SECOND INTERNATIONAL
SLAG VALORISATION SYMPOSIUM
THE TRANSITION TO SUSTAINABLE MATERIALS MANAGEMENT

FEhS Institut für Baustoff Forschung

European environmental policy and its influence on the use of slag products

Motz, H.; Bialucha, R.; Merkel, Th.

HT centre

SMART-PRO²

European Environment policy - Targets

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- **Preservation and protection of the environment as well as improvement of the quality**
- **Protection of human health**
- **Careful and efficient use of natural ressources**
- **Funding of measures on international level for coping with environmental problems on global or regional level**

These targets have to be basis of slag use!!

Production of Iron and Steel Slag in Europe

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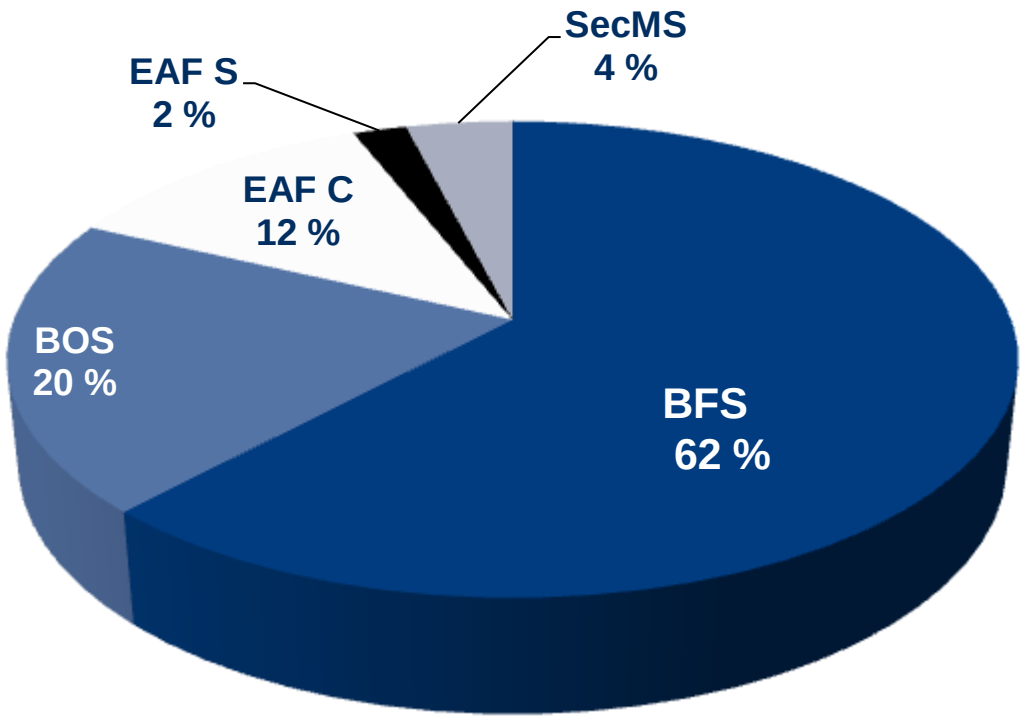
2008: 45.6 million tonnes



BFS:	**Blast Furnace Slag**
BOS:	**Basic Oxygen Furnace Slag**
EAF C:	**Electric Arc Furnace Slag - Carbon Steel**
EAF S:	**Electric Arc Furnace Slag - Stainless Steel**
SecMS:	**Secondary Steelmaking Slag**

EUROSLAG Questionnaire 2009

Use of Iron and Steel Slag in Europe

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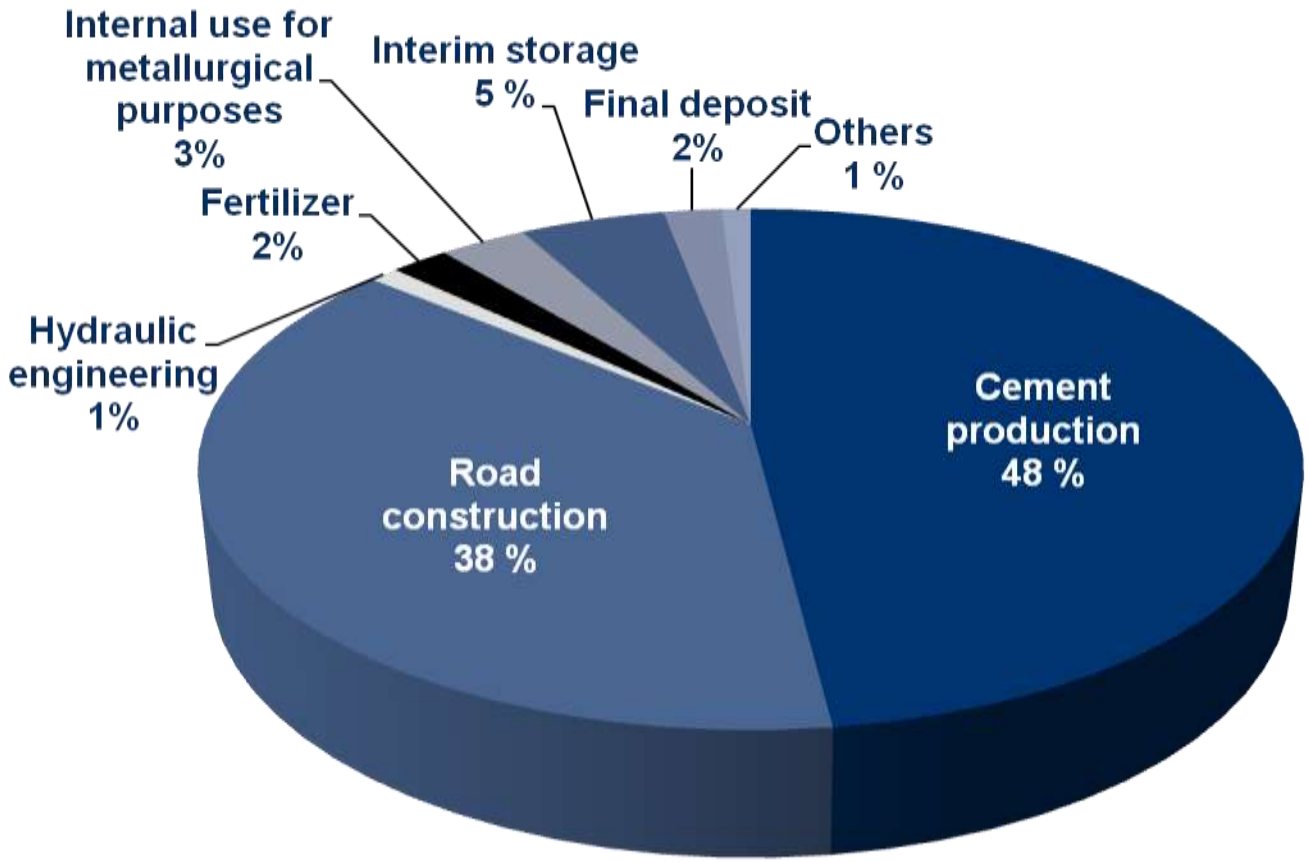
2008: 46.9 million tonnes



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FEhS Institut für Baustoff Forschung

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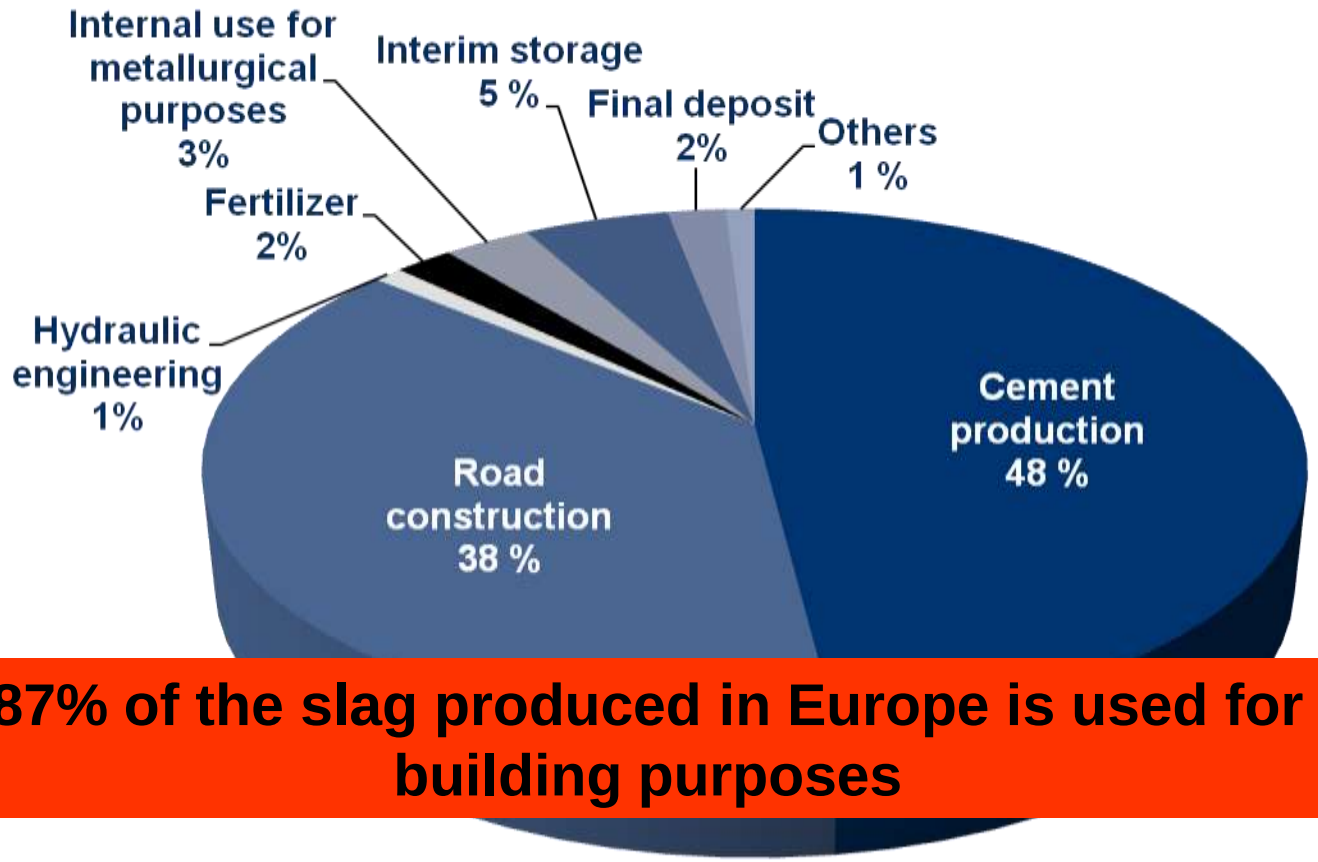

87% of the slag produced in Europe is used for building purposes

EUROSLAG Questionnaire 2009

Issues of Concern concerning Environment

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- What is slag - Waste or Product?
- Effects on human beings (ecotoxicity and toxicity)
- Effects on air (emissions)
- Effects on water (surface and groundwater) and
- Effects on soil (retention, enrichment of substances)

Evaluation based on

- European legislation
- European harmonised standards
- Requirements on the place of use

EU Environmental Directives and Regulations

Source: CEMBUREAU

Examples of environmental Directives and regulations in Europe which concern slag use

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- EU-Waste catalogue [2000]
- EU-Council Decision on the Landfill of Waste [2002]
- EU-Waste Shipment Regulation [2006]
- EU-REACH Regulation [2006]
- EU-Waste Framework Directive [2008]
- EU-Water Framework Directive [2008]
- EU-Construction Products Directive [1988]
  under revision as Regulation [2011?]
  (Basis for European standardisation of building materials)

[year of publication]

EU-Waste Catalogue 2000

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The European Waste Catalogue (EWC) established by the Commission Decision 2000/532/ECC of 3 May 2000 contains two entries regarding slag:

- **10 02 01 waste from the processing of slag**
- **10 02 02 unprocessed slag**

Conclusion:
Processed slag is a (By)-Product

Question:
What is meant by processing?

EU-Waste Cataloque 2000

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In 2002 the EU Commission agreed that

- **granulation**
- **pelletisation**
- **foaming**
- **proper solidification connected with a specified heat treatment**
- **separation, crushing, sieving, milling**

are examples of slag processing.

Nearly 90% of slag generated in Europe is running through these processing steps and are marketed as (By)-Product!

EU-REACH Regulation

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Issues to be discussed by the Consortium:

- lack of data, examination of literature
- classification (decision of the Consortium: slags are registered as UVCB substances)
- definition of generation processes
- substance identity (contents)
- leaching concentrations
- evaluation of studies
- uses
- relevance of fines and fibres
- test methods
- election of test laboratories
- development of test protocols
- inhalation tests
- performance of eco-toxicological and toxicological tests

EU-REACH Regulation

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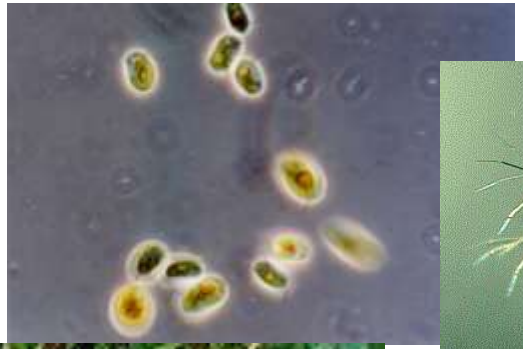
Tests which were carried out or are still running:

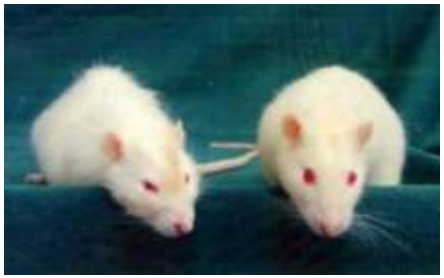
Eco-toxicological tests, e.g.

- Growth inhibition of algae
- Short-term and long-term toxicity to invertebrates
- Effects on soil micro-organisms
- Short-term toxicity to plants



Toxicological tests, e.g.

- Cytogenicity studies in mammalian cells
- Gene mutation studies in mammalian cells
- Skin irritation tests
- Eye irritation tests
- Inhalation studies



EU-REACH Regulation

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Tests which were carried out or are still running:

Eco-toxicological tests, e.g.

- Growth inhibition of algae
- Short-term and long-term toxicity to invertebrates
- Effects on soil micro-organisms
- Short-term toxicity to plants

Evaluation of toxicity of slags:

Slags are non hazardous substances

Basis for the registration before 1st December 2010

Toxicological testing

- Cytogenicity studies in mammalian cells
- Gene mutation studies in mammalian cells
- Skin irritation tests
- Eye irritation tests
- Inhalation studies

EU-Waste Shipment Regulation 2005

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Entries before Revision WSR - Version 2005

- GREEN List

Wastes included may not be subject to the general information requirements laid down in Article 18

GC070:

Slags arising from the manufacture of iron and steel (including low alloy steel) excluding those slags which have been specifically produced to meet both national and relevant international requirements and standards.

EU-Waste Shipment Regulation 2005

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Entries after Revision WSR - Version 2005

- GREEN List

Wastes included may not be subject to the general information requirements laid down in Article 18

B1200:

Granulated slag arising from the manufacture of iron and steel

B1210:

Slag arising from the manufacture of iron and steel including slags as a source of TiO_2 and Vanadium

EU-Waste Shipment Regulation 2005

Entries after Revision WSR - Version 2005

- Amber List

Wastes included will be subject to the procedure of written notification and consent

AA010:

Dross, scalings and other wastes from the manufacture of iron and steel [1)]

[1)] **This listing includes wastes in the form of ash, residue, slag, dross, skimming, scaling, dust, powder, sludge and cake, unless a material is expressly listed elsewhere.**

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Relevance of WSR

The Waste Shipment Regulation is applicable only to wastes - without regulating the differentiation between wastes and products in general.

What concerns the term "waste" in Article 2, the Waste Shipment Regulation refers only to Article 1 of the Waste Framework Directive. (Prof. Versteyl 2005)

Question!

Are Slags Wastes or (By-)Products?

Relevant for many other substances generated parallel to the main product!

Classification as Waste or By-Product

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT
on the Interpretative Communication on waste and by-products
21st February 2007

Annex 1 – examples of wastes and non-wastes

1. SLAGS AND DUSTS FROM IRON AND STEEL PRODUCTION

Blast furnace slag can be used directly at the end of the production process, without further processing that is not an integral part of this production process (such as crushing to get the appropriate particle size).

This material can therefore be considered to fall outside of the definition of waste.

Classification as Waste or By-Product

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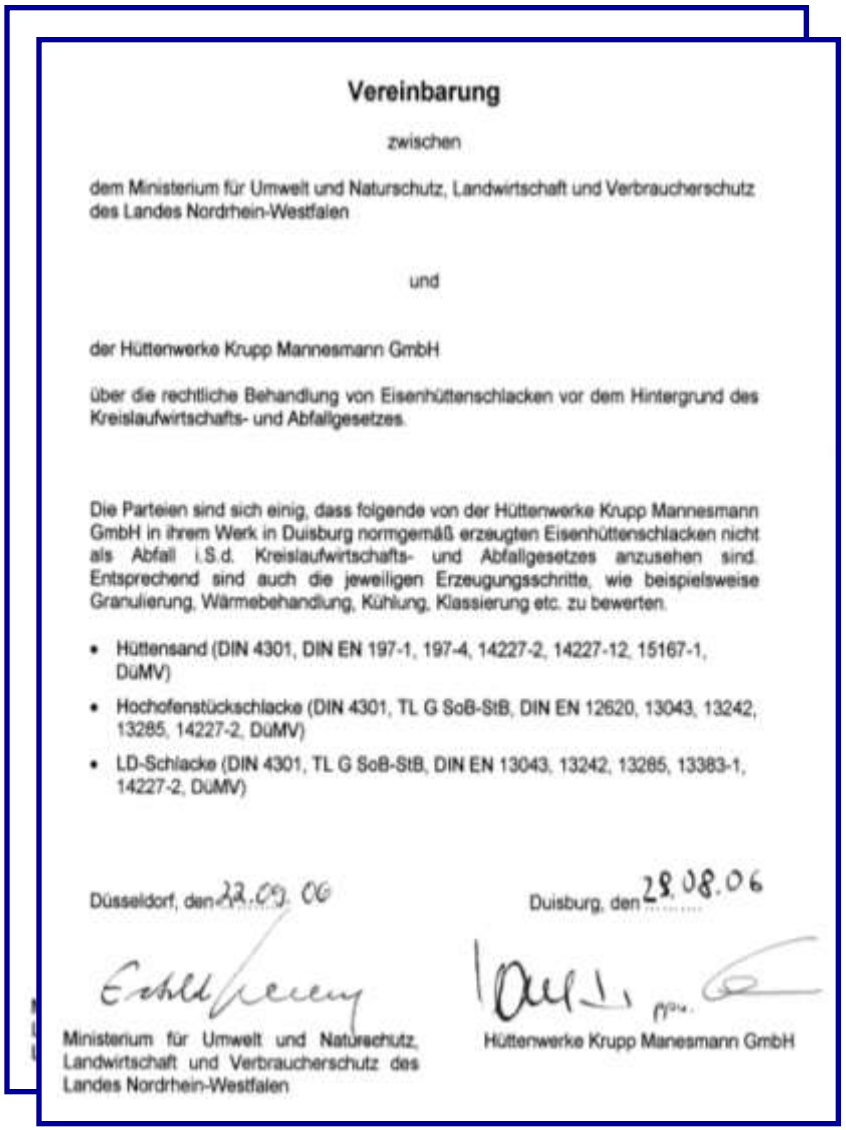
Further examples for the classification of Slags

• Austria 1991:	GBS	non waste
• EWC 1993:	10 02 01 waste from slag processing 10 02 02 unprocessed slag	
	conclusion: processed slag	non waste
• Germany 1997:	EAF-slag produced by BSW	non waste
• Austria 1999:	GBS	product
• EPA, 2000:	GGBS	by-product
• EU 2002:	Slag from the steel industry	waste
• Finland 2005:	Ferrochromium slag	non waste
• Belgium 2007:	GBS	non waste
• EU 2007:	GBS/ABS	by-product
• UK 2007:	GBS/ABS	by-product

GBS: Granulated Blast Furnace Slag, GGBS: Ground GBS, ABS: Air cooled Blast Furnace Slag

Classification as Waste or By-Product



Vereinbarung

zwischen

dem Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen

und

der Hüttenwerke Krupp Mannesmann GmbH

über die rechtliche Behandlung von Eisenhüttenschlacken vor dem Hintergrund des Kreislaufwirtschafts- und Abfallgesetzes.

Die Parteien sind sich einig, dass folgende von der Hüttenwerke Krupp Mannesmann GmbH in ihrem Werk in Duisburg normgemäß erzeugten Eisenhüttenschlacken nicht als Abfall i.S.d. Kreislaufwirtschafts- und Abfallgesetzes anzusehen sind. Entsprechend sind auch die jeweiligen Erzeugungsschritte, wie beispielsweise Granulierung, Wärmebehandlung, Kühlung, Klassierung etc. zu bewerten.

- Hüttensand (DIN 4301, DIN EN 197-1, 197-4, 14227-2, 14227-12, 15167-1, DüMV)
- Hochofenstückschlacke (DIN 4301, TL G SoB-StB, DIN EN 12620, 13043, 13242, 13285, 14227-2, DüMV)
- LD-Schlacke (DIN 4301, TL G SoB-StB, DIN EN 13043, 13242, 13285, 13383-1, 14227-2, DüMV)

Düsseldorf, den 22.09.06

Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen

Duisburg, den 28.08.06

Hüttenwerke Krupp Mannesmann GmbH

Agreement

Ministry of Environment (North Rhine-Westphalia)

and

Hüttenwerke KruppMannesman

respectively

ThyssenKrupp Steel Europe

Iron and steel slags are by-products

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Conclusion 1

Concerning the classification of slag there are three cases possible:

- **Slags are considered being by-products already in the liquid state directly after manufacture with or without processing steps.**

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- **Slags are considered being by-products already in the liquid state directly after manufacture with or without processing steps.**

- **Slags are first considered being wastes but cease to be wastes after a number of recovery measures.**

Conclusion 1

Concerning the classification of slag there are three cases possible:

- **Slags are considered being by-products already in the liquid state directly after manufacture with or without processing steps.**
- **Slags are first considered being wastes but cease to be wastes after a number of recovery measures.**
- **Slags remain waste**

Conclusion 2

Need of

- Criteria for by-products
- End of waste criteria

EU-Waste Framework Directive 2006

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Waste Framework Directive - WFD

entered into force on 12 December 2008

Article 5 "By-products"

A substance ..., may be regarded as not being waste ... but as being a by-product only if the following conditions are met:

(a) further use is certain;

(b) direct use without any further processing other than normal industrial practice;

(c) production is an integral part of a production process;

(d) further use is lawful, i.e. with regard to all relevant product, environmental and health protection requirements.

EU-Waste Framework Directive 2006

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Waste Framework Directive - WFD

entered into force on 12 December 2008

Article 6 "End of Waste Status"

Certain specified waste shall cease to be waste ... when it has undergone a recovery, including recycling, operation and complies with specific criteria to be developed in accordance with the following conditions:

The substance or object

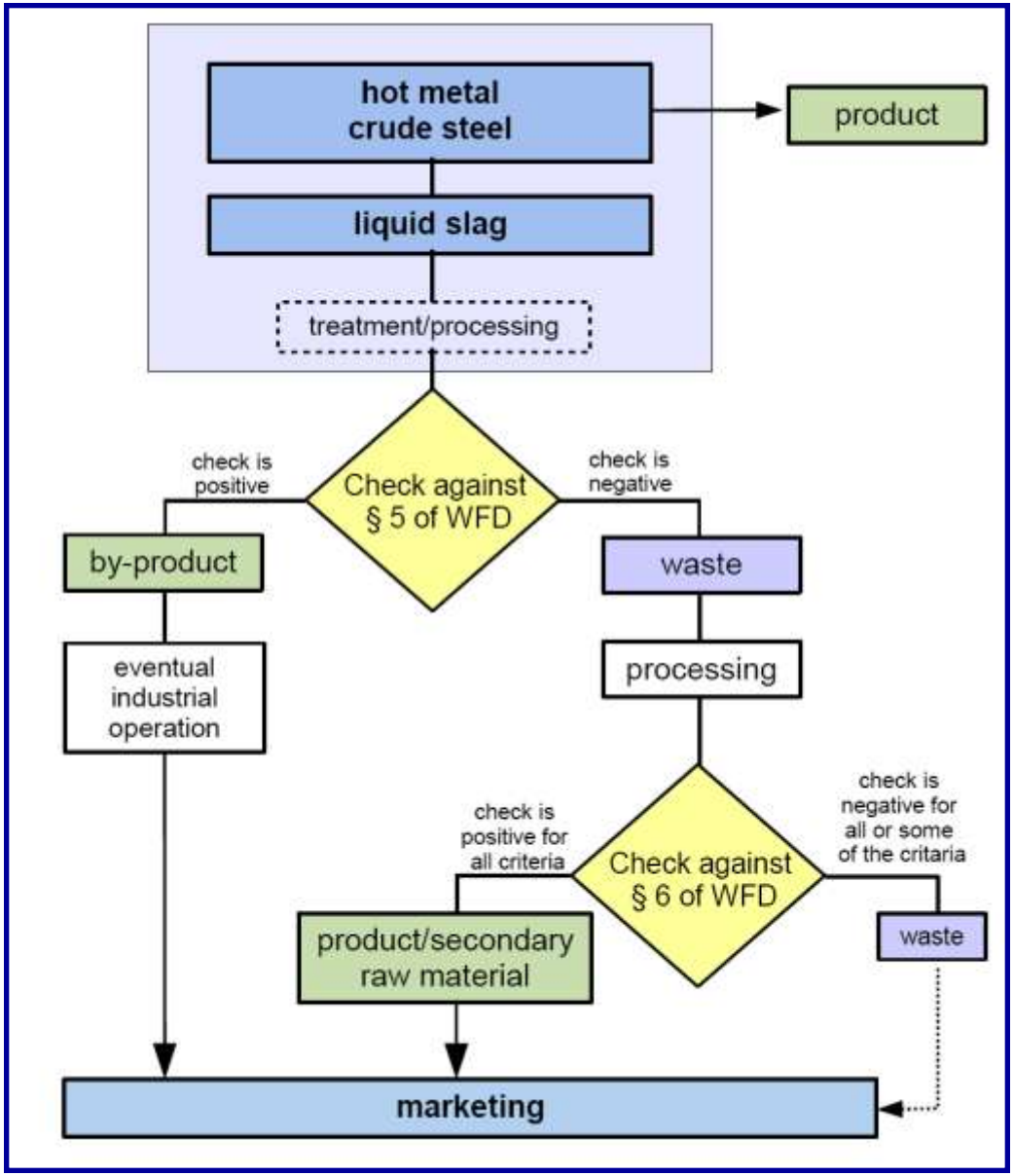
(a) is commonly used;

(b) is marketed or demanded;

(c) fulfils the existing legislation and standards;

(d) will not lead to adverse environmental or human health impacts.

EU-Waste Framework Directive 2006



Evaluation of slag

Decision tree

§ 5 By-products

and

§ 6 End of waste status

EU-Waste Framework Directive 2006

Contents

EU-Waste Framework Directive 2006

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Consequences for slag

EU-Waste Framework Directive

Evaluation of slags as by-products or via EoW-criteria

Discussion and decision on

- **which slag is a by-product**
- **which slag enters EoW criteria**

by Comitology Procedure

Foundation of an expert group headed by the EU-Commission

EU-Waste Framework Directive 2006

Activities of the Commission in 2010 to define EoW criteria

Invitation to tender

IPTS-2010-J06-41-OC

Institute for Prospective Technological Studies

Technical Specifications

Study on methodological aspects regarding limit values for pollutants in aggregates in the context of the development of end-of-waste criteria under the EU Waste Framework Directive

INDEX

Materials for aggregates to be considered:

- Blast furnace (BF) slag
- Basic oxygen furnace (BOF) slag
- Electric arc furnace (EAF) slag
- Argon oxygen decarburization (AOD) slags
- Blast furnace (BF), basic oxygen furnace (BOF), electric arc furnace (EAF) dust
- Fly ash (from coal combustion)
- Bottom ash (from coal combustion)
- Boiler slag (from coal combustion)
- FBC ash (from coal combustion)
- Fly ash, bottom ash, boiler ash (from household waste incineration)

EU-Waste Framework Directive 2006

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Activities of the Commission to define EoW criteria

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IPTS-2010-J06-41-OC

Technical Specifications

Study on methodological aspects regarding limit values for pollutants in aggregates in the context of the development of end-of-waste criteria under the EU Waste Framework Directive

INDEX

Tasks of the study

1: Identify the potential pollutants from aggregates

2: Identify the most suitable testing approaches and methods, including simplified modes of compliance

3: Describe the legislation and regulatory practice for controlling pollution from aggregates

4: Assess the need for including limit values for pollutants in end-of-waste criteria

5: Identify and assess the different methodological approaches for deriving pollutant limit values

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Consequences for slag

EU-Water Framework Directive →

Evaluation of by-products e.g. slags

Discussion on

- **typical potential pollutants**
- **limiting values for pollutants**
- **controlling of typical pollutants**
- **fields of application**

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Implementation EU Water Framework Directive into law in Germany

- **EU-Water Framework Directive**
  - → **Federal Water Act, Germany**
- → **Surface waters: Daughter Directive "Environmental quality"**
  - → **Ordinance concerning the protection of surface water, Germany**
- → **Groundwater: Daughter Directive "Groundwater protection"**
  - → **Ordinance concerning the protection of groundwater, Germany**

EU-Water Framework Directive 2008

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Groundwater:
Daughter Directive "Groundwater protection"

Ordinance concerning the protection of groundwater in Germany

Minimum list of pollutants (inorganic parameters) for which member states have to define thresholds according to Article 3:

- Arsenic
- Cadmium
- Lead
- Mercury
- Ammonium
- Chloride
- Sulphate

7 substances !

List of pollutants (inorganic parameters)

- Antimony
- Arsenic
- Barium
- Lead
- Boron
- Cadmium
- Chromium
- Cobalt
- Copper
- Molybdenum
- Nickel
- Mercury
- Selenium
- Thallium
- Vanadium
- Zinc
- Ammonium
- Chloride
- Cyanide
- Fluoride
- Nitrate
- Sulphate
- ……

22 substances !

Essential requirements (ER) of construction products to be respected by European harmonised Standards (CPD)

1. Mechanical resistance and stability
2. Safety in case of fire
3. Hygiene, health and the environment
4. Safety in use
5. Protection against noise
6. Energy economy and heat retention

European Standards relevant for slag

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1st/2nd Generation

EN 197: Cement
EN 206: Concrete
EN 13139, 12620 etc.: Aggregates
EN 13383: Armourstones
EN 12945: Fertiliser
EN 13285: Unbound mixtures
EN 14227: Slag bound mixtures
EN 15167: GGBS in Concrete

Essential requirements (ER) of construction products to be respected by European harmonised Standards

1. Mechanical resistance and stability
2. **Safety in case of fire**
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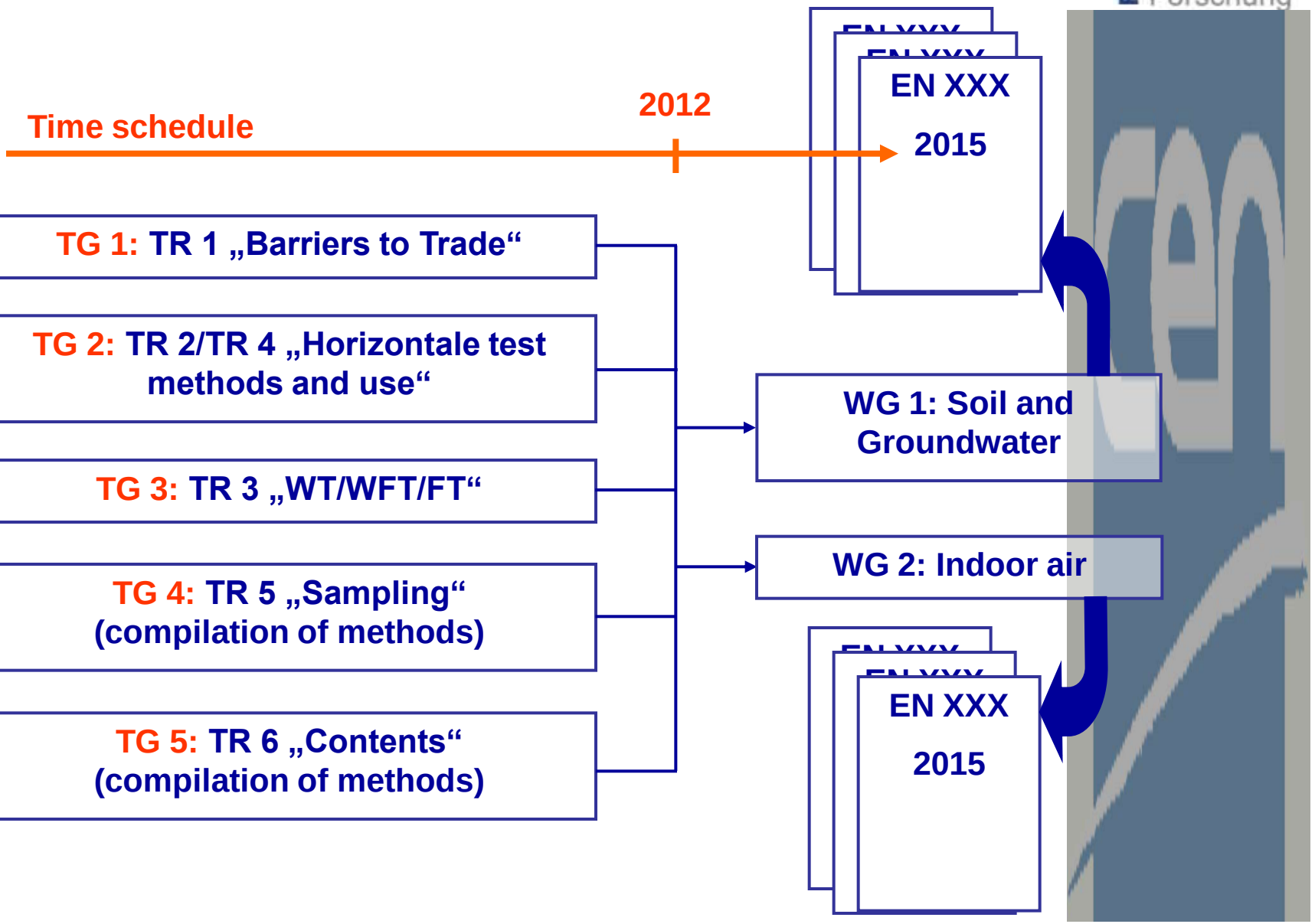
4. **Safety in use**
5. Protection against noise
6. Energy economy and heat retention

will not be respected by the 1st/2nd Generation of European Standards

CEN/TC 351 "Dangerous Substances"



CEN/TC 351 "Dangerous Substances"

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WG 1 Tasks:

- **Regulated Dangerous Substances (RDS) to be respected**
- **Assessment of the release performance of RDS from construction products during use based on the**

WT- / WFT- / FT- Classification Procedures

- **Development of test methods e.g. to assess leaching behaviour**

CEN/TC 351 "Dangerous Substances" - List of RDS

Metals and their compounds				
Heavy metals	Chromium (VI)	18540-29-9	Directive 2003/53/EC, 2004-71-D Chromium (VI) compounds are classified carcinogenic (Cat. 2) and as dangerous for the environment (Directive 67/548/EEC).	In many mineral raw materials as well as in secondary materials (e.g. recycled aggregates, road construction products) and in industrial by-products (e.g. fly ash)
	Chromium	7440-47-3	Directive 80/68/EEC, 2005-283-NL, 2006-90-D, 1999-263-A, 2005-735-FIN, 2004-71-D, 2006223-E	
	Copper	7440-50-8		
	Cobalt	7440-48-4	Directive 80/68/EEC, 2005-283-NL, 2006-90-D Classified dangerous for the environment (Directive 67/548/EEC).	
	Molybdenum	7439-98-7	Directive 80/68/EEC, 2005-283-NL, 2005-735-FIN, 2006223-E, 2006-90-D,	

List of RDS

The list is completed.
Now an adjustment of the mandates will be necessary.
Associations shall prepare dossiers, e.g. for slag via EUROSLAG

TS 351 WG1 TS-1

Guidance standard for CEN Product TC´s for selection of leaching tests appropriate for their product(s) – General principles

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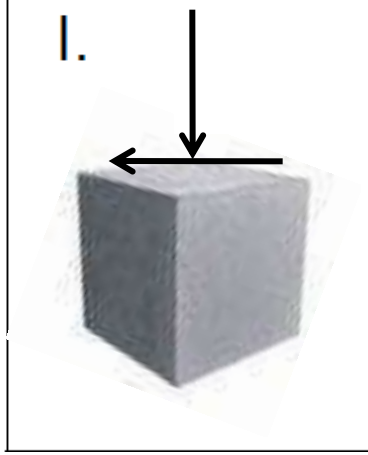
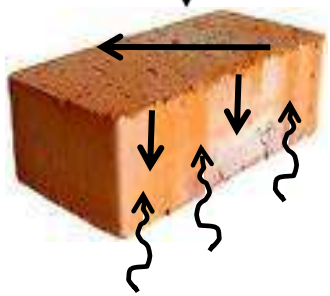
I.



Non permeable product. Water is flowing over the surface of the product

Leaching scenarios for horizontal tests

II.



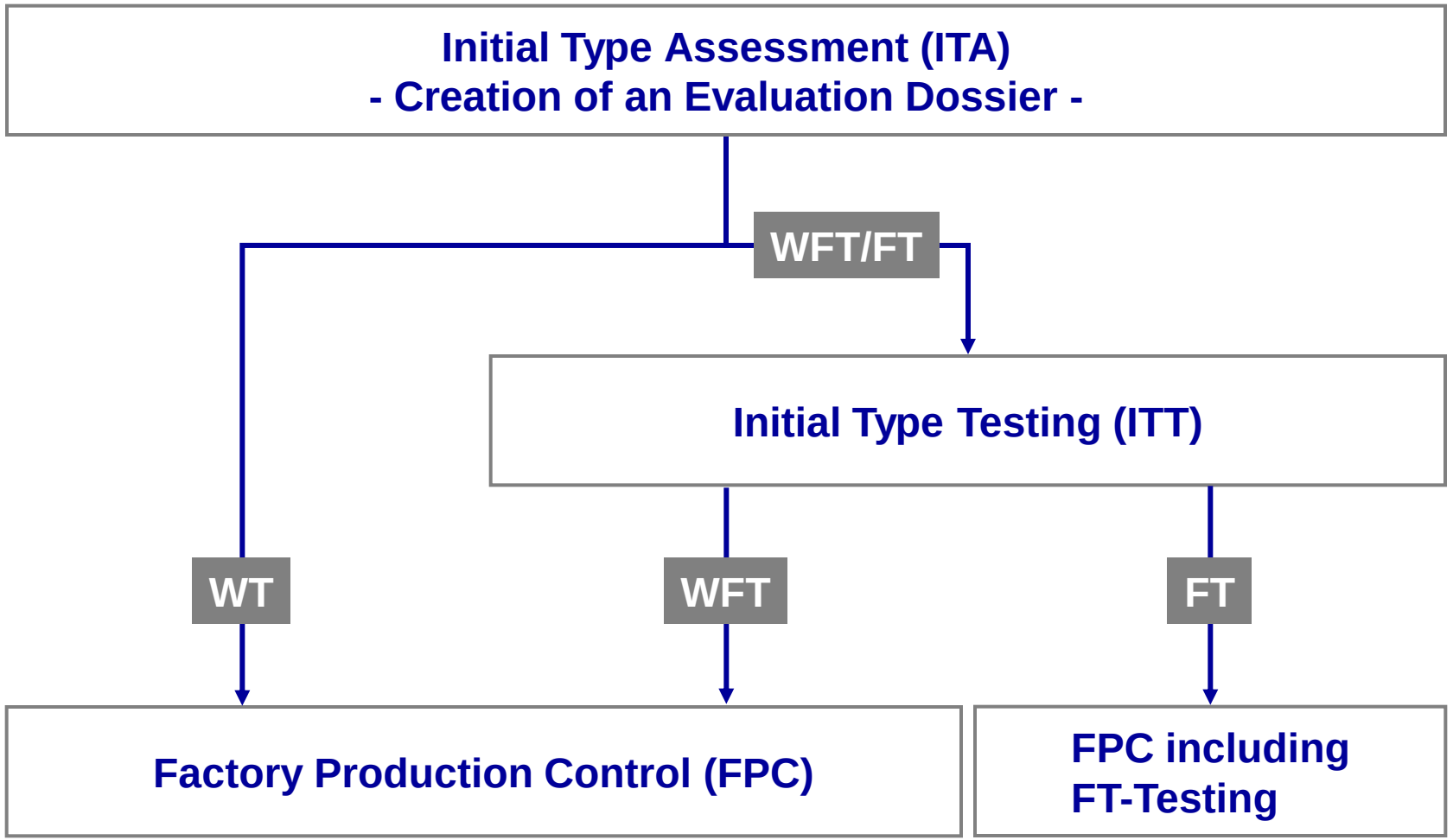
Low permeable product. Water is transported into the matrix by capillary forces; contribution of core to surface

III.

Permeable product. Water may infiltrate into the matrix driven by gravity

Based on the identified leaching scenarios appropriate leaching tests will be deveoped e.g. tank test, percolation test

Principal of the WT/ WFT/ FT-Classification



CEN/TC 351 "Dangerous Substances" - Standards

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 13242

Aggregates for unbound and hydraulically bound materials for use in civil engeneering work and road constructon

This draft European Standard is submitted to CEN members for formal vote. It has been drawn up by the Technical Committee CEN/TC 154.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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ref. No. prEN 13242:2001 E

Procedures for:

- **WT/ WFT/ FT - classification**
- **Initial Type Assessment - ITA**
- **Initial Type Testing - ITT**
- **Evaluation and description of results**
- **Factory Production Control - FPC (including test frequency)**

CEN/TC 351 "Dangerous Substances" - Standards

EUROPEAN STANDARD
NORME EUROPÉENNE
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Central Secretariat: rue de Stassart, 36 B-1050 Brussels

ref. No. prEN 13242:2001 E

Possible Classification of RDSs

- **NPD:** No Performance Determined
- **Class A, B, C..:** threshold values (e.g.
  Cr: 0.5, 0.1, 0.01 mg/l
  V: 0.1, 0.05, 0.01 mg/l)
- **DV:** Manufactor´s declared value

2. Generation of European Aggregates standards

1 Scope

This European Standard...

... incorporates a general requirement that aggregates shall not release any dangerous substances in excess of the maximum permitted levels specified in a relevant European Standard for the material ...

NOTE 1 ... Additional characteristics and requirements may be specified on a case by case basis .... In the case of new and unfamiliar source materials this may be particularly relevant to release of regulated dangerous substances. ...

NOTE 4 Requirements for the declaration of the potential of aggregates to release regulated dangerous substances are currently under development. Until such time as these are finalised attention should be paid to requirements at the place of use.

Conclusions

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Long time successful application of iron and steel slags as building materials and fertilizer including saving of resources and CO_2 emissions

but

- **overrating environmental issues by e.g. baseless tightening of limiting values and non reality based modelling of percolation processes**
- **missing acceptance concerning the use of by-products of the steel industry**
- **protracted permission procedures**

may hinder the successful use of ferrous slags in future.

Thank you for your attention

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