definitions of solid waste and hazardous waste. As used in this Act, the term solid waste means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

The term *hazardous waste* means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may

(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness: or
(B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

Regulations under RCRA designated according to the Code of Federal Regulations (CFR) in general do not refer to specific industries. The CFR, besides abridged definitions following the RCRA terms, gives detailed lists of hazardous wastes, mixture rules, and exclusions from RCRA. According to these regulations (40 CFR 261.2), *solid wastes include any liquid, solid, semisolid, or contained gas that is discarded or stored prior to discarding*. Waste classified as hazardous must meet two criteria: (i) be a solid waste; (ii) to either exhibit at least one of four hazard characteristics defined in 40 CFR 261 (ignitability, reactivity, corrosivity, extraction-procedure toxicity), or be located in the lists of hazardous wastes. The related lists and regulations are as follows:

- non-specific-source hazardous wastes (40 CFR 261.31)
- specific-source hazardous wastes (40 CFR 261.32)

- acutely hazardous wastes (40 CFR 261.33 (e)
- generally hazardous wastes (40 CFR 261.33 (f)

A number of wastes are excluded from RCRA regulations and incorporated into other environmental laws. These exclusions listed in 40 CFR 261.4 in about 18 lists comprise four major categories: (1) materials which are not solid wastes; (2) solid wastes that are not hazardous wastes; (3) hazardous wastes that are exempted from certain regulations; and (4) laboratory samples. The subcategories excluded from RCRA cover among others, the following solid wastes:

- nuclear or nuclear by-product materials as defined by Atomic Energy Act;
- mining overburden returned to the site;
- cement-kiln dust waste;
- fly ash, bottom ash, slag and flue-gas emission control waste from fossil fuel combustion;
- drilling waste in oil, gas and geothermal exploration.

Asbestos waste is regulated under separate Provisions of the Asbestos Hazard Emergency Response Act of 1986, Asbestos Information Act of 1986, Superfund Act and Toxic Substances Control Act. The Asbestos Information Act defines the term "asbestos-containing material" as "any material containing more than one percent asbestos by weight".

Also, infectious wastes and toxic chemicals such as PCBs and that originated from certain combustion processes such as dioxins are exempted from regulations under RCRA. These chemicals are regulated under the Toxic Substances Control Act. Section 222 of the 1984 RCRA Amendments, Listing and Delisting of Hazardous Waste, pertains to waste containing persistent organic pollutants (POPs) such as dioxins, dibenzofurans, chlorinated aromatics and aliphatics, and other chemicals such as dimethyl hydrazine, toluene diisocyanate (TDI), carbamates, bromacil, linuron, organobromines and waste containing hazardous chemicals such as inorganic chemical industry wastes, refining wastes, coke by-products, dyes and pigments and lithium batteries. This amendment specifically directs the EPA to list and explicitly consider for listing such wastes, and to develop additional hazardous waste characteristics, including measures of toxicity, to be added to the four basic characteristics contained in 40 CFR 261.S.

RCRA does not define "inert waste"; it also does not characterize a waste that is not hazardous and also not inert. Nevertheless, the essentially important statement given in RCRA as a Congressional finding is that "disposal of solid waste and hazardous waste in or on the land without a careful planning and management can present a danger to human health and the environment". This means that solid waste that is not hazardous is not yet safe and also may pose a serious current or future threat. The RCRA also indirectly defines all discarded recyclable materials as waste, but strongly stresses a need to separate usable materials from solid waste or to produce usable energy from solid waste. This Act in Sec. 1004 also defines the terms "disposal", "recoverable", "recovered material" and "recovered resources". The term disposal means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters". The term recoverable refers to the capability and likelihood of being

recovered from solid waste for a commercial or industrial use. The term recovered material means waste material and by-products, which have been recovered or diverted from solid waste. This term "does not include those material and by-products generated from, and commonly reused within an original manufacturing process". The term recovered resources means material or energy recovered from solid waste. These definitions do not leave any spare room for misinterpretation, showing clearly that discarded waste containing usable material indisputably *remains a waste*. Recovery of solid wastes in most cases results in a separation of usable material or energy from the non-recoverable waste residue to be disposed. Recycled materials that are solid waste come under RCRA regulations.

RCRA definitions contain also the term "virgin material", which means "a raw material, including previously unused copper, aluminum, lead, zinc, iron, or other metal or metal ore, any "underdeveloped" resource that is, or with new technology will become, a source of raw material". This definition seems to be controversial, since the material has been extracted from its natural environment, processed to separate usable components and exposed to the new ambient conditions and active weathering processes. This must cause accelerated transformations of the original properties, along with potential for mobilization of metals in hazardous concentrations. The word "virgin" suggests unchanged primary character of the material. Under the circumstances, it is questionable and does not fit to the underdeveloped material.

This brief discussion shows the major terms and definitions related to solid waste and hazardous waste in the present US federal legislation and regulations, and the dynamic character of hazardous waste listing while the terms and definitions concerning waste remain unchanged.

More detailed information concerning these definitions can be found in Appendix A to Chapter I.2 that contains excerpts from Code of Federal Regulations, CITE 40CFR261.1-261.4 (CFR, Rev. 1999). The current version of CFR and any future revisions can be also downloaded from the relevant website.

I.1.3. Legal definitions of waste in the European Union: current status and trends

I.1.3.1. EU waste legislation and legal terminology

Unification of Europe has evoked a need of developing the European standards on waste, harmonization of national legislation and integration of waste management policy. Adaptation of the European Directives by the European countries and progress in the EU standardization, also in the standards on waste-related terminology, greatly contribute to achieving this goal, despite legislative discrepancies and arguments, which still exist both between the EU Directives and within the legislative bodies. To acquaint the reader with the terms and definitions given in these regulations, which stimulate the harmonization of national legislation on the European level, some major terms and lists will be discussed here in more detail.

The EU waste legislation until January 2002 was based on 3 general Directives and 2 catalogues, in particular:

- Waste Directives: Council Directive 75/442/EEC followed by the amending it Council Directive 91/156/EEC on waste.
- European Waste Catalogue 94/3/EC (*repealed*).
- Hazardous waste Directive: Council Directive 91/689/EEC on hazardous waste.
- Hazardous waste list: Council Decision 94/904/EC, establishing a list of hazardous; waste pursuant to Article 1(4) of Council Directive 91/989/EC on hazardous waste (*repealed*).

On 3 May 2000, the European Commission approved a revised version of the key official list of wastes that should be classified as hazardous in the EU. The new list with effect from January 2002 incorporates also the European Waste Catalogue (EWC, 1994) of non-hazardous wastes, creating for the first time a single EU waste list (Commission Decision 2000/532/EC amended in 2001 by Commission Decisions 2001/118/EC of 16.02.2001; 2001/119/EC of 22.01.2001, and 2001/573/EC of 23.07.2001). This one list integrates the list of wastes laid down in Decision 94/904/EC and that of hazardous wastes laid down in Decision 94/904/EC, and simultaneously repeals these Decisions. The single waste list markedly increases transparency of the listing system and simplifies existing provisions.

Several Council Directives enacted since 1989 and continuously updated, are related to waste incineration, mainly in conjunction with air pollution. The relevant regulations in force have been included in Council Directive 94/67/EC on the incineration of hazardous waste; in December 2000 the European Parliament and the Council approved Directive 2000/76/EC on the incineration of waste, which updates and extends a scope of the previous legislation. Waste disposal of is regulated by Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste.

A number of Council Directives are related to specific wastes, e.g. Directive 2000/53/EC on end-of-life vehicles; or Packaging Waste Directive (European Parliament and Council Directive 94/62/EC on packaging and packaging waste; amending this existing Packaging Waste Directive is in preparation—Com (2001) 0729); Animal Waste Directive (Council Directive 90/667/EEC, laying down veterinary rules for the disposal and processing of animal waste); Waste Oil Directive (Council Directive) 75/439/EEC has been continuously under revision and was amended in 1987, 1991, 1994 and 2000; Battery Waste Directive 91/157/EEC was adapted to technical progress by Council Directive 93/86/EEC and Commission Directive 98/101/EC on batteries and accumulators. Sewage Sludge Directive 86/278/EEC updated by Directive 91/692/EEC is being revised by the European Commission (EC DG ENV, 2000); also the Biowaste Directive on biological treatment of biodegradable waste is under preparation (EC DG ENV, 2001), both regulations being currently at the stage of working documents of the EC Directorate General – Environment. The Directives of the European Parliament and European Council comprise other specific waste streams, for example, Directive on Waste Electrical and Electronic Equipment (WEEE) (2003) and Directive on the restriction on use of certain hazardous substances in this waste (2003). Plastics waste (PVC and other resins) is currently being extensively studied with respect to environmental behavior; European Commission has also funded a report called "Construction and demolition waste management practices and their economic impacts" as a basis for further proposal for a Directive (EC Europa website).

Directory of Community legislation in force and in preparation on waste management and clean technology is available in the continuously updated EC EUR-Lex websites. Each of these documents provides for specific terms and definitions related to the scope of regulations.

In addition to the terms defined in the above European regulations, two European Standards prepared by the European Committee for Standardization, CEN/TC 292/WG 4: "Characterization of waste – Terminology, Part 1: Material related terms and definitions", (EN 13965-1 = WI 292025) and "Characterization of waste – Terminology, Part 2: Management related terms and definitions" (EN 13965-2 = WI 292026) underwent the formal vote (stage 49 document) in 2003. After final approval by CEN, its members are bound to comply with CEN/CENELEC Internal Regulations, which stipulate the conditions for giving it the status of a national standard of CEN member states without any alteration. The aim of these CEN standards is to develop systematic definitions of waste concepts in accordance with ISO 10241 – International terminology standards – Preparation and layout.

Waste terminology and definitions used in the EU Directives, catalogues and standards are intended to be the base of common language assuring compliance with regulatory provisions or a contractual situation between parties in waste management chain. The waste legislation in the EU, alike national waste legislation of the majority of Member States, primarily addresses environmental and public health, and to a lesser extent, resource concerns. These concerns and awareness of the consequences in the area of waste management on the recycling, treatment and disposal of wastes are reflected also in legal terms and definitions of waste. The basic prerequisite is, that these terms and definitions are to be in accordance with the Framework Directive on Waste (75/442/EEC), which constitutes the essential objective of all provisions relating to waste disposal. This objective "must be the protection of human health and the environment against harmful effects caused by the collection, transporting, treatment, storage and tipping of waste".

I.1.3.2. The EU definition of a waste

The legal definition of a waste at European level is given in the EU Council Directives 75/442/EEC and 91/156/EEC amending Directive 75/442/EEC. The latest Council Directive 91/156/EEC defines waste as *any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard* (Annex I comprises a list of 16 categories Q1 to Q16 based on the OECD Council Decision 88/90 (1988) where these categories are specified, e.g. Q1 *Production or consumption residues not otherwise specified below* or Q16 *Any materials, substances or products which are not contained in the above categories*. The list is subject to periodical review and revision – see Appendix A). This definition replaced the one given by the Council Directive 75/442/EEC on waste, which does not refer to any list, but considers differences in the national law *(waste is any substance or object which the holder disposed or is required to dispose of pursuant to the provisions of national law in force).* The revised contemporary definition of waste given in the Council Directive 91/156/EEC tends to provide a uniform European interpretation of the concept of this term. Unfortunately, the referred list of categories of the Annex 1 evokes more debates and field of misinterpretation than it has been intended, and makes this definition extremely inconvenient for use in other regulations, in particular

in those also based on lists, e.g. in the integrated waste list (Commission Decision 2000/532/EC) coded according to the generic origin or composition. This poses problems with the adopting the definition of waste of the Framework Directive 91/156/EEC for the purposes of some posterior EC Council Directives. Council Directive 94/62/EC on packaging waste, the Council Directive 1999/31/EC on the landfill of waste, the Council Regulation 259/93/EEC on the shipments of waste and Commission Decision 2000/532/EC creating for the first time a single EU waste list refer hence to waste according to non-revised Directive 75/442/EEC. The adopting the non-revised definition by these Directives, in particular, Commission Decision 2000/532/EC (amended by Commission Decision 2001/118/EC) that should comprise continuously updated coded list of waste, shows clearly that the listing in the general definition of waste is a source of confusion in many other waste-related terms and definitions. To avoid further problems, the essential Regulation (EC) No. 2150/2002 on waste statistics has stated that waste *shall mean any substance or object as defined in Article 1(a) of Council Directive 75/442/EEC of 15 July 1975 on waste.* This statement evidently gets out of the way all obstacles related to restoring the original definition of waste. Without reference to the aforementioned and exemplified list adopted from the OECD Council Decision C(88)90 Final (1988) concerning transfrontier movements of hazardous waste, the definition of waste becomes clear, simple, non-disputable and applicable to all relevant terms and definitions. At any rate, no double definition should exist in legislation for the purposes of the particular Directives.

I.1.3.3. EC list of wastes

Unlike the inclusion of waste categories into the definition of waste, the former European Waste Catalogue 94/3/EC (EWC) and also the new single EC List of wastes (Commission Decision 2000/532/EC amended by 2001/118/EC in 2001), which incorporates both the key official list of wastes that classified as hazardous in the EU, and also updated EWC of non-hazardous waste, do not intend to specify unanimously whether material is a waste. According to the introductory statement of the integrated List of wastes, "the inclusion of a material in the list does not mean that the material is a waste in all circumstances. Materials are considered to be waste only where the definition of waste in Article 1(a) of Directive 75/442/EEC is met," i.e. if this material "is disposed by the holder or is required to dispose of pursuant to the provisions of national law in force" and is outside the commercial cycle or chain of utility. For example, packaging, which is rotationally refilled or reused for the same purpose for which it was conceived will become packaging waste when no longer subject to reuse.

The main purpose of the integrated list of wastes is to increase the transparency of the listing system and to simplify existing provisions in order to establish a common terminology for the states, which adopt it, in particular for the EC Member States, to provide support to the generation of precise and reliable statistics on waste generation, which, in turn, are indispensable for improving waste management. The integrated EU List of wastes contains a register of about several hundreds items in the list divided into 20 major categories and two sub-levels of information coded principally on the basis of source or composition of waste material. The listed types of waste are defined by the six-digit code for the waste and the respective two-digit and four-digit chapter headings,

which specify 20 broad source categories of waste (two-digit) and 109 more narrow mainly product-based groups (four-digit).

I.1.3.4. The definition of hazardous waste

The definition of hazardous waste in the EU legislation is more extended and detailed than the relevant one in the US regulations. According to the Council Directive 91/689/EEC of 12 December 1991, Article 1(4), the term hazardous waste means:

- "wastes featuring on a list to be drawn up in accordance with the procedure laid down in Article 18 of Directive 75/442/EEC on the basis of Annexes I and II to this Directive.... These wastes must have one or more of the properties listed in Annex III. The list shall take into account the origin and composition of the waste and, where necessary, limit values of concentration. This list shall be periodically reviewed and if necessary by the same procedure.
- Any other waste which is considered by a Member State to display any of the properties listed in Annex III. Such cases shall be notified to the Commission and reviewed in accordance with the procedure laid down in Article 18 of Directive 75/442/EEC with a view to adaptation of the list."

In short, as it has been defined in Article 2 paragraph (c) of the Landfill Directive 1999/31/EC, the term hazardous waste means any waste, which is covered by Article 1(4) of Council Directive 91/689/EEC of 12 December 1991 on hazardous waste. The definition of hazardous waste in the Directive 91/689/EEC refers to the Directive 75/442/EEC (Article 18), and based on lists given in Annexes I, II to this Directive. This waste must have one or more properties listed in Annex III. Domestic waste has been exempted from the provisions of this Directive in order to take into consideration the particular nature of this waste. Waste classified as hazardous need not meet a criterion of being solid waste. This is a significant difference compared to the US definition under RCRA, where waste classified as hazardous must be a solid waste according to the definition.

The full quotation of Annexes I, II and III is given in the Appendix B to this Chapter (Excerpt from Council Directive 91/689/EEC on hazardous waste):

- Annex I (parts I.A. and I.B.) comprises currently 40 categories or generic types of hazardous waste listed according to their nature or the activity, which generated them (waste may be liquid, sludge or solid in form);
- Annex II contains list of constituents (C1–C51) of the wastes listed in Annex 1.B., which render them hazardous when they have the properties, described in Annex III;
- Annex III defines properties of wastes which render them hazardous (H1–H14): explosive, oxidizing, highly flammable, flammable, irritant, harmful, toxic, corrosive, infectious, toxic for reproduction, mutagenic, releasing toxic gases, yielding another harmful substance, ecotoxic. The last term, which may have different meaning elsewhere, is defined as "substances and preparations, which present or may present immediate or delayed risks for one or more sectors of the environment".

Wastes classified as hazardous are considered to display, as regards H3 to H8, H10(6) and H11 of the Annex III to Directive 91/680/EEC, one or more of the properties specified

in the Commission Decision 2001/118/EC amending Decision 2000/532/EC (see Appendix C).

The list of hazardous waste pursuant to Article 1 (4) of Council Directive 91/689/EEC on hazardous waste was established by the Council Decision 94/904/EC of 22 December 1994. Commission Decision 2000/532/EC replaced Commission Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1 (4) of Council Directive 91/689/EEC on hazardous waste. Waste marked with an asterisk (*) in the list of wastes is considered a hazardous waste pursuant to article 1(4) first indent of Directive 91/689/EEC on hazardous waste.

Besides, "without prejudice to Article I (4) second indent of Directive 91/689/EEC, Member States may decide, in exceptional cases, that a waste indicated in the list as being non-hazardous displays one or more of the properties listed in Annex III to Directive 91/689/EEC". All such cases are subject to notification to the Commission and examination with a view to amending the list. The full actual list of wastes is included into the Annex to the Commission Decision 2001/118/EC amending Decision 2000/532/EC as regards the list of wastes.

I.1.3.5. Other basic terms and definitions

The definition of solid waste is given in the European Standard prEN 13965-1 as "waste that predominantly consists of material that has the properties of a solid".

The term non-hazardous waste is defined in the Article 2 paragraph (d) of the Council Directive 1999/31/EC on the landfill of waste as "waste which is not covered by paragraph (c)", i.e. by the definition of hazardous waste.

The term inert waste appears in the consecutive paragraph (e) of the Landfill Directive. It is defined as "waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater".

There is, though, no term either in any Directive or the European Standard on terminology that defines *waste, which is not hazardous but also not inert.* Commonly used term non-hazardous waste defined in the Landfill Directive, Article 2 (Definitions) as "waste which is not covered by paragraph (c)" includes both not hazardous and inert waste. The experience shows that *the waste not hazardous in terms of Council Directive 91/689/EEC as defined in paragraph (c) but also not inert in terms of paragraph (e) includes major amounts of waste generated and disposed of, and thus should be termed and defined.* The antithetic term and definition non-hazardous waste suggests that these wastes are "safe", which is not true. The definition of this group should refer to *waste, which is not covered by the Council Directive 91/689/EEC on hazardous waste, but at any stage of its disposal as freshly generated material or due to physical, chemical or biological transformations, by itself or in contact with other matter at the disposal site is likely to give rise to environmental pollution, and in particular can endanger the quality of*

groundwater and/or surfacewater. The term for this group of waste should reflect their life-cycle pollution potential. The notion "environmentally harmful waste" seems to be the best matching with environmental impacts of these materials. Unfortunately, the term "harmful" is already listed in the Annex III to the Council Directive 91/687/EEC on hazardous waste among the properties of wastes, which renders them hazardous in another context. According to this list the term harmful means "substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risk". This definition more fits for the term "noxious", though since the notion harmful has been already used instead, this term cannot be applied to another definition. Therefore, for this group of waste the synonymous term "detrimental waste" or alternatively "environmentally damaging waste" can be used.

I.1.3.6. "Recyclable waste" or "secondary raw material"?

In conjunction with a legal terminology, another issue, which arouses emotions and disputes, is the possible changing of the definition of recyclable waste. Existing legal definitions of waste refer to substances or objects "which the holder discards or intends or is required to discard", including those technically suitable for recovery. Currently, due to continuing calls from industry to exclude recyclable materials from the category of waste and to define them secondary raw material, trends to avoid the term waste and use instead a more "neutral" notions are evolving also in legislative and standardization areas. A comprehensive report on the legal definitions of waste and their impact on waste management in Europe prepared by EC Institute for Prospective Technological Studies as a first draft for comments (Bontoux and Leone, 1997) reflect the confusion in the waste debate, in particular in the issue of definitions in waste management. The study admits that "defining a material as waste or secondary raw material bears many consequences" and articulates the principal equitable thesis that "definitions must not become a barrier to an efficient and sustainable European waste management system". The basic question, which arises in this matter is the objective evaluation of whether the classification of a discarded recyclable material as waste indeed "hampers any recovery, treatment and disposal option susceptible of providing the best possible solution on an economic and/or environmental point of view", and vice versa, whether re-defining recyclable waste as secondary raw material would provide the best such solution. After discussion of some examples of the issues and concerns related to transboundary shipment of recyclable waste or the tarnishing public image and even losing market by waste management industries because of the negative public perception of the concept of waste, the discussed study among other recommendations proposes "to expressly exclude certain categories of materials from the definition of waste". Simultaneously, it refers to Article 3 of the Directive 91/156/EEC as "opening the door to such a solution". The aforementioned Article statement is as follows: "Member States shall take appropriate measures to encourage [...] the recovery of waste by means of recycling, re-use or reclamation or any other process with a view to extracting secondary raw material". It should be though stressed that this statement does not give any consent to exclude recyclable waste from the definition of waste through a simple rename of waste into e.g. secondary raw material, as the efficiency of such way of encouragement of waste recycling is more than doubtful.

Another example of the industrial pressure on the legislative bodies of the EU is the Resolution 183 of the 10th Meeting of the European Committee for Standardization, CEN/TC 292 in Vienna, Austria, Dec. 10/11, 1997, which "asks the national committees to review a possible replacement of the term waste by *material* in its current standards and standards under development – with exception of title and scope". Fortunately, this resolution was finally rejected at the 11th Meeting of CEN/TC 292 in Oslo in 1998 and after the negative results of a national committees' enquiry. Nevertheless, the calls from the industry have not ceased, and the attempts in this direction are periodically renewed, as in this case the legal term has substantial direct economic consequences. The impact of the legal definitions on the waste strategy as an essential element of global sustainable development and the environmental protection should be thus thoroughly understood. One of the essential prerequisites is that the legal definition in no case should absolve the producer or the holder from the responsibility for the generated waste from the moment of generation until it is utilized in an environmentally safe end product or is taken for utilization by an end-user. Since assignment of waste from producer to end-user occurs, the end-user is to bear the legal responsibility for the proper management of waste if it is not converted instantly into an environmentally neutral or friendly product, unless another agreement between the generator and end-user defining the scope of responsibility of each party exists.

It is clear that waste disposal must have direct economic consequences for the waste generator or holder to make the legal definitions and regulations work properly in the implementation arena not just in the European, but also in a global scale. The best proof of the efficacy of the legislation and regulatory system is in an implementation area. The pro-environmental and pro-recovery/recycling policy must be based on the term waste and on the "polluter pays" principle. A good example is utilization of coal combustion waste (CCW) in countries where its generation is high. It is well known that this waste due to its properties can be used in a wide array of field-proven applications on par with competing virgin, processed and manufactured engineering material. It is also known that the use of this waste in high CCW producing countries is strongly affected by local and regional factors including production rates vs. market demand and saturation; processing, transportation and handling costs; availability and price of competing materials, etc. In the USA, of approximately 82 million tons of CCW produced in 1992, only 27% were utilized. The remainder went to disposal sites (Tyson, 1994). More recent data does not show any improvement in this field, reporting the amounts in 1996 to be of over 92 million tons generated with about 25% of it utilized (Butalia and Wolfe, 1999; Chugh and Sengupta, 1999; Stewart, 1999). Huge amounts of this waste are already lying in disposal sites throughout the country.

In India, at the current level of coal and power production, around 50 million tons of CCW is generated annually, and a further growth up to 90 million tons/a is anticipated. At present, the utilization rate there is negligible (2–5% in total), mainly due to the weakness of implementation and enforcement system (Kumar et al., 1996; Singh and Gambhir, 1996; Prasad et al., 2000). This reflects a global status concerning CCW utilization, despite the fact that several European countries, small CCW producers, where the demand for CCW and its generation is fortunately balanced, use almost all the CCW that they produce (Clarke, 1994).

In Poland, 18.8 million tons (Mt) of CCW was generated in 2001, out of which 13.8 Mt (73%) of the annual production was utilized (Central Statistical Office, 2002). This places Poland at the top of the countries, which are producing comparably high amounts of CCW with respect to the percentage of use of this waste. In the mining area of the Upper Silesia coal basin, 87% of CCW generated was utilized, mainly in the deep mines for backfilling, goaf filling (stowing), simplification of ventilation system and fire prevention (State Environmental Protection Inspectorate, 2001). For these purposes, CCW in this area has been used since 1989. Therefore, coal mines are indisputable beneficents of CCW utilization. Though, all expenses connected with the environmentally safe CCW hermetic transportation by specialized firms, preparation of transportable mixtures and their location in the mines, along with testing, environmental control, etc. are being covered by power producers, which are generators of CCW. The basis for this expenditure by the power producers is a cost-benefit study: the power plants benefit from the difference between the charge for disposal of CCW, regulated currently by the National Directive of the Cabinet of 2003 *on charges for the use of the environment*, which replaced earlier Directive of 1998 with amendments of 1999, Directives updated annually in 1993–1997 and Directive of 2001 *on charges for the disposal of wastes*. Thus, there are five beneficent at once: power plants, coal mines, CCW transportation companies, and last but not the least, the whole region and the country. This is the best proof of the efficiency of the system based on the financial responsibility of waste generators. Defining CCW by a neutral term, e.g. secondary raw material or "by-product" would bring about disastrous consequences. Power plants would not have any incentive for bearing the costs of CCW utilization. Mines, which benefit from use of CCW, would not be able or willing to cover additional expenses that raise the costs of coal production. Transportation companies would collapse. Environment and safety in mines would get worse. This example shows that seemingly innocent playing on words can be dangerous. Waste is waste. Economic and technical factors not associated with waste generation dictate the major production. The amounts and place of its generation only occasionally fit to the demand for waste. Calling waste material will not reduce the waste stream. Waste generators would immediately use the opportunity to shift off the responsibility as producers of a "beneficial raw material".

Waste technically suitable for recovery does not become automatically a raw material if there is no market for it, or its use is commercially not effective. A sound waste management strategy requires global thinking and regional acting. Global thinking starts from the terminology. Well thought-out regional enforcement systems including incentives, charges and penalties based on the precise terms may greatly improve utilization of waste.

Our experience shows that majority of waste is not environmentally safe. Very often its strong adverse environmental impact is time-delayed, e.g. occurs in the post-closure period of a waste site. Waste as a freshly generated anthropogenic material is not geochemically stable. There is extensive evidence of a striking discrepancy between long-term risk assessment based on accelerated simulation tests or predictive models, and real situations (Twardowska and Szczepańska, 2001). This shows the insufficient knowledge of the long-term environmental behavior of many kinds of waste. Therefore, waste should not be put into the same bag as natural raw material. To facilitate waste utilization in an environmentally safe way and to prioritize its use, special environmentally safe

reuse-oriented enforcement strategies and regulations should be developed with respect to waste and not "materials" or secondary raw materials, or "by-products". Charges for waste disposal should encourage waste producers to advance their seeking of opportunities for waste utilization, minimization of the waste stream generated during the production or rendering it harmless by means other than disposal. The charges for the disposal are ought to be the highest with respect to recoverable waste, which use is technically and technologically sound, commercially effective and environmentally safe. Systems of charges should be directed to advancing waste utilization, among others through financial support of waste recycling industries and end-users by waste generators, as well as to stimulating technologies, which assure waste minimization.

The replacement of the legally defined term waste by the broad notion that softens the definition and makes it vague and meaningless will not facilitate improving waste management.

I.1.3.7. Waste disposal, recovery and recycling

To make the questions concerning waste management clear along with the above discussion on what is waste and why, and what is not, the terms "waste disposal", "recovery" and "reuse" must be well defined. In a wider regional or global scale, these terms should not be conflicting or incompatible with other national or regional definitions. The Framework Council Directive 75/442/EEC and amending it Directive 91/156/EEC on waste, defines disposal as "any of the operations provided for in Annex II.A." This Annex which "is intended to list disposal operations such as they occur in practice", specifies 15 such operations (D1–D15). The term recovery means "any of the operations provided for in Annex II.B", which is "intended to list recovery operations as they are carried out in practice" and specifies 13 such operations (R1–R13). The specification of these operations uses as synonyms such wording as "recycling, reclamation, regeneration, recovery of components and re-use" (operations R1–R8). Storage pending any of the operations defined either as "disposal of" or recovery is also included in the list of acceptable operations. In accordance with Article 4 (of the Directive) waste must be either disposed of or recovered "without endangering human health and without the use of processes and methods likely to harm the environment" (see Appendix A).

In Council Directive 94/62/EC on packaging waste, for the purposes of this Directive, a differentiation between the terms "reuse", recovery and "recycling" has been made. While the definitions disposal and recovery mean "any applicable operations provided for Annex IIA" and "Annex II B to Directive 75/442/EEC", the term reuse means any operation by which packaging, which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations, is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled; such reused packaging will become packaging waste when no longer subject to reuse. In this definition, reused packaging is not a waste as long as it remains continuously in the production cycle. "Recycling means the reprocessing in a production process of the waste materials for the original purpose or for other purposes including organic recycling but excluding energy recovery". Lastly, "energy recovery shall mean the use of combustible packaging waste as a means to generate energy through direct incineration with or without other waste but

with recovery of the heat". Thus, discarded package used for recycling or energy recovery is a waste.

In general, the more extended general definitions of the terms disposal, and recovery do not conflict with the US Solid Waste Disposal Act (RCRA). Like in the definition of reused package in Council Directive on packaging waste, the definition of the recovered material in RCRA clearly indicates that "the materials and by-products generated from, and reused within an original manufacturing process" are not a waste. Any other recovered material is a waste.

I.1.4. International definitions

Besides EU definitions that are not considered here to be international in face of gradual harmonization and unification of laws and regulations within the European Union, other international regulations of a wider geographical coverage are in force in the EU area. In particular, these regulations comprise OECD Council Decisions and the Basel Convention related to transboundary movements of wastes. The 29 Member Countries of OECD, besides the EU members, include associated (Norway) or pre-accessory stage countries (Poland, Hungary and Czech Republic), as well as 8 non-European countries, including the most developed ones: Australia, Canada, Iceland, Japan, Korea, Mexico, New Zealand, and USA.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal has been ratified as for 19 June 2002 by 151 parties all over the world and thus has the strongest impact on the waste terminology and legislative area worldwide. The Parties to the Basel Convention, besides the EU Member States, comprise most of Asia, Oceania and South America. The biggest white spot area occurs in Africa, Central and North America, due to the United States not joining the Convention (Tieman, 1998). Also several new counties – former republics of the USSR in Europe and Asia – have not yet ratified the Convention.

Adoption of the terminology used in OECD and Basel Convention legislative documents and regulations brings about the requirement of harmonization of the legal definitions to avoid all the discrepancies between the directives in force, which unavoidably leads to intended or unintended misinterpretation and legislative confusion.

I.1.4.1. Waste definitions in OECD regulations

The OECD Council Decision C(88)90 Final of 27 May 1988, which was enacted to control the transfrontier movement of hazardous wastes, defines waste as *materials other than radioactive materials intended for disposal, for reasons specified in Table 1* Table 1 is entitled "Reasons why material are intended for disposal" and contains 16 different categories of waste (Q1–Q16) (see Appendix I). These categories were introduced into the definition of waste in the Framework Directive on Waste 91/156/EEC of 1991 as "set out in Annex 1" to comply with the OECD Council Decision C(88)90 Final. The European Commission, in accordance with the procedure laid down in Article 18, was required to draw up "a list of wastes listed in Annex 1" not later than 1 April 1983. The European Waste Catalogue (EWC), which was developed as a realization of this obligation, and the

EC list of wastes that replaced EWC in 2000 (Commission Decision 2000/532/EC), consists of 20 categories (two-digit code), as well as four-digit subcategories and six-digit types of waste. In fact, it has no definite relation to the OECD list, but constitutes a well systemized and easy-to-handle inventory of waste. This has evoked a serious problem with regard to the general definitions of waste in the Framework Directive 91/156/EEC and OECD Council Decision C(88)90 with double listing, and as discussed above, resulted in simultaneous adopting the general definition of waste from the non-amended Framework Directive 75/442/EEC, Article 1(a) by the Council Directives 91/989/EEC on hazardous wastes, 94/62/EC on packaging waste, Council Directive 1999/31/EC on the landfill of waste and Council Regulation 259/93 on the shipment of waste.

On the other hand, the adoption in 1992 by OECD Member States of the Council Decision Concerning the Control of Transfrontier Movements of Wastes Destined for Recovery Operations C(92)39/Final, which uses the same definition of waste as that in the OECD Council Decision C(88)90 Final, implies the alignment of the OECD Member Countries on this definition until it is in force. For the EU countries, that means the aforementioned burden with double legal definitions of the term waste.

The OECD Council Decision C(88)90 Final also gives the definition of hazardous wastes as those belonging to the categories listed in Table 3 of its Annex entitled "Generic types of potentially hazardous wastes". Again, this list differs from the "Categories or generic types of hazardous waste..." listed in the Annex I to the Council Directive 91/689/EEC on hazardous waste, from the repealed list of hazardous waste annexed to the Council Decision of 22 December 1994 and from the list of hazardous waste incorporated into the integrated list of wastes (Commission Decision 2001/532/EC amended by 2001/118/EC).

The Council Decision Concerning the Control of Transfrontier Movements of Wastes Destined for Recovery Operations C(92)39/Final does not define the waste- and hazardous waste-related terms, but indirectly introduces the three-level gradation of waste according to the increasing potential hazard: the Green, Amber and Red Tiers. Wastes belonging to the Amber and Red Tiers are considered hazardous; these of the Red Tier display the highest level of hazard.

The Council Regulation 259/93/EC on the shipment of waste has been harmonized with the OECD Council Decision C(92)39 Final to enable its formal implementation through national legislation, and therefore refers to the same three tiers, despite the fact that some discrepancies between these listings and the European List of Hazardous Waste established by Council Decision 94/904/EC and at present incorporated into the harmonized list of wastes enacted by the Commission Decisions 2000/532/EC and 2001/118/EC also occur.

In the question of distinguishing waste from "non-waste", OECD proposed a step-by-step approach organized in a flow chart, where the destination of the material, its environmental and public health protection and economic criteria are considered (OECD ENV/EPOC/WMP (96)1, (97)2, 1996, 1997). From these criteria can be concluded, that if the material can only be used with being subjected to recovery operation, it is ultimately a waste. If the material can be used without being subjected to recovery operation, a further consecutive analysis is to be accomplished to identify clearly its nature.

I.1.4.2. The terms and definitions of the Basel Convention

The definition of waste used by the Basel Convention is convergent with that of the Framework Directive 75/442/EEC and is formulated as follows: "Wastes are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law." The discrepancy of this basic term between two international regulations justifies parallel functioning of the two definitions of waste in the EU legislation referring to two international regulations being simultaneously in operation in its area. Other countries, which ratified both OECD Council Decisions and the Basel Convention, face the same problems. On the other hand, much wider spread of the Basel Convention, as well as a short and clear definition free of unnecessary listing, gives this definition an advantage to become a harmonized worldwide one.

The term hazardous waste like definitions in other regulations discussed above refers to the list of categories and to the properties making the waste hazardous. It is defined as: " (a) wastes that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III; and (d) wastes that are not covered under paragraph (a) but are defined as, or considered to be hazardous wastes by the domestic legislation of the Party of export, import and transit". Radioactive wastes are excluded from this definition. The list of categories to be controlled, which is contained in Annex I, has been adopted from the OECD Council Decision C(88)90/Final, which designated a "core list" of wastes unanimously considered hazardous. This way, at least two international lists in force have been harmonized. This list contains two categories of waste. Waste to be controlled covers 45 categories (Y1–Y45) having as constituents organic and inorganic hazardous substances. Waste of particular concern includes two categories Y46 and Y47 (household waste and the residues from their incineration) (see Appendix A in Chapter II.2).

A further development of international regulations on hazardous waste transboundary movement under the Basel Convention was a ban on the export of hazardous recyclable waste from OECD countries to non-OECD countries since January 1, 1998. For the purpose of this regulation, new lists were set up to specify the waste to be covered by the export ban:

- list A contains the hazardous waste covered by the ban;
- list B contains the waste not covered by the ban as non-hazardous;
- list C contains the waste to be classified in either the list A or list B.

Lists A and B were incorporated into the text of the Basel Convention as Annex VIII and IX, respectively (SBC, 1999). (For more information concerning the Basel Convention see Chapter II.2).

The efforts to harmonize the EC regulations with the Basel Convention resulted in amendment of Council Regulation 259/93/EC on the shipment of waste by the Council Regulation 120/97. It added to the Amber and Red Tiers incorporated from OECD Council Decision C(92)39 in Annexes III and IV, an Annex V referring to the Basel Convention's export ban. Council Decision 97/640/EC of 22 September 1997 updated regulations on the control of transboundary movements of hazardous wastes and their disposal in accordance with Decision III/1 of the Conferences of the Parties of Basel Convention.

I.1.5. National definitions

The national definitions related to waste differ from country to country and depend predominantly on the level of economic and cultural development, besides the specificity of the local geographical, political and historical conditions. These factors greatly influence the general status of the national environmental legislation. While some countries suffer from overgrowth of the incompatible legislative regulations, others have no national legislation on waste at all. Both cases can result in fatal errors in the waste management practice, although of different nature.

The European Framework and Council Directives on waste have contributed to harmonization of the waste-related definitions in the EU Member States to the extent that can be achieved considering the lack of harmony between the Directives itself and attachment of some EU Member countries to their national regulations. For example, Belgium, Denmark, Germany, Ireland, Italy, The Netherlands and the UK, in their national legislation, adopted the definition of a waste according to Framework Directive 91/156/EEC. Spain, Greece and Portugal use the non-amended Framework Directive 75/442/EEC. French Act 75-633 1975 revised in July 1992 defines waste as "material originating from a production or transformation process, or use, which the holder discards or intends to discard". Luxembourg defines waste as any substance or object, which the holder disposes of, or it is required to discard. Also the product and any substance for recovery operations is considered waste till it enters again in the commercial cycle (Bontoux and Leone, 1997).

All the EU Member States and candidate countries (Poland, Hungary, Czech Republic) adopted the definition of hazardous waste from Council Directive 91/689/EEC Art. 1 (4) and the continuously updated list of hazardous waste currently incorporated into the EC list of wastes (Commission Decisions 2000/532/EC and 2001/118/EC).

In most cases national regulations of the EC Member States follow the general definition of the Framework Directives on waste also in the question of recyclable discarded material, which is indirectly defined as a waste. Several EC Member countries (Belgium, Germany, France, Luxembourg, The Netherlands, the UK) have developed specific *criteria for distinguishing waste from non-waste*, which are articulated in a different way, but may be summarized on a basis of the common approach. According to this approach, the major prerequisite of not being considered waste is that the material, besides having a use value and fulfilling high environmental protection demands, should: (i) be continuously integrated into a production process, commercial cycle or chain of utility; (ii) have guaranteed immediate use (i.e. have stable users, be transported directly and have set and contractual relations between producer and user); and (iii) not be subjected to any process comparable to waste disposal or recovery. These criteria comply with the definition of waste given in Framework Council Directive 75/442/EEC and amending it Framework Council Directive 91/156/EEC. In general, they are also consistent with those proposed by OECD guidance (OECD ENV/EPOC/WMP (96)1, (97)2, 1996, 1997).

In Canada, the national legislation on waste and hazardous waste is regulated under the Canadian Environment Protection Act, 1988 (CEPA). Specific testing, criteria and protocols exist in the Canadian Transportation of Dangerous Goods Regulations (TDGR) for the hazard classes that are in most cases analogous to the Basel Annex III characteristic

identified. Canada controls all of Basel Annex I and Annex II wastes, all OECD amber and red listing, and a number of other wastes that do not have a corresponding Annex I or II entry. The more than 3000 listed wastes by Canadian regulations include a few hundred substances identified as being hazardous to the environment.

In the countries other than the USA and EU Member States the status of national legislation, which provides for definition of terms related to waste management is different, from more or less developed to almost none. In countries associated with the EU, in particular in candidates to the EU in the pre-accession stage, the national legislation on waste gradually adopt or harmonize national regulations with the EU legislation. For example, in Poland waste management is regulated by Waste Act of 27 April 2001. Polish terminological standards and legislation on waste in force are distinctly influenced by the EU regulations, in particular through the direct adoption of the EU list of wastes (Polish Waste Act, 2001). Poland adopts definition of wastes from Council Directive 91/156/EEC. Hazardous wastes are defined in Waste Act after Council Directive 91/689/EEC on hazardous waste. Poland adopted subsequently EWC and harmonized lists of wastes following Commission Decisions 2000/532/EC and 2001/118/EC, and incorporated the relevant lists of wastes also into subsequent national Directives of the Cabinet on charges for the use of the environment and for the disposal of waste (1993, 1998, 2001, 2003). According to the practical application of the definitions, waste has to be paid for disposal, but ceases being waste when it is actually within the "commercial cycle or chain of utility" and has "set and contractual relations between producer and user". This creates strong incentive for waste producers to look for customers or re-use technologies, based on the system of fees and penalties for the disposal of waste (Directives of the Cabinet, 1993, 1998, 2001, 2003; Waste Act, 2001; Environment Protection Act, 2001; see also Chapter II.1).

Simultaneously, lack of equivocal formulation and scope of the quoted definition of waste, hazardous waste and waste that are not hazardous but not inert, not only between the national and EU legal definitions, but within the national standards and regulations is symptomatic and reflects the difference in approaches within the regulatory bodies.

In many other countries of the world there is still no agreed definition of the term hazardous waste. The criteria for this definition consider either only the danger to human health or also the threat to the environment. Some national regulations define hazardous waste in terms of hazard characteristics (ignitability, reactivity), other give as criteria the "hazardous concentrations" of substances (UNEP, 1992). Significant and growing influence on the integration of national legislation of the participating parties is exerted by the Basel Convention due to its worldwide scope and activity. Gradually, the parties to the Basel Convention that had no national legal definition adopt the Basel Convention definitions and list for hazardous waste classification that makes worldwide national reporting and statistics much more clear and reliable. In many countries there are no other hazard criteria, categories of wastes to be controlled and categories of wastes requiring special consideration in addition to those listed in Annexes I and II of the Basel Convention (e.g. Albania, Benin, Bulgaria, Cyprus, Iran, Japan, Nigeria, Panama, Romania). Some countries incorporate definitions and lists of the Basel Convention into the national laws (e.g. Australia, Switzerland), or introduce additional categories of wastes requiring special consideration to those listed in Annexes I and II of the Basel Convention (e.g. Bolivia, Brazil, China, Indonesia, Republic of Macedonia, Saint Lucia, Sri Lanka,

Turkey). In Argentina the legal term hazardous wastes means "any waste that may cause damage, directly or indirectly, to living creatures or to pollute the soil, water, the atmosphere or the environment in general". This definition, which is broad and vague, became more specific by referring to wastes of categories listed in Annex I or having any of the characteristics of the Annex III of the Basel Convention (Hazardous Waste Law 24051-92. Article 2nd). In Russian Federation, the national definition of hazardous wastes is formulated by the Federal Law "On Wastes of Production and Consumption" of 26 June 1998. According to this definition hazardous waste is the waste containing harmful substances having hazardous properties (toxicity, explosivity, flammability, high-reaction ability) or containing the agents causing contagious diseases or that posing an immediate or potential threat to environment and human health either by themselves or on contact with other substances". Other former republics of the USSR, Kyrgyzstan and Uzbekistan have the national definitions of hazardous wastes close to that of Russian Federation, some other have their national legislation in preparation (Georgia, Moldova, Lithuania). A number of other countries have not yet national legislation on hazardous waste (e.g. Andorra, Senegal, Gambia) (SBC, 1999, 2000, 2001). Indian legal definition of hazardous wastes also differed substantially from this adopted by the Basel Convention. Indian national legislation on hazardous waste management was brought in line with the ratified Basel Convention through amendment its Hazardous Waste Rules (1989), which came into force in 2000 (Anonymous, 2001).

To harmonize the national legislation of the parties, which display exemplified different status, the "Revised Model National Legislation on the Management of Hazardous Wastes and other Wastes as well as on the Control of Transboundary Movements of Hazardous Wastes and their Disposal" (SBC, 1995), was adopted by the third meeting of the Conference of the Parties (COP3) to the Basel Convention and brought out in 1996 by the Secretariat of the Basel Convention (SBC). This model national law defines also relevant terms on waste, in conformity with the Convention (SBC, 1995, 1996).

I.1.6. Summary and conclusions

The brief review of the terminological issues shows clearly that still much is to be done for integration and harmonization of waste-related legal terms and definitions. The growing number of parallel national, regional and international regulations in force evokes problems with discrepancy of definitions of the basic terms related to waste in general and solid and hazardous waste in particular. This, in turn, exerts negative impact on environmentally safe and economically effective waste management in the national, regional and global scale. In the light of the current terminological problems and multitude of lists related to waste terminology, the focusing of efforts on the integration of the legislative arena directed to the development of well-thought and fully justified equivocal terminology with a reduced number of well-systemized lists and thorough analysis of consequences on environmental safety, economy and sustainable development of waste management system has now become a task of utmost priority. The importance and the weight of this task are difficult to overestimate. Beginning now, not the developing and enacting of new regulations, which multiply definitions for the same terms, but careful revision of the national, regional and international terminology by the competent

international body should be the first step towards the harmonized, integrated, environmentally and economically optimized waste management, worthy of the 21st century.

Appendix A

Excerpt from: Council Directive 91/156/EEC of 18 March 1991 amending Directive 75/443/EEC on waste *OJ L 078 26.03.1991, p. 32–37.*

Annex I

Categories of waste

Q1 Production or consumption residues not otherwise specified below
Q2 Off-specification products
Q3 Products whose date for appropriate use has expired
Q4 Materials spilled, lost or having undergone other mishap, including any materials, equipment, etc., contaminated as a result of the mishap
Q5 Materials contaminated or soiled as a result of planned actions (e.g. residues from cleaning operations, packing materials, containers, etc.)
Q6 Unusable parts (e.g. reject batteries, exhausted catalysts, etc.)
Q7 Substances, which no longer perform satisfactorily (e.g. contaminated acids, contaminated solvents, exhausted tempering salts, etc.)
Q8 Residues of industrial processes (e.g. slags, still bottoms, etc.)
Q9 Residues from pollution abatement processes (e.g. scrubber sludges, baghouse dusts, spent filters etc.)
Q10 Machining/finishing residues (e.g. lathe turnings, mill scales, etc.)
Q11 Residues from raw material extraction and processing (e.g. mining residues, oil field slops, etc.)
Q12 Adulterated materials (e.g. oils contaminated with PCBs, etc.)
Q13 Any materials, substances or products whose use has been banned by law
Q14 products for which the holder has no further use (e.g. agricultural, household, office, commercial and shop discards, etc.)
Q15 Contaminated materials, substances or products resulting from remedial action with respect to land
Q16 Any materials, substances or products, which are not contained in the above categories.

Annex IIA

Disposal operations

NB: This annex is intended to lit disposal operations such as they occur in practice. In accordance with Article 4, waste must be disposed of without endangering human health and without use of processes or methods likely to harm the environment

D1 Tipping above or underground (e.g. landfill, etc.)
D2 Land treatment (e.g. biodegradation of liquid or sludge discards in soils, etc.)
D3 Deep injection (e.g. injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc.)
D4 Surface impoundment (e.g. placement of liquid or sludge discards into pits, ponds or lagoons, etc.)
D5 Specially engineered landfill (e.g. placement into lined discrete cells, which are capped and isolated from one another and the environment, etc.)
D6 Release of solid waste into a water body except seas/oceans
D7 Release into seas/oceans including seabed insertion
D8 Biological treatment not specified elsewhere in this Annex which results in final compounds or mixtures, which are disposed of by means of any of the operations in this Annex (e.g. evaporation, drying, calcination, etc.)
D9 Physico-chemical treatment not specified elsewhere in this Annex, which results in final compounds or mixtures, which are disposed of by means of any of the operations in this Annex (e.g. evaporation, drying, calcinations, etc.)
D10 Incineration on land
D11 Incineration at sea
D12 Permanent storage (e.g. emplacement of containers in a mine, etc.)
D13 Blending of mixture prior to submission to any of the operations in this Annex
D14 Repackaging prior to submission to any of the operations in this Annex
D15 Storage pending any of the operations in this Annex, excluding temporary storage, pending collection, on the site where it is produced.

Annex IIB

Operations, which may lead to recovery

NB: This Annex is intended to list recovery operations as they are carried out in practice. In accordance with Article 4, waste must be recovered without endangering human health and without the use of processes or methods likely to harm the environment

R1 Solvent reclamation/regeneration
R2 Recycling/reclamation of organic substances, which are not used as solvents
R3 Recycling/reclamation of metals and metal compounds
R4 Recycling/reclamation of other inorganic materials
R5 Regeneration of acids or bases
R6 Recovery of components used for pollution abatement
R7 Recovery of components from catalysts
R8 Oil re-refining or other re-uses of oil
R9 Use principally as a fuel or other means to generate energy
R10 Spreading on land resulting in benefit to agriculture or ecological improvement, including composting and other biological transformation processes, except in the case of waste excluded under Article 2 (1)(b)(iii)
R11 Use of wastes obtained from any of the operations numbered R1–R10
R12 Exchange of wastes for submission to any of the operations numbered R1–R11

R13 Storage of materials intended for submission to any operation in this Annex, excluding temporary storage, pending collection, on the site where it is produced.

Appendix B

Excerpt from: Doc. 391L0689, Council Directive 91/689/EEC of 12 December 1991 on hazardous waste, *OJ L 377 31.12.1991, p. 20; Amended by* **394L0031** *(OJ L 168 02.07.1994,* p. 28).

Annex I

Categories or generic types of hazardous waste listed according to their nature or the activity which generated them(*) *(waste may be liquid, sludge or solid in form)*

Annex I. A

Wastes displaying any of the properties listed in Annex III and which consist of

1. anatomical substances; hospital and other clinical wastes;
2. pharmaceuticals, medicines and veterinary compounds;
3. wood preservatives;
4. biocides and phyto-pharmaceutical substances;
5. residue from substances employed as solvents;
6. halogenated organic substances not employed as solvents excluding inert polymerized materials;
7. tempering salts containing cyanides;
8. mineral oils and oily substances (e. g. cutting sludges, etc);
9. oil/water, hydrocarbon/water mixtures, emulsions;
10. substances containing PCBs and/or PCTs (e. g. dielectrics etc);
11. tarry materials arising from refining, distillation and any pyrolytic treatment (e. g. still bottoms, etc);
12. inks, dyes, pigments, paints, lacquers, varnishes;
13. resins, latex, plasticizers, glues/adhesives;
14. chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or the environment are not known (e.g. laboratory residues, etc);
15. pyrotechnics and other explosive materials;
16. photographic chemicals and processing materials;
17. any material contaminated with any congener of polychlorinated dibenzo-furan;
18. any material contaminated with any congener of polychlorinated dibenzo-*p*-dioxin.

(*) Certain duplications of entries found in Annex II are intentional.

Annex I.B

Wastes which contain any of the constituents listed in Annex II and having any of the properties listed in Annex III and consisting of

19. animal or vegetable soaps, fats, waxes;
20. non-halogenated organic substances not employed as solvents;
21. inorganic substances without metals or metal compounds;
22. ashes and/or cinders;
23. soil, sand, clay including dredging spoils;
24. non-cyanidic tempering salts;
25. metallic dust, powder;
26. spent catalyst materials;
27. liquids or sludges containing metals or metal compounds;
28. residue from pollution control operations (e. g. baghouse dusts etc.) except (29), (30) and (33);
29. scrubber sludges;
30. sludges from water purification plants;
31. decarbonization residue;
32. ion-exchange column residue;
33. sewage sludges untreated or unsuitable for use in agriculture;
34. residue from cleaning of tanks and/or equipment;
35. contaminated equipment;
36. contaminated containers (e.g. packaging gas cylinders etc.) whose contents included one or more of the constituents listed in Annex II;
37. batteries and other electrical cells;
38. vegetable oils;
39. materials resulting from selective waste collections from households and which exhibit any of the characteristics listed in Annex III;
40. any other wastes which contain any of the constituents listed in Annex II and any of the properties listed in Annex III.

Annex II

Constituents of the wastes in Annex I.B which render them hazardous when they have the propertles described in Annex III(*)

Wastes having as constituents:

C1 beryllium; beryllium compounds;
C2 vanadium compounds
C3 chromium (VI) compounds;
C4 cobalt compounds;
C5 nickel compounds;
C6 copper compounds;

(*) Certain duplications of generic types of hazardous wastes listed in Annex I are intentional.

C7 zinc compounds;
C8 arsenic, arsenic compounds
C9 selenium; selenium compounds;
C10 silver compounds;
C11 cadmium; cadmium compounds;
C12 tin compounds;
C13 antimony; antimony compounds;
C14 tellurium, tellurium compounds;
C15 barium compounds; excluding barium sulfate;
C16 mercury; mercury compounds;
C17 thallium; thallium compounds;
C18 lead, lead compounds;
C19 inorganic sulfides;
C20 inorganic fluorine compounds, excluding calcium fluoride;
C21 inorganic cyanides
C22 the following alkaline or alkaline earth metals lithium, sodium, potassium, calcium, magnesium in uncombined form;
C23 acidic solutions or acids in solid form;
C24 basic solutions or bases in solid form;
C25 asbestos (dust and fibers);
C26 phosphorus: phosphorus compounds, excluding mineral phosphates;
C27 metal carbonyls;
C28 peroxides;
C29 chlorates;
C30 perchlorates;
C31 azides
C32 PCBs and/or PCTs;
C33 pharmaceutical or veterinary compounds;
C34 biocides and phyto-pharmaceutical substances (e.g. pesticides, etc.);
C35 infectious substances;
C36 creosotes;
C37 isocyanates; thiocyanates;
C38 organic cyanides (e.g. nitriles, etc);
C39 phenols; phenol compounds;
C40 halogenated solvents;
C41 organic solvents, excluding halogenated solvents;
C42 organohalogen compounds, excluding inert polymerized materials and other substances referred to in this Annex;
C43 aromatic compounds; polycyclic and heterocyclic organic compounds;
C44 aliphatic amines;
C45 aromatic amines
C46 ethers;
C47 substances of an explosive character, excluding those listed elsewhere in this Annex;
C48 sulfur organic compounds;
C49 any congener of polychlorinated dibenzo-furan;
C50 any congener of polychlorinated dibenzo-*p*-dioxin;

C51 hydrocarbons and their oxygen; nitrogen and/or sulfur compounds not otherwise taken into account in this Annex.

Annex III

Properties of wastes, which render them hazardous

H1 "Explosive": substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene.

H2 "Oxidizing": substances and preparations, which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances.

H3 -A "Highly flammable":
-liquid substances and preparations having a flash point below 21 °C (including extremely flammable liquids). or
-substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any application of energy or
-solid substances and preparations which may readily catch fire after brief contact with a source of ignition and which continue to burn or to be consumed after removal of the source of ignition, or
-gaseous substances and preparations which are flammable in air at normal pressure, or
-substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities.

H3 -B "Flammable": liquid substances and preparations having a flash point equal to or greater than 21°C and less than or equal to 55°C.

H4 "Irritant": non-corrosive substances and preparations, which through immediate prolonged or repeated contact with the skin or mucous membrane can cause inflammation.

H5 "harmful": substances and preparations which, if they are inhaled or ingested or if they penetrate the skin may involve limited health risks.

H6 "Toxic": substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin may involve serious acute or chronic health risks and even death.

H7 "Carcinogenic": substances and preparations which, if they are inhaled or ingested or if they penetrate the skin may induce cancer or increase its incidence.

H8 "Corrosive": substances and preparations, which may destroy living tissue on contacts.

H9 "Infectious": substances containing viable microorganisms or their toxins, which are known or reliably believed to cause disease in man or other living organisms.

H10 "Teratogenic": substances and preparations which, if they are inhaled or ingested or if they penetrate the skin may induce non-hereditary congenital malformations or increase their incidence.

H11 "Mutagenic": substances and preparations which, if they are inhaled or ingested or if they penetrate the skin may induce hereditary genetic defects or increase their incidence.

H12 Substances and preparations which release toxic or very toxic gases in contact with

water air or an acid.

H13 Substances and preparations capable by any means, after disposal, of yielding another substance, e.g. a leachate, which possesses any of the characteristics listed above.

H14 "Ecotoxic": substances and preparations, which present or may present immediate or delayed risks for one or more sectors of the environment.

Notes

1. Attribution of the hazard properties "toxic" (and "very toxic"), "harmful", "corrosive" and "irritant" is made on the basis of the criteria laid down by Annex Vl, part I A and part II B of Council Directive 67/548/EEC of 27 June 1967 of the approximation of laws regulations and administrative provisions relating to the classification, packaging and labeling of dangerous substances[1] in the version as amended by Council Directive 79/831/EEC.[2]
2. With regard to attribution of the properties "carcinogenic" and "mutagenic", and reflecting the most recent findings, additional criteria are contained in the Guide to the classification and labeling of dangerous substances and preparations of Annex VI (part II D) to Directive 67/548/EEC in the version as amended by Commission Directive 83/467/EEC.[3]

Test methods

The test methods serve to give specific meaning to the definitions given in Annex III.

The methods to be used are those described in Annex V to Directive 67/548/EEC, in the version as amended by Council Directive 84/449/EEC,[4] or by subsequent Commission Directives adapting Directive 67/548/EEC to technical progress. These methods are themselves based on the work and recommendations of the competent international bodies, in particular the OECD.

Appendix C

Excerpt from: Doc. 300D052: Commission Decision 2000/532/EC of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of council Directive 91/689/EEC on hazardous waste (notified under document number C(2000)1147) (Text with EEA relevance), *OJ L226 06 09.2000, p. 3*

[1] OJ No I 196, 16.8.1967, p. 1.
[2] OJ No 1 259, 15.10.1979, p. 10.
[3] OJ No 1 257, 16.9.1983, p. 1.
[4] OJ No 1 251, 19.9.1984, p. 1.

Amended by **301D0118** *OJ L 047 16.02.2001, p. 1)*
Amended by **301D0119** *(OJ L 047 16.02.2001, p. 32)*
Commission Decision of 16 January 2001 amending Decision 2000/532/EC as regards the list of wastes *(notified under document number C(2001)108) (2001/118/EC):*

Article 1
Decision 2000/532/EC is amended as follows:
1. Article 2 is replaced by the following:
   Article 2
   Wastes classified as hazardous are considered to display one or more of the properties listed in Annex III to Directive 91/689/EEC and, as regards H3 to H8, H10(*) and H11 of the said Annex, one or more of the following characteristics:

- flash point $\leq 55°C$,
- one or more substances classified(**) as very toxic at a total concentration $\geq 0.1\%$.
- one or more substances classified as toxic at a total concentration $\geq 3\%$.
- one or more substances classified as harmful at a total concentration $\geq 25\%$.
- one or more corrosive substances classified as R35 at a total concentration $\geq 1\%$.
- one or more corrosive substances classified as R34 at a total concentration $\geq 5\%$.
- one or more irritant substances classified as R41 at a total concentration $\geq 10\%$.
- one or more irritant substances classified as R36, R37, R38 at a total concentration $\geq 20\%$.
- one substance known to be carcinogenic of category 1 or 2 at a concentration $\geq 0.1\%$.
- one substance known to be carcinogenic of category 3 at a concentration $\geq 1\%$.
- one substance toxic for reproduction of category 1 or 2 classified as R60, R61 at a concentration $\geq 0.5\%$.
- one substance toxic for reproduction of category 3 classified as R62, R63 at a concentration $\geq 5\%$.
- one mutagenic substance of category 1 or 2 classified as R46 at a concentration $\geq 0.1\%$.
- one mutagenic substance of category 3 classified as R40 at a concentration $\geq 1\%$.

2. The Annex is replaced by the text in the Annex to this Decision.
   Article 2
   This Decision shall apply from January 2002
   Article 3
   This decision is addressed to the Member States.

(*) In Directive 92/32/EEC amending for the seventh time Directive 67/548/EEC the term "toxic for reproduction" was introduced. The term "Teratogenic" was replaced by a corresponding term toxic for reproduction. This term is considered to be in line with property H10 in Annex III to Directive 91/689/EEC.
(**) The classification as well as the R numbers refer to Directive 67/548/EEC on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labeling of dangerous substances (O) L 196, 16.8.1967, p. 1) and its subsequent amendments. the concentration limits refer to those laid down in Directive 88/379/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labeling of dangerous preparations (O) L 187, 16.7.1988, p. 14) and its subsequent amendments.

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