

**Coal Ash Utilisation and
its Environmental Implications
Update on the EC's attitude
– A Demonstrational Case Study -**

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- 1. Introduction**
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- 3. Sustainability/Environmental Considerations**
- 4. Revision of the Waste Directive**
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1. Introduction

- ◆ **Production of CCPs in Europe (EU15) was 61 million tonnes in 2007**
- ◆ **Out of this about 50 million tonnes of coal ash**
- ◆ **Total production of CCPs in EU 27 is estimated to be more than 100 million tonnes annually in EU 27**
- ◆ **10 new Member States joined the EU in 2004**
- ◆ **2 new Member States joined the EU in 2007**

1. Introduction

Use of CCPs

The CCPs are mainly utilised in the building material industry, in civil engineering, in road construction, for construction work in underground coal mining as well as for recultivation and restoration purposes in open cast mines.

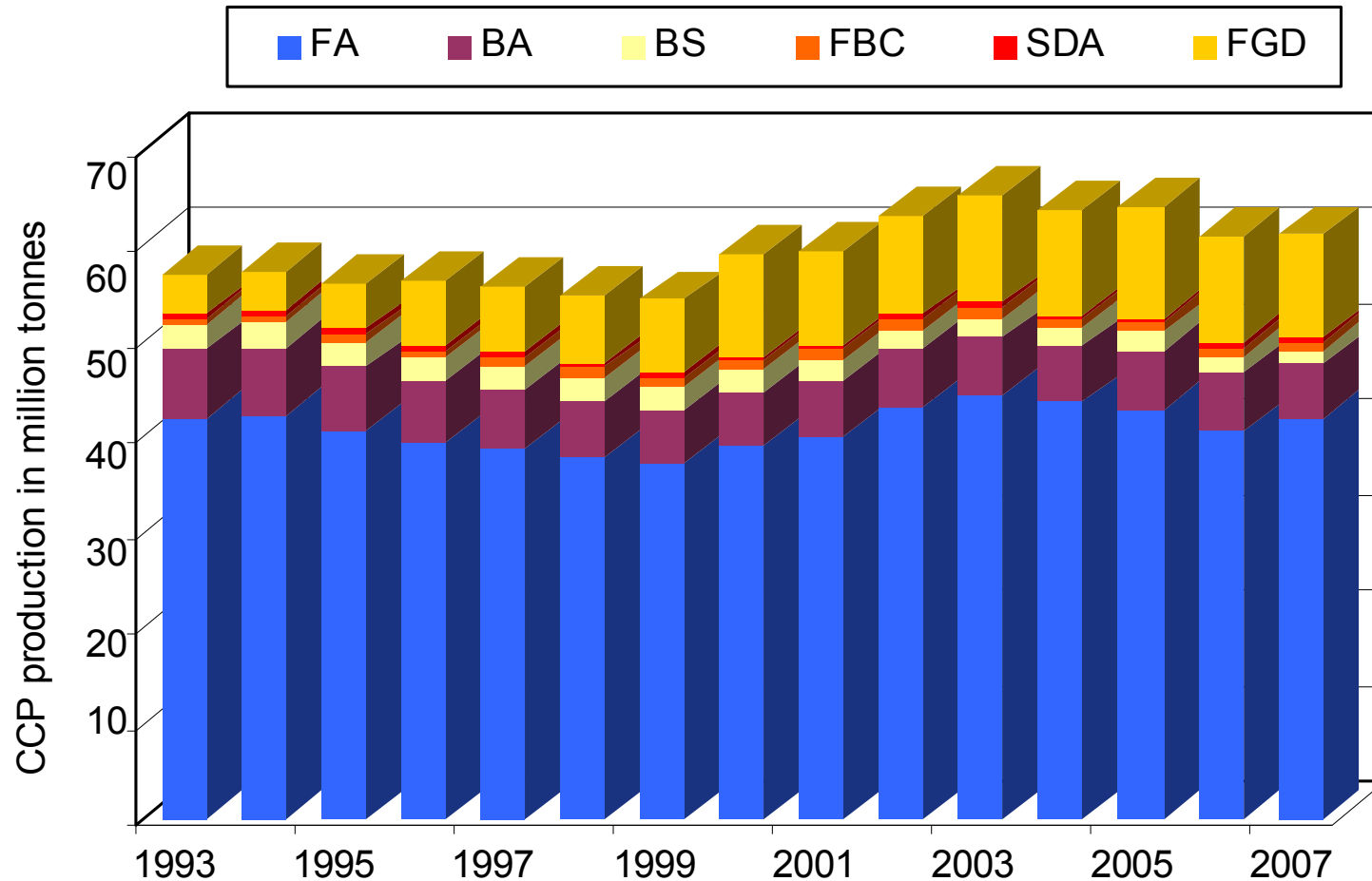
The majority of the CCPs is produced to meet certain requirements of standards or other specifications with respect to utilisation in certain areas.

1. Introduction

Influences on CCPs utilisation and production

- ◆ **Retrofitting of existing and construction of new coal-fired power plants (LCPD, energy demand, ..)**
- ◆ **Environmental legislation**
 - **Waste Directive (by-products//waste//end of waste)**
 - **REACH regulation**
- ◆ **Revision European standards and national regulations**
e.g. EN 450, EN 13282, EN 14227, EN 13055
- ◆ **Revision of the CPD - implementation of ER 3**

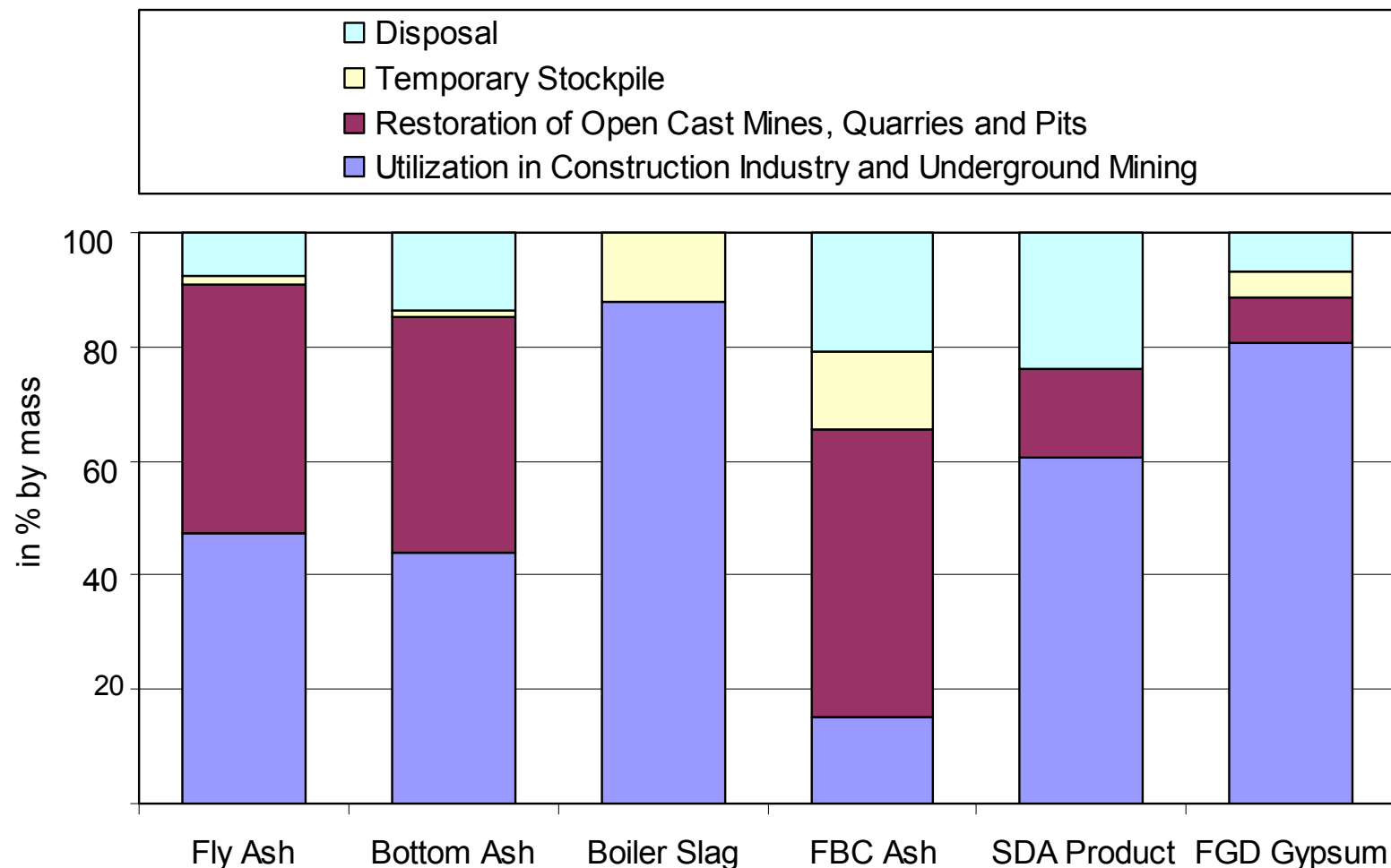
2. Coal ash production and utilisation



FGD = flue gas desulphurization gypsum; SDA = spray dry absorption product;
 FBC = fluidized bed combustion ash; BS = boiler slag; BA = bottom ash; FA = fly ash

Development of CCP production (EU 15) from 1993 to 2007

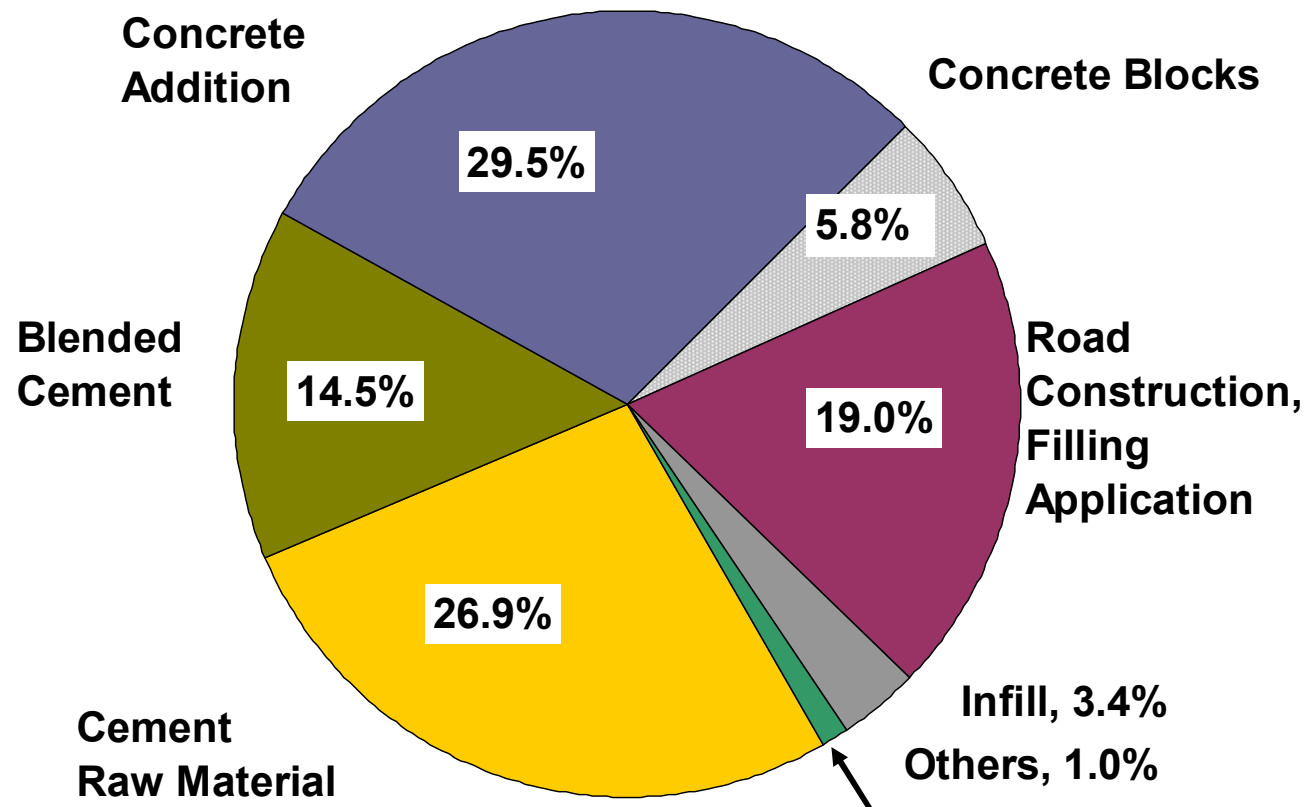
2. Coal ash production and utilisation



Utilisation, temporary stockpile and disposal of CCPs in Europe (EU 15) in 2007

2. Coal ash production and utilisation

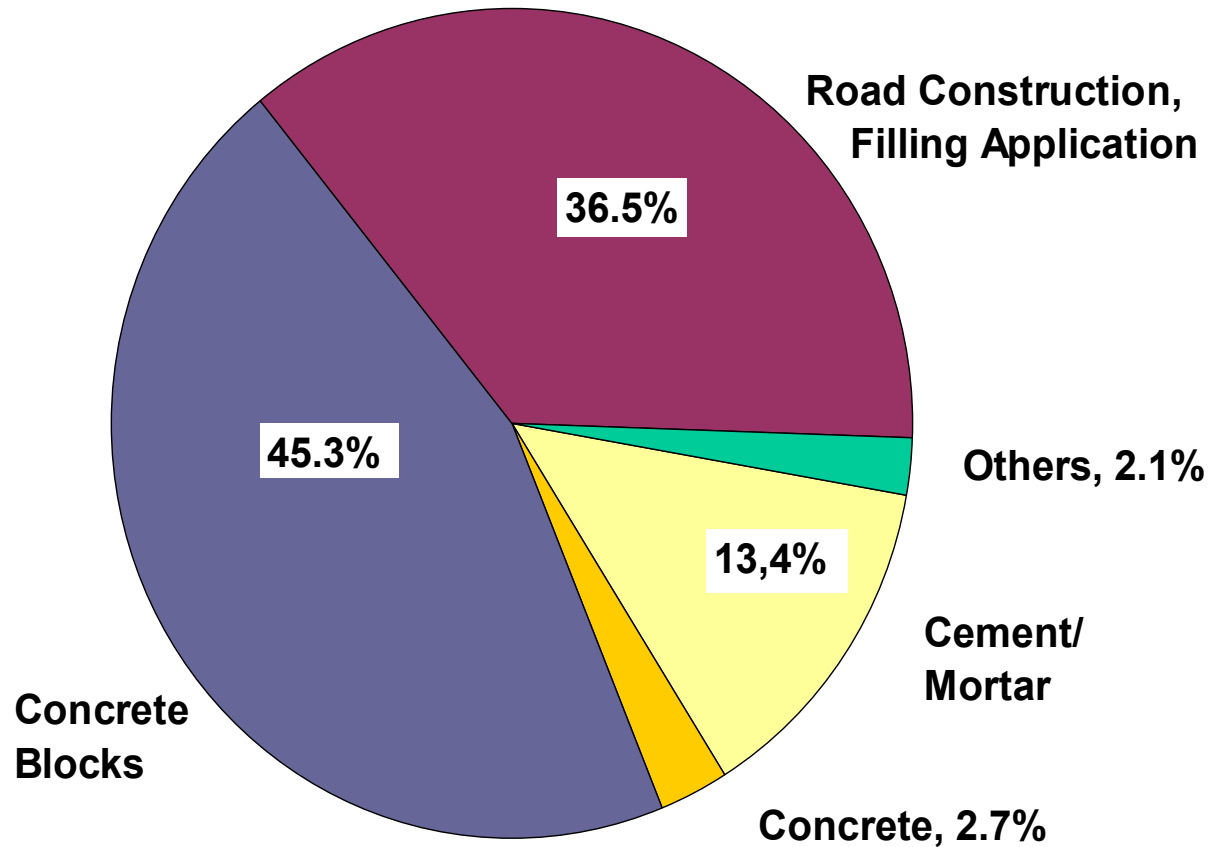
Utilisation of fly ash in the construction industry and in underground mining in Europe (EU 15) in 2007



Total utilisation: 20.0 million tonnes

2. Coal ash production and utilisation

Utilisation of **bottom ash** in the construction industry and in underground mining in Europe (EU 15) in 2007



Total utilisation: 2.5 million tonnes

3. Sustainability / Environmental considerations



- ▶ **saving of natural resources**
 - mining
 - processing
 - transport
- ▶ **reduction of energy demand**
- ▶ **reduction of emissions (CO₂) needed for or result from manufacturing process of products which are replaced**


- ▶ **CCPs are fine grained raw materials**
- ▶ **CO₂ reduction in**
 - **cement production (0.7 to 1.2 kg CO₂ per kg clinker, dep. on fuel)**
 - **concrete when fly ash is used as conc. add.**
- ▶ **saving of drying energy when fly ash is used to dry wet raw materials**

4. Revision of the Waste Directive

**Revised Waste Directive
Proposal by the European Parliament and the Council for the
waste hierarchy:**

Article 4 “Waste hierarchy”

*1. The following waste hierarchy shall apply as a priority order in
waste prevention and management legislation and policy:*

- 
- A large red triangle pointing downwards, positioned to the left of the list items.
- (a) prevention**
 - (b) preparing for re-use**
 - (c) recycling**
 - (d) other recovery, e.g. energy recovery; and**
 - (e) disposal**

4. Revision of the Waste Directive

Article 4 “Waste hierarchy” (2)

- 2. When applying the waste hierarchy referred to in para. 1, member states shall take measure **to encourage the options that deliver the best overall environmental outcome.** This may require specific waste streams departing from the hierarchy where this is **justified by life cycle thinking** on the overall impact of the generation and management of such waste.*

4. Revision of the Waste Directive

Article 4 “Waste hierarchy” (3)

*Member states shall ensure that the development of waste legislation and policy is a **fully transparent process**, observing existing national rules about the consultation and involvement of citizens and stakeholders.*

*Member states shall **take into account the general environmental protection principals of precaution and sustainability, technical feasibility and economic viability, protection of resources as well as the overall environmental, human health, economic and social impacts, in accordance with articles 1 and 13.***

4. Revision of the Waste Directive

Revised Waste Directive

Proposal by the European Parliament and the Council for the definition of by-products:

Article 5 “By-products”

*„A **substance** or object, resulting from a production process, the primary aim of which is not the production of that item, **may be** regarded as **not being waste** referred to in point (1) of Article 3 **but as being a by-product** only if the following **conditions** are met:*

4. Revision of the Waste Directive

- (a) ***further use of the substance or object is certain***
- (b) ***the substance or object can be used directly without any further processing other than normal industrial practice***
- (c) ***the substance or object is produced as an integral part of a production process; and***
- (d) ***Further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.***

Article 6 “End-of-waste” (1)

- 1. Certain specified waste shall **cease to be waste** within the meaning of point (1) of Article 3 when it **has undergone a recovery**, including recycling, operation and complies with specific criteria to be developed in accordance with the following conditions:*
 - (a) the substance or object is **commonly used** for specific purposes;*
 - (b) a **market or demand exists** for such a substance or object;*

Article 6 “End-of-waste” (2)

- (c) the substance or object **fulfils the technical requirements** for the specific purposes and meets the existing legislation and standards applicable to products; and*
- (d) the use of the substance or object will **not lead to overall adverse environmental or human health impacts.***

*The **criteria** shall include limit values for pollutants where necessary and shall take into account any possible adverse environmental effects of the substance or object.*

4. Revision of the Waste Directive

Article 5 “By-products”, para 2

On the basis of the conditions laid down in paragraph 1, measures may be adopted to determine the criteria to be met for specific substances or objects to be regarded as a by-product and not as waste referred to in point (1) of Article 3. These measures, ...

Article 6 “end-of-waste”, para 2

The measures relating to the adoption of such criteria and specifying the waste, designed to amend non-essential elements of this Directive, by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 39(2). End-of-waste specific criteria should be considered, among others, at least for aggregates, paper, glass, metal, tyres and textiles.

4. Revision of the Waste Directive

IPTS project: End-of-waste-criteria

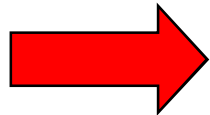
*The **Institute for Prospective Technological Studies (IPTS)** and **DG Joint Research Centre (JRC)** were ordered by the **Commission to develop a **general methodology for determining end-of-waste criteria.*****

The main objective of the project is to identify those waste streams where the use of "end of waste" could be appropriate as well as

- to develop a set of criteria enabling the selection and comparison of potential waste streams*
- to analyse the waste streams by applying the criteria*
- to propose a list of waste streams with their relative importance.*

5. REACH Regulation

Registration Evaluation Authorisation and Restriction of Chemicals



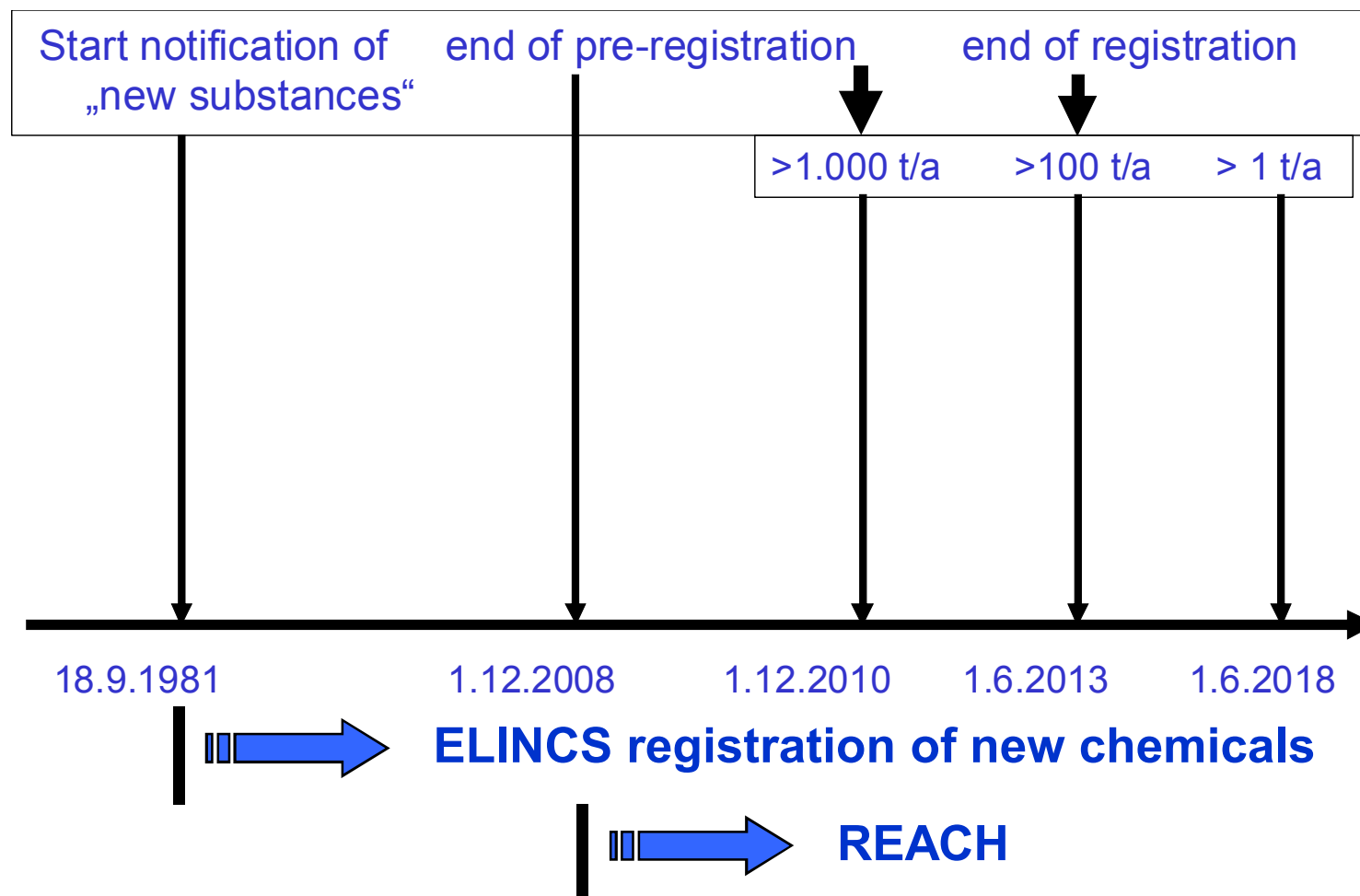
In Europe, non registered substances can not be placed on the market after **1st June 2008** any more!

Each **producer or importer** of coal combustion products (CCPs) placed on the market as construction materials have to register their substances.

The **registration** requires i.a. comprehensive information about human toxicology and ecotoxicology of the substances.

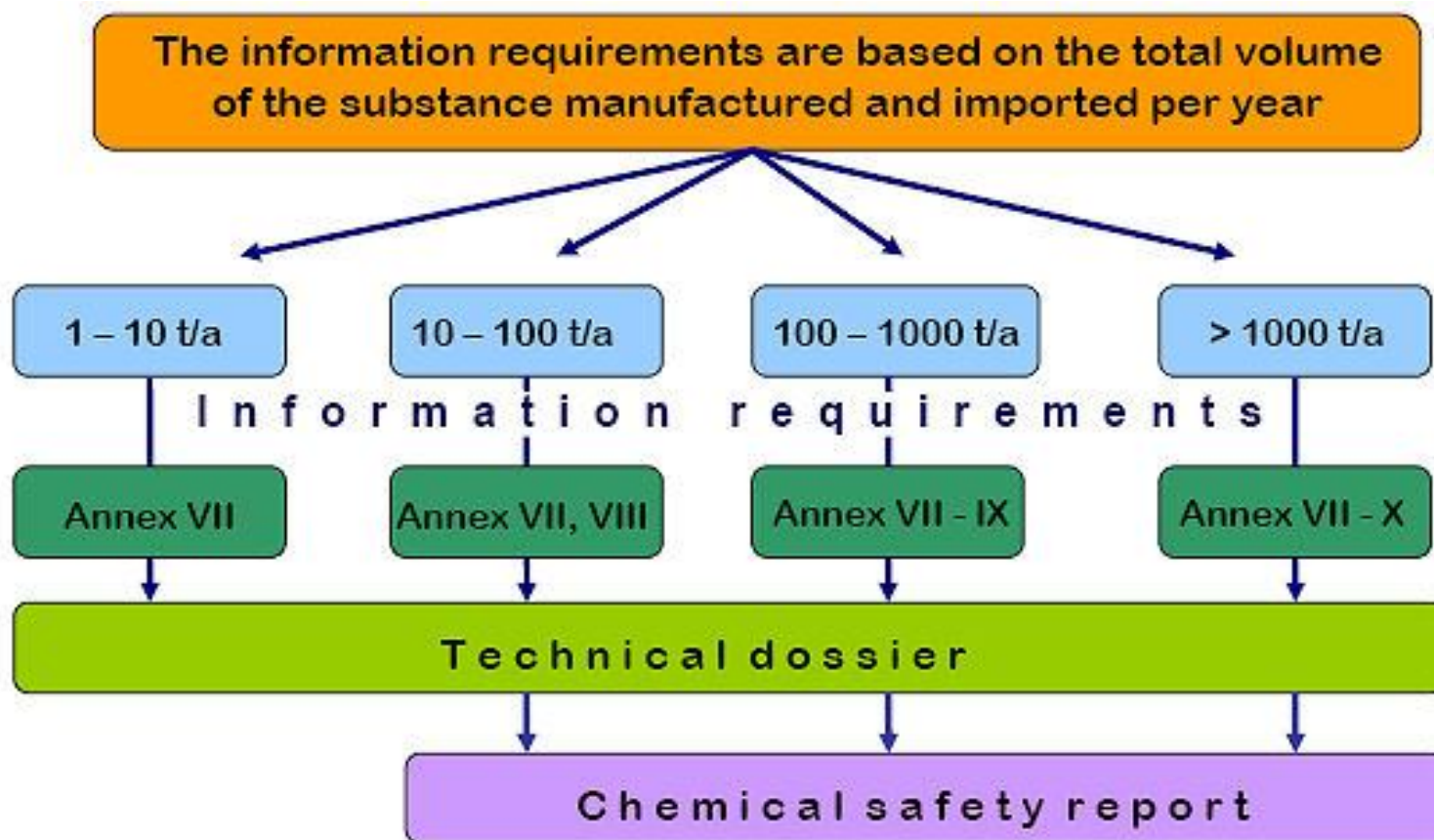
5. REACH Regulation

EINECS – European Inventory of existing commercial chemical substances



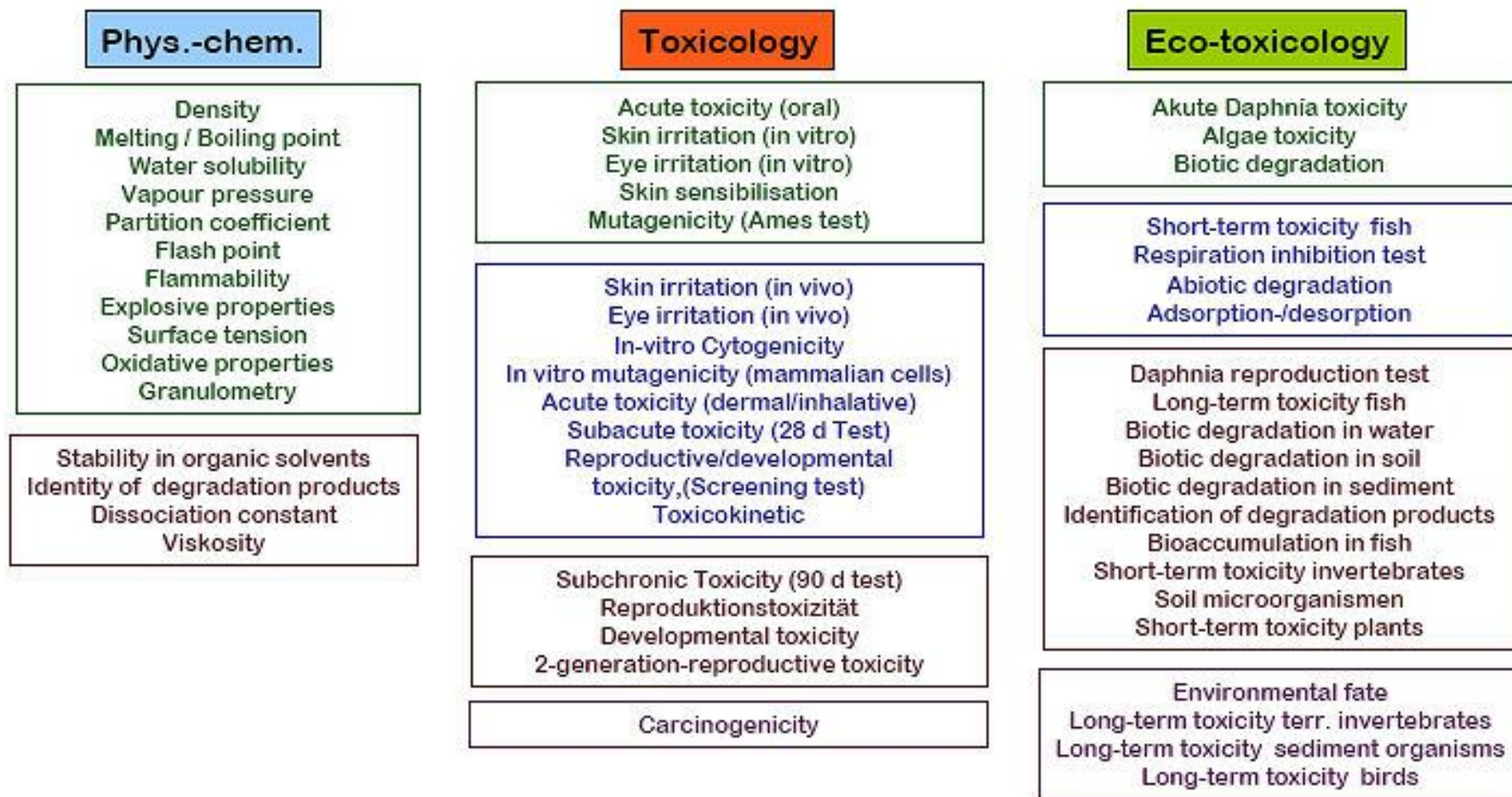
5. REACH Regulation

REACH Information requirements – dossier/report



5. REACH Regulation

REACH Information requirements - tests



5. REACH Regulation

CCPs and REACH – Status of Pre-/registration activities

EC-Nr.	EC-Name /preSIEF	Number pre-registered Parties	CCPs	preSIEF-facilitator	consortia
231-900-3	Calcium sulphate	1578	FGD-gypsum	EUROGYPSUM	Calcium sulphate consortium
268-627-4	Ashes (residues)	1084	FA, BA, BS, FBC-ash, CE? BMA?	EVONIK Steag	Ash-REACH-Consortium By-Products Consortium Mixed Ash Consortium
300-212-6	Ashes (residues) Cenospheres	113	CE	B-Lands Consult	Not defined
270-708-4	Slags, coal	524	FA, BA, BS, FBC-ash, CE?, BMA?	EVONIK Steag	Ash-REACH-Consortium By-Products Consortium
302-652-4	SDA-product - >10% ash - < 10% ash	99 11	SDA-product	B-Lands Consult -	By-Products Consortium -
297-049-5	Biomass ash	97	BMA	Södra?-	Not defined

4. Revision of European Standards

European Standards are – once prepared - subject of revision in a five year term.

Selected standards recently revised or under revision are:

- ▶ **EN 450** **Fly ash for concrete**
- ▶ **prEN 13282** **Hydraulic road binder**
- ▶ **EN 14227** **Hydraulically bound mixtures**
- ▶ **EN 13055** **Aggregates**

4. Revision of European Standards

Revision of EN 450: Provisions for fly ash from co-combustion

4.1 Co-combustion materials

Fly ash from co-combustion as defined in 3.2 is obtained from pulverised coal fired simultaneously with co-combustion materials as listed in Table 1.

Existing:

The **minimum** percentage, by dry mass, of **coal** (Kc) shall not be less than **80 %** and the **maximum** proportion of **fly ash** derived from co-combustion materials (M) shall not be greater than **10 %** when calculated from the Formula (1):

New:

The **maximum** percentage, by dry mass, of **co-combustion materials** (Ki) shall be **40 %** by mass and the **maximum** proportion of **fly ash** derived from co-combustion materials (M) shall not be greater than **25 %** by mass.

4. Revision of European Standards

Revision of EN 450: Limiting parameters for co-combustion materials (basis table 1 of new EN 450-1)

	Type	Limited by
1	Solid Bio Fuels complying with CEN/TS 14588 including animal husbandry residues	
	green wood 1	Co-combustion fuel based
	green wood 2	Co-combustion fuel based
	green wood 3	Co-combustion fuel based
	bark wood	reactive CaO
	Cacao shells	Na ₂ O equivalent (K)
	palm kernels	total P ₂ O ₅
	poultry dung	reactive CaO
2	Animal meal (meat and bone meal)	
	meat & bone meal	total P ₂ O ₅
3	Municipal sewage sludge	
	municipal sewage sludge	total P ₂ O ₅
4	Paper sludge	
	Paper sludge	CaO
5	Petroleum coke	
	Petroleum Cokes	-*
6	Virtually ash free liquid and gaseous fuels	
	Industrial HC liquid	Co-combustion fuel based

4. Revision of European Standards

Revision of EN 450: Existing and revised chem. requirements

Property	Unit	Existing	Revised
loss on ignition (LOI) class A class B class C	% by mass	≤ 5,0 2,0 -7,0 4,0- 9,0	≤ 5,0 ≤ 7,0 ≤ 9,0
chloride (Cl ⁻)	% by mass	≤ 0,10	n.m. ³
sulphuric anhydride (SO ₃)	% by mass	≤ 3,0	n.m. ³
free calcium oxide (CaO)	% by mass	≤ 2,5 ¹	²
reactive calcium oxide (CaO)	% by mass	≤ 10,0	n.m. ³
reactive silicon dioxide (SiO ₂)	% by mass	≥ 25	n.m. ^{3,4}
sum SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃	% by mass	≥ 70	n.m. ³
total content of alkalis (Na ₂ O equivalent)	% by mass	≤ 5,0	n.m. ³
magnesium oxide (MgO)	% by mass	≤ 4,0	n.m. ^{3,4}
soluble phosphate (P ₂ O ₅)	mg/kg	≤ 100	n.m. ³
total phosphate (P ₂ O ₅)	% by mass	-	≤ 5,0

¹ if the content of free lime is greater than 1.0 % by mass, soundness have to be tested

² if the content of free lime is greater than 1.5 % by mass, soundness have to be tested

³ n.m. = not modified

⁴ tests for initial type testing only

4. Revision of European Standards

Revision of the CPD - Implementation of ER3

Environmental compatibility in European standards (e.g. EN 450-1)

4.3 Environmental compatibility

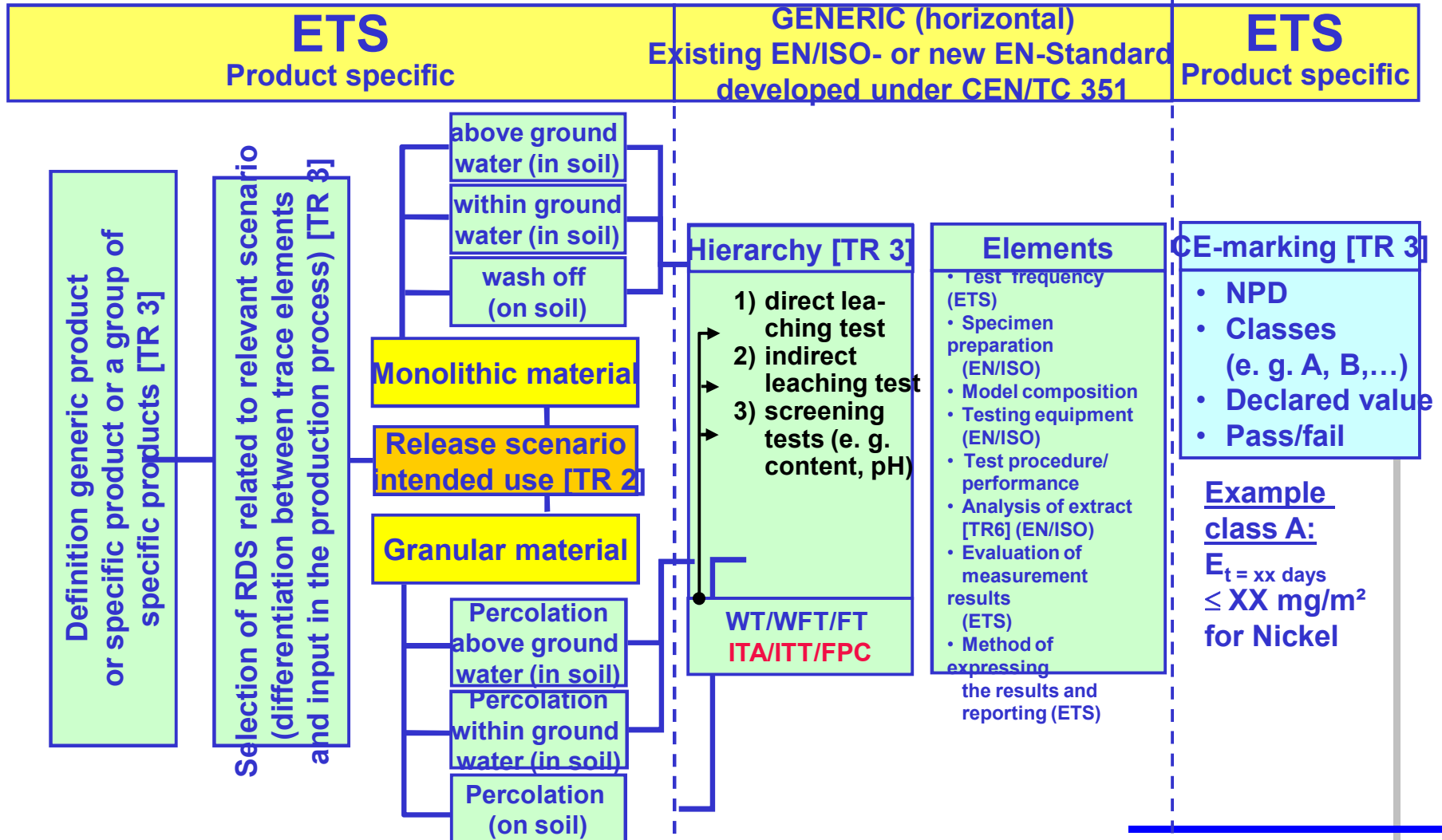
Should there be **any additional requirements resulting from national laws, regulations and administrative provisions in the place of use of the fly ash** regarding e.g.

- the fly ash,
- the leachate of concrete produced with fly ash,
- the co-combustion material,

these are to be considered with respect to environmental compatibility, and conformity to the relevant regulations has, where required, to be evaluated before production.

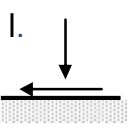
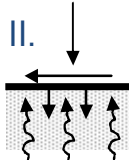
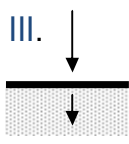
4. Revision of European Standards

TC 351 horizontal approach

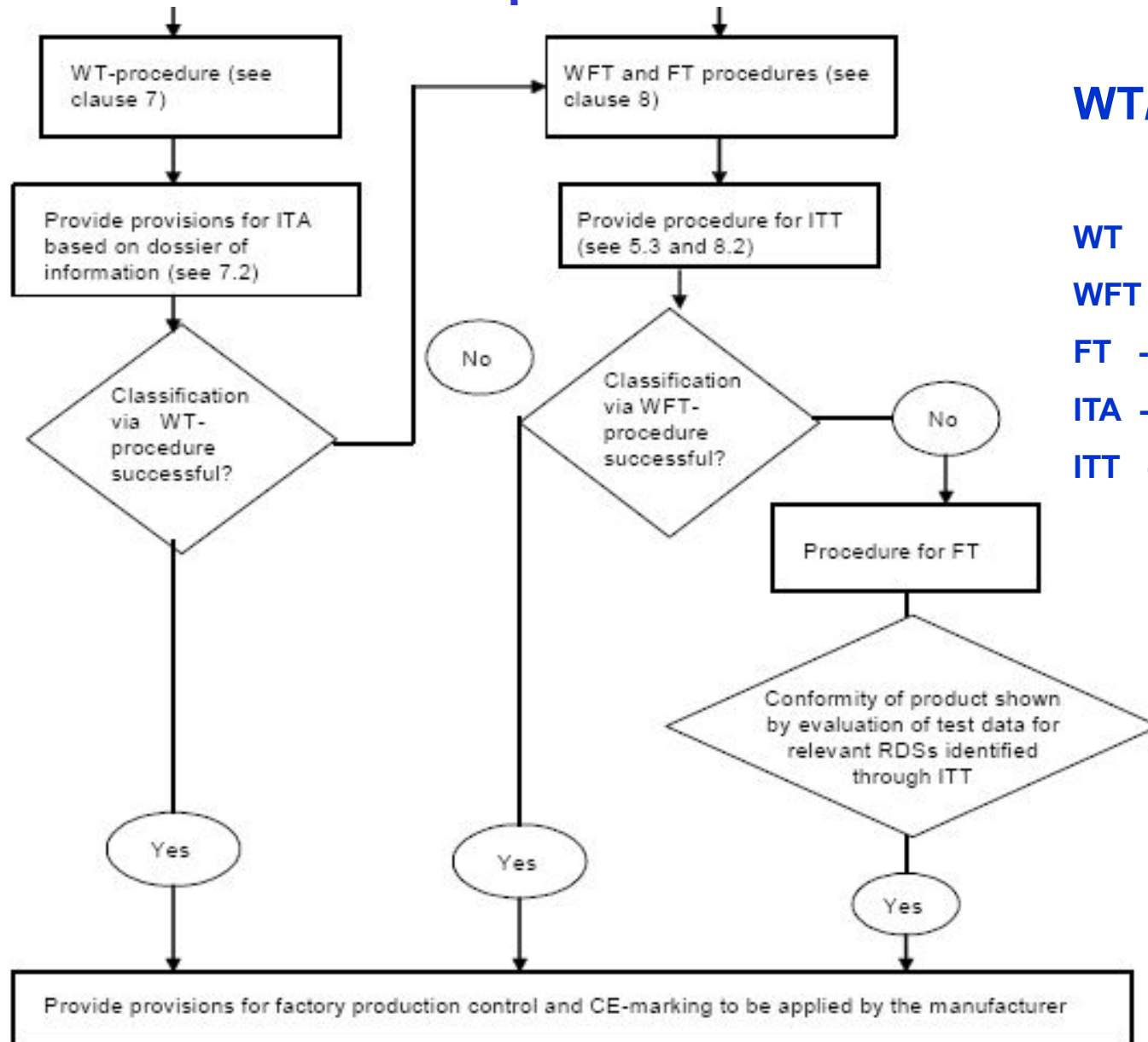


4. Revision of European Standards

TC 351 horizontal approach – leaching scenarios

Geeral scenario		Test Method to be developed related to scenario		Products (examples)	Boundary conditions in test and/or scenarios	
					Test	Scenario
I. 	Non permeable product. Water is flowing over the surface of the product	Dynamic surface leaching test (DSL) for conformity testing TS351WG1XXX-2 Source: existing draft of CEN/TC 292/WG6	<div style="border: 2px solid red; padding: 2px; display: inline-block; color: red; font-weight: bold;">merged</div> pH-dependence test (in most cases only for characterisation and modelling (guidance paper or TR)) Source: CEN/TS 14429 and 14997	Metal sheets and strips, coatings, ceramic tiles, glass, bituminous products...	Leachant (e. g. pH), Particle size, L/S ratio, Volume/ Surface ratio, Contact time...	pH (also carbonation), Salinity, DOC, Redox, Dry/wet cycles...
II. 	Low permeable product. Water is transported into the matrix by capillary forces; contribution of core to surface	Dynamic surface leaching test (DSL) TS351WG1XXX-2 (including procedure for granular products)		structural concrete, bricks, treated wood, cement mortar, coatings, road materials, ...		
III. 	Permeable product. Water may infiltrate into the matrix driven by gravity	Percolation (column) test for conformity testing TS351WG1XXX-3 (short test, first eluates or alternatively batch EN 12457-1 to -4) Source percolation test: CEN/TS 14405		unbound aggregate, drain concrete, ...		

4. Revision of European Standards



WT/WFT approach

WT - without testing

WFT - without further testing

FT - further testing

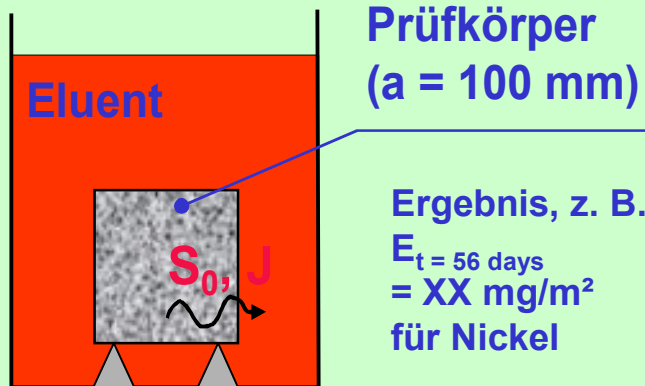
ITA - initial type assessment

ITT - initial type testing

4. Revision of European Standards

DSLIT (Tank Leaching Test)

Standtest (Labor)

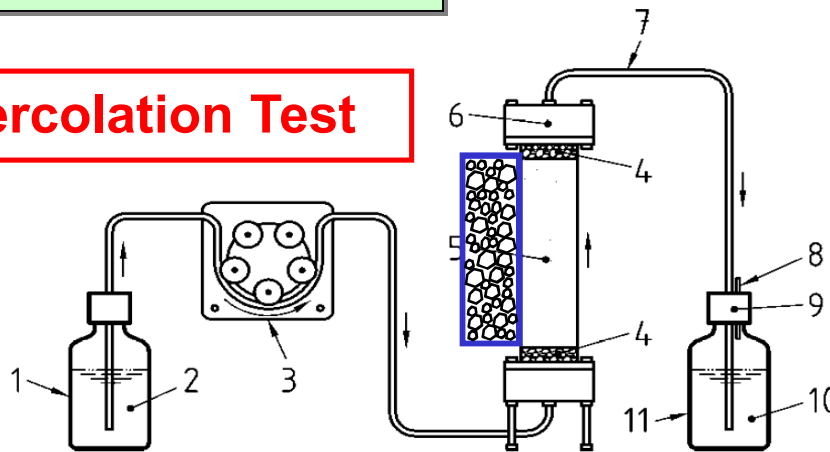


CEN/TC 351/WG1 AHG "Working plan" N 0122
fourth draft TS-2 (rev1) - 2009-10-26

Generic horizontal **dynamic surface leaching test (DSLIT)** for determination of surface dependent release of substances from monolithic or plate-like or sheet-like construction products

Up-flow Percolation Test

Based on
NEN 7343

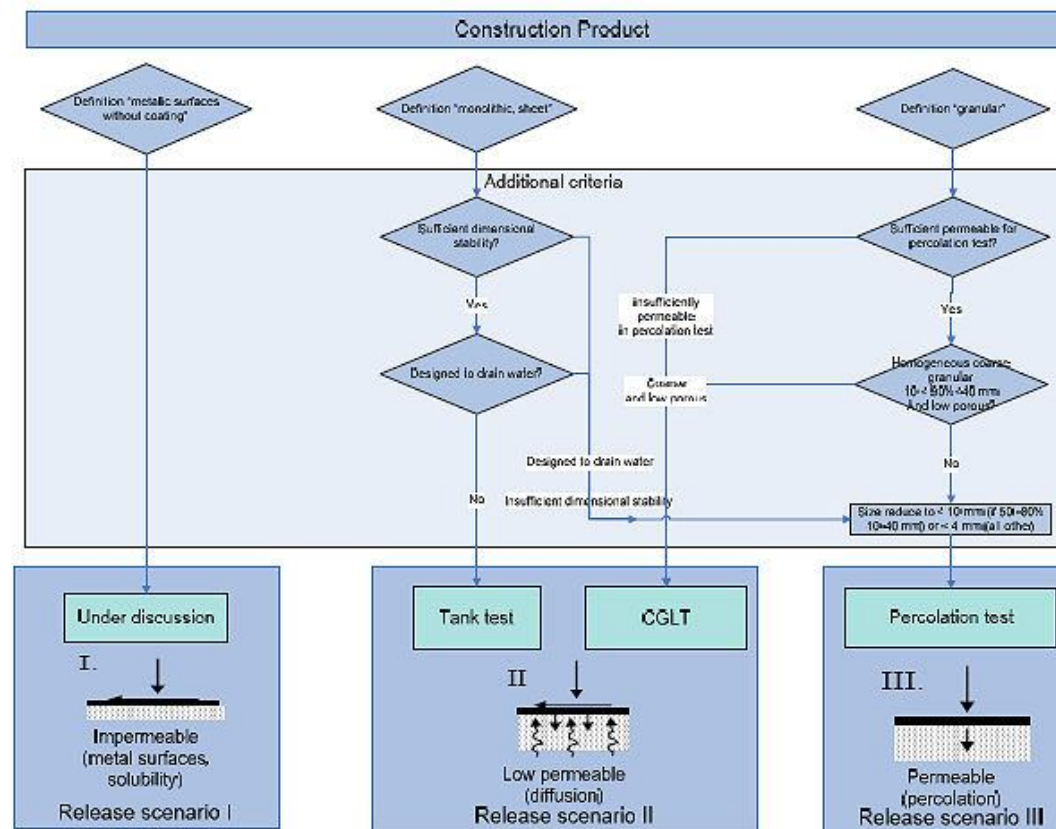


CEN/TC 351/WG1 AHG "Working plan"
N0120 TS XXX-3 – 2009-10-01

Generic horizontal **up-flow percolation** for determination of the release of substances from granular construction products

4. Revision of European Standards

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



Scheme for the selection of a test to assess release from a construction product.

4. Revision of European Standards

CEN/TC 351 Workshop on Radiation from Construction Products on October 30, 2009

Recommendation 1

Develop (in CEN/TC 351) a standardised measurement method for activity concentrations of radioactivity (gamma radiation).

Recommendation 2

If it is necessary to develop a harmonised method for the calculation of the dose caused by gamma radiation, this should be covered in a separate standard.

Recommendation 3

There is a need for a European standardised method for the measurement of indoor radon concentration.

However, this method is not specific for construction products and thus not covered by the scope of CEN/TC 351.

4. Revision of European Standards

CEN/TC 351 Workshop on Radiation from Construction Products on October 30, 2009

Recommendation 4

Radon exhalation is covered by the Austrian regulation, but not by the Finnish nor Polish or the revised BSS. As pre-normative research seems necessary, CEN/TC 351 shall not start developing a radon exhalation measurement and dose assessment method now, but CEN/TC 351/TG 6 shall deliver a state of the art report regarding radon exhalation measurement and dose assessment methods.

Recommendation 5

Development of an assessment method for thoron (^{220}Rn) shall be postponed.

Recommendation 6

Involvement of DG TREN in this work is highly appreciated and shall be continued.

6. Concluding remarks

- ▶ **Every year more than 100 million tonnes of CCPs are produced in Europe (EU-27).**
- ▶ **61 million tonnes of Coal Combustion Products (CCPs) were produced in Europe (EU-15) in 2007**
- ▶ **CCPs may be redefined as by-products according the revised Waste Directive.**
- ▶ **By-products and end-of-waste-substances are subject to REACH. Consortia are currently formed for registration of calcium sulphate and different types of ashes.**
- ▶ **The technical and environmental requirements for products are addressed in European and national product standards which are subject to regular revision. The future revision will include ER 3 in the CE-marking of products.**



EUROCOALASH 2010



International Conference

May 27/28, 2010

Ingeniørforeningen in

Copenhagen/Denmark

Organizer

IDA-Energie

Co-Organizers:

ECOBA,

Emineral A / S

Thank you for your attention!



European Coal Combustion Products Association