

# Waste / Air

## Guidelines

### Disposal of Wastes in Cement plants

April 1998

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### **Note for the English readers:**

According to the „Swiss Federal law relating to the protection of Environment“ **disposal** of wastes includes their recovery or placing in a landfill as well as the preliminary stages like collection, transport, storage and treatment.



## 1. Introduction

The raw materials for the production of Portland cement – mainly limestone and marl or clay – are mixed with the additives necessary to produce the correct cement constitution in the form of "raw meal". The raw meal is fed continuously through a preheater to the cylindrical rotary kiln of the cement plant, where it is calcined in direct contact with the hot combustion gases from the burner for approx. 20 minutes at temperatures between 850 and 1450 °C. In this stage, CO<sub>2</sub> is expelled from the limestone; the calcium, aluminum, silicon and iron compounds present in the raw meal combine to form cement clinker. After cooling, the clinker is ground together with approx. 10% gypsum and other materials to produce the final "Portland cement" product.

Both the raw materials and the fossil fuels (mainly hard coal and heavy oil) may be substituted in part by waste of suitable composition. This is desirable in terms of conservation of resources. It must, however, be guaranteed that waste is valorised or disposed of in cement plants in an ecologically sound way. The quality of the clinker and cement products must be maintained both in terms of material composition and in their use as building materials, and they must not be misused as a sink for heavy metals. The heavy metals should be concentrated and recycled as far as possible by suitable technical means. The use of waste in cement plants must also not lead to significantly higher emission of pollutants in the flue gases. It is therefore necessary to specify quality requirements for the waste employed, and in certain cases, to restrict the use of waste.

The cement industry in Switzerland has announced its objective to satisfy a large part of its thermal energy needs with suitable combustible waste. It is also interested in suitable incombustible waste as a substitute for mineral raw materials. The ability of cement plants to process large quantities of waste, particularly waste with high calorific value, influences waste planning by the Confederation and the cantons. Sufficient capacity will soon be available throughout Switzerland to incinerate household waste by existing waste incineration plants and those under construction. Certain waste incineration plants, particularly in the large conurbations, are at present underutilized. However, this situation will change following the prohibition from 1.1.2000 on dumping combustible waste.

Furthermore, a number of special waste incineration plants which process mainly special solid or paste wastes have reported free capacity. Nevertheless, special liquid waste (waste oil, solvents) would present a disposal problem without the cement industry's contribution. Thus, the various incineration routes available in Switzerland, although sometimes in competition, also complement one another. In disposing waste in cement plants, the particular characteristics of the Swiss waste industry must be taken into consideration.

To ensure consistent implementation and coordination of waste planning, the present Guidelines clearly specify the types of waste that may be disposed of in cement plants and the requirements which must be observed. The Guidelines are based on the Ordinance on Air Pollution Control (OAPC), Appendix 2, subsection 111 (revised 15.12.1997). During the next revision of the Technical Ordinance on Waste (TOW), SAEFL will decide whether to include regulations on waste disposal in cement plants in the TOW.

In 1993, SAEFL established the working group "Waste in Cement Plants", comprising representatives of the cantons, the cement industry, the waste industry, environmental organizations and federal research institutes. This group prepared a report, published in draft

form in 1994, the first part of which contained suggestions on requirements for alternative fuels. The complete report under the name of "Thesenpapier" (List of Proposals)<sup>1</sup> was published in June 1997 as No. 70 of the SAEFL Environment Materials. The report presents technical and scientific principles, ecological objectives and specific proposals for the requirements for disposal of waste in cement plants.

The criteria selected are based on the concept of least total impact on the ecosystem combined with optimum deployment of resources. The working group has attempted the complex task of reconciling the demands of holistic environmental protection, waste and resource policy, waste economy and the CO<sub>2</sub> problem. The procedure is a pragmatic one. The **positive list** (list of permitted waste) which is the mainstay of this, is tailored to the waste situation in Switzerland with its 28 municipal waste and 5 special waste incineration plants, and also contains exceptions for specific categories of waste. The resulting requirements are intended to be simple and easy to use, to optimize the disposal of waste in cement plants in the overall interest of ecology (as far as we understand it today). It is the wish of all those concerned that a cement plant that processes waste should 'remain' a cement plant, i.e. neither its environmentally relevant emission nor its economic objectives should take it beyond the limits typical of commercial cement plants. The basic principles and requirements contained in the "Thesenpapier" (Chapter 6.1) are shown below.

#### Basic principles in "Thesenpapier":

Waste may be disposed of in cement plants provided this

- is ecologically more advantageous than any other form of disposal and
- is in accord with the waste planning of the Confederation and the cantons and
- is not in competition with more ecological deployment of resources

#### Requirements in "Thesenpapier":

- Disposal in cement plants must fulfill the *re-use objective*, i.e. substitution of the required fuels and materials (basic materials, grinding additives and process materials).
- Unavoidable dilution of *extraneous substances* to the cement production process must be minimized.
- The process must provide an overall solution for the relevant waste, i.e. no subsequent disposal problem should arise for the community as a whole.

**SAEFL will periodically revise the Guidelines, and particularly the "positive list" in Appendix I. To this end, it will appoint an expert group comprising representatives of the cantons, the cement industry and the waste industry, which will convene at least once a year.**

<sup>1</sup> "Waste Disposal in Cement plants, Thesenpapier", Environment Materials No. 70, SAEFL, Documentation Service, CH-3003 Bern, Switzerland, 1997

## 2. Field of application of the Guidelines

The Guidelines specify which types of waste according to Appendix 2, subsection 111, OAPC<sup>2</sup> are suitable for the production of cement clinker and Portland cement in Swiss Cement Industry works according to SIA 215.002. The Guidelines also contain the requirements on utilization of this waste.

Waste may be used for various purposes in cement production according to composition and properties:

- a. Use as a **fuel**, either in the main burner at the clinker outlet of the rotating kiln or the inlet of the rotating kiln.
- b. Use as an **alternative raw material**; this includes both actual substitution of part of the normal raw material and use for any adjustment of the elementary composition of the raw meal which may be necessary.
- c. Use at the **grinding stage** in the production of Portland cement.
- d. Use as a **process material**, e.g. aqueous waste that can be used, for example, for flame cooling for the purpose of NO<sub>x</sub> reduction. Aqueous waste containing ammonia used for nitric oxide reduction is also of increasing importance.

Note: Many fuels, particularly those of low calorific value, contain a significant proportion of incombustible, inorganic substances that are incorporated to 100% in the product in the cement kiln, i.e. are used as alternative raw materials (combination of uses a. and b. above).

## 3. Requirements for permitted waste

### 3.1 Basic principles

- a) In general, only bulk wastes of suitable composition, low in pollutants, can be disposed of in cement plants. This is particularly the case for waste whose quality is comparable with that of the fuels or raw materials customarily used in the production of Portland cement.
- b) Municipal waste and municipal waste components that have been sorted (e.g. WDF, "waste derived fuel"), as well as other waste comparable to municipal waste with respect to origin, material properties, chemical and physical behaviour and chemical composition, shall not be disposed of in cement plants if it is not contained in the "positive list" (Appendix I) (the "positive list" contains, for example, used paper and cardboard).

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<sup>2</sup> Ordinance on Air Pollution Control (OAPC), SR 814.318.142.1, revision of 15.12.1997

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- c) Heavily polluted special waste and other problematic special waste under OMSW<sup>3</sup> not satisfying the requirements of Section 3, as well as other waste which, owing to its chemical composition, material properties or potential hazards, may influence the safety or operation of a cement plant, or whose disposal of in a cement plant would lead to significant additional environmental impact, may not be disposed of in cement plants.

### 3.2 What kinds of waste are permitted?

Subject to the further requirements in Chapter 5 of these Guidelines, the following waste may be used as fuel or raw material in cement plants:

- a. The types of waste listed in the **positive list (Appendix I)** are permissible. In case of special waste under OMSW, the additional requirements under **Section 5.2.2** shall be complied with.
- b. Waste not contained in the positive list may be disposed of in cement plants provided the pollutant content complies with the **standard values<sup>2</sup> in Table 1**. Where special waste under OMSW is concerned, the additional requirements in **Section 5.2.2** apply.
- c. If necessary, the throughput of waste shall be restricted, i.e. if as a result of the disposal of waste the pollutant content in the clinker or cement exceeds the **standard values<sup>4</sup> in Table 2**, or if the concentration of particular substances is significantly increased (cf. Section 4.1).

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<sup>3</sup> Ordinance of 12 Nov. 1986 on movements of special wastes (OMSW), SR 814.014

<sup>4</sup> Cf. intended Appendix III

**Table 1: Standard values for pollutant content of wastes not contained in the positive list.**

Element		Standard value [mg/kg dry matter]			
		Column A for combustible wastes ( <b>left:</b> in mg/MJ; <b>right:</b> in mg/kg, based on a lower calorific value of 25 MJ/kg)		Column B for wastes used as raw alternative raw materials	Column C for wastes used at the grinding stage in the production of Portland cement
		mg/MJ	mg/kg (at 25 MJ/kg)	mg/kg	mg/kg
Arsenic	As	0.6	15	20	30
Antimony	Sb	0.2	5	1	5
Barium	Ba	8	200	600	1000
Beryllium	Be	0.2	5	3	3
Lead	Pb	8	200	50	75
Cadmium	Cd	0.08	2	0.8	1
Chromium	Cr	4	100	100	200
Cobalt	Co	0.8	20	30	100
Copper	Cu	4	100	100	200
Nickel	Ni	4	100	100	200
Mercury	Hg	0.02	0.5	0.5	0.5
Selenium	Se	0.2	5	1	5
Silver	Ag	0.2	5	-	-
Thallium	Tl	0.12	3	1	2
Vanadium	V	4	100	200	300
Zinc	Zn	16	400	400	400
Tin	Sn	0.4	10	50	30
TOC, toxic organic compounds	No universal standard value. Special procedure according to OAPC, Appendix 2, subsection 719, and the precept of minimisation whenever substances such as PCB, dioxins or similar toxic compounds are suspected. For PCB in waste materials, the values specified in Section 5.2.2 or in the positive list are applicable. For organic compounds in general, Section 4.2 shall be observed.				

**Notes to Table 1**

**Column A** applies to wastes used as **fuel** introduced either in the main burner at the clinker outlet of the rotating kiln or the inlet of the rotating kiln. The standard values in column A [mg/MJ] are based on the lower calorific value of the waste. For reasons of clarity, the standard values in [mg/kg waste] are based on a lower calorific value of 25 MJ/kg. The value of 25 MJ/kg corresponds to the calorific value of hard coal. If the calorific value of the waste is less than or greater than 25 MJ/kg, the permissible heavy metal content changes proportionally.

**Column B** applies to wastes used as **alternative raw materials** in producing clinker. This waste substitutes part of the raw material normally used or serves to correct the raw meal composition, i.e. the calcium, iron, silicon or aluminum content (according to remarks on page 46 of the "Thesenpapier").

**Column C** applies to wastes used at the **grinding stage** in the production of Portland cement. Portland cement consists of 90-95% ground cement clinker and 5-10% gypsum, as well as other materials added at the grinding stage (according to pages 27 and 28 in the "Thesepapier").

Note: Table 1 contains no standard values for process materials. These are therefore only permissible if they are contained in the positive list.

## 4. Quality requirements for clinker, cement and flue gases

### 4.1 Quality of clinker and cement

Standard values limiting the pollutant content of clinker and Portland cement are contained in Table 2 of these Guidelines. If the standard values are exceeded<sup>5</sup>, the throughput of the waste used must be reduced. The cement plants must monitor the relevant parameters according to Section 5.1.b., subsection 2. Further, for those elements (Be, Cd, Hg and Tl) marked with an asterisk (\*), no significant increase in the pollutant concentration of the clinker or cement may occur as a result of waste use (i.e. no topping up)<sup>1</sup>.

The standard values for the heavy metal content of clinker in Table 2 are based on raw materials obtained from quarries being worked in Switzerland at the time of preparation of these Guidelines. The possibility cannot be ruled out that raw materials might later be acquired abroad or from other sources in Switzerland, making it impossible to comply with the standard values in Table 2 owing to an increased content of certain minerals. Non-compliance of this nature is not covered by the Guidelines. However, waste that would lead to a further increase in already inadmissible values in the clinker would no longer be permitted in the cement plant concerned.

**Table 2: Standard values for pollutants<sup>1</sup> in clinker and cement**

Element		Standard value [mg/kg]	
		for clinker	for Portland cement
Arsenic	As	40	-
Antimony	Sb	5	-
Beryllium	Be	5 *	-
Lead	Pb	100	-
Cadmium	Cd	1.5	1.5 *
Chromium	Cr	150	-
Cobalt	Co	50	-
Copper	Cu	100	-
Nickel	Ni	100	-
Mercury	Hg	no standard value for clinker (no assimilation)	0.5 *
Selenium	Se	5	-
Thallium	Tl	2	2 *
Zinc	Zn	500	-
Tin	Sn	25	-
Chlorine (inorg.)	Cl	-	1000
Sulphur	S	-	3.5% SO <sub>3</sub>

For elements designated \* the use of waste may not lead to a significant increase in their content in clinker or Portland cement (i.e. no topping up)<sup>6</sup>.

<sup>5</sup> Cf. intended Appendix III

<sup>6</sup> Cf. intended Appendix III

## 4.2 Flue gas quality

### a. Basic principles

1. The requirements for emissions from cement plants are contained in the OAPC<sup>7</sup>. The general values for permitted emissions are contained in Appendix 1 of the OAPC and the supplementary provisions and exceptions in Appendix 2, subsection 11. When using waste in cement plants, the additional provision for emission of mercury in paragraph b below applies.
2. For peripheral plants, e.g. temporary storage, reloading points and conveyors to the cement kilns, the provisions in Appendix 1 of the OAPC apply.

### b. Supplementary provision for mercury emission

Cement plants that dispose of waste must comply with the emission limit for mercury of 0.1 mg Hg/m<sup>3</sup>.

### c. No "topping up" of flue gas pollutants to limit value

Cement plants that dispose of waste must carry out checks and satisfy the responsible authorities that the disposal of waste causes no significant increase in pollutant emission in the flue gas (i.e. no "topping up" of flue gas pollutants to limit value)<sup>8</sup>.

### d. Emission of organic compounds

Cement plants that dispose of waste must measure the emission of organic substances from the cement kiln, temporary storage (if present) and charging systems at regular intervals. The quantity or quality of organic compound emissions can alter significantly when waste is used as fuel in the secondary furnace in an inadmissible way (i.e. incomplete combustion). This is also the case when organic compounds are expelled from waste aggregated to the raw meal on heating. If necessary, the emission of organic compounds must be limited by technical means.

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<sup>7</sup> Ordinance on Air Pollution Control of 16 Dec. 1985 (OAPC, SR 814.318.142.1), revision of 15.12.97

<sup>8</sup> Cf. intended Appendix III

## 5. Further requirements

### 5.1 Operation, monitoring and transport

#### a. Mixing of waste

Mixing of (permitted) waste is allowed only if the pollutant content of each individual batch complies with the standard values stipulated in the Guidelines (cf. in addition Art. 10 TOW<sup>9</sup>, and for special waste, Art. 4 OMSW<sup>10</sup>). However, the special provisions for CSS in Appendix II are excepted and may deviate from this.

#### b. Material inspection, emission monitoring and quality control

Cement plants that dispose of (permitted) waste must:

- (1) organise the necessary qualified personnel and the required technical equipment to ensure proper material inspection, temporary storage and disposal of the waste received;
- (2) by means of the specified measurements and material flow calculations, ensure that both the requirements on flue gas quality (Section 4.2) and the requirements on quality of the clinker and cement with respect to pollutant content (Table 2, standard values) are complied with;
- (3) perform reception checks comprising the necessary chemical analyses to ensure that the waste delivered for disposal satisfies the requirements of these Guidelines and the cantonal provisions;
- (4) keep a list of the waste disposed of, with information on its origin, type, quantity and composition, together with copies of the analyses performed on receipt.

#### c. Temporary storage and other peripheral plants (e.g. charging systems)

The temporary storage and peripheral plants which a cement plant operates in connection with the disposal of waste must use state-of-the-art technology, comply with the requirements of Art. 37 TOW, and in particular comply with the following conditions:

- (1) the pollutants contained in the waste may not pass into the effluent;
- (2) the flue gases are to be captured and purified to the extent necessary to fulfil the requirements of the OAPC;
- (3) necessary safety measures must be taken (e.g. retention basin, fire safety installations);
- (4) waste must be stored and handled only by personnel trained for this purpose;
- (5) for plants that do not comply with the present provisions, the canton stipulates a rehabilitation period pursuant to the aims of these Guidelines.

#### d. Waste transport

Transport of waste that, owing to its properties, is classified as "dangerous goods", is to be performed according to currently valid regulations.

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<sup>9</sup> Technical Ordinance on Waste (TOW) of 10 Dec. 1990, SR 814.015

<sup>10</sup> Ordinance of 12 Nov. 1986 on movements of special wastes (OMSW), SR 814.014

## 5.2 Disposal of special wastes in cement plants

### 5.2.1 Permissible special wastes

Special wastes must be disposed of in suitable installations, according to OMSW. Generally, special waste with high pollutant content, or other problematic special waste that cannot be recycled, should be incinerated in special waste incineration plants. The special waste permitted in these Guidelines can be disposed of in cement plants. This requires a cantonal authorisation under Art. 16 OMSW ("licence of consignee").

Disposal in cement plants is permitted for special waste that is either contained in the positive list (Appendix I), or that complies with the standard values in Table 1. The remaining requirements, in particular the additional requirements given below, must be fulfilled. The requirements for use of CSS in Chapter 6 and Appendix II are excepted from this.

### 5.2.2 Additional requirements for special waste disposed of in cement plants

- a. Special waste disposed of in cement plants shall not originate from the production, preparation, distribution or use of potent biologically active substances (e.g. production of pharmaceuticals), or have a detrimental effect on workplace hygiene.
- b. Unless otherwise stipulated in the positive list, the content of halogenated organic compounds shall not exceed 1 percent by weight and that of PCB/ PCT (used as fuel substitute) 10 mg/kg. When used as an alternative raw material, at the grinding stage or as process material, the PCB/PCT content must be kept as low as possible and on no account exceed 1 mg/kg. The canton specifies the requirements in any particular case. Excessive costs in connection with analysis should be avoided.
- c. Cement plants may accept (permissible) special waste only from the following consignors:
  - (1) Industrial works in which the waste originates, and only if it arises from a defined process in large quantities. Producers of special waste may mix large batches provided each batch alone complies with the standard values, and an explicit OMSW code applies to the resulting mixture (e.g. codes 1270 to 1274). In all other cases, mixing is prohibited (Art. 4 OMSW and Art. 10 TOW).
  - (2) Companies that accept special waste for treatment and have the necessary cantonal licence. In producing large batches for delivery to the cement plants, such companies may intermix special waste only if each individual batch satisfies the relevant criteria for pollutant content (prohibition of mixing, Art. 4 OMSW and Art. 10 TOW).

## **6. Special requirements for preparation and use of “alternative solid fuels”**

### **6.1 Initial position**

In Switzerland, the company Cridec SA in Eclépens (Canton of Vaud) operates an installation for mixing certain types of special waste with sawdust or other cellulose carrier substances. The alternative fuel prepared in this way, known under its French name of CSS (Combustibles solides de substitution) is supplied to a neighbouring cement plant as fuel. A new production plant was commissioned at the end of 1995, i.e. before the present Guidelines came into force.

Most of the special waste currently processed by Cridec is not contained in the positive list (Appendix I of these Guidelines). Special requirements for this waste are specified to enable the firm of Cridec to modify the present plant in accordance with the new provisions. The result of this is that unsuitable waste fractions must be removed and handled by other means (e.g. in a special waste incineration plant) to ensure that the specified limits on pollutant loads are not exceeded. SAEFL is preparing guidelines to define the acceptance requirements for waste used as fuel in municipal waste incineration plants (MSWI) and to make these requirements tighter than is currently the practice.

### **6.2 Prohibition of new installations**

New installations for the production of CSS may not be authorised. First, specific special waste incineration plant is available for disposal of problematic high-pollutant special waste, and second, low-pollutant bulk waste such as used oil or low-pollutant solvent waste can be introduced directly to the kiln in a cement plant without prior mixing with sawdust.

### **6.3 Requirements for use of CSS and its preparation**

- a. All requirements of these Guidelines concerning clinker and cement quality, flue gas pollutants, operation and control apply to cement plants that use of CSS under Appendix II. The special requirements of Appendix II shall apply to the composition of mixtures of special waste whose use as alternative fuel is permitted.
- b. Installations that produce CSS or that mix special waste for the purpose of producing CSS must comply with the special requirements of Appendix II of these Guidelines. If not otherwise specified in Appendix II, the requirements of Section 5.2. apply.



# Appendix I

## Positive List

The positive list specifies certain types of waste that may be disposed of in cement plants, despite the fact that, as experience shows, they exceed the standard values in Table 1. The disposal of the waste in question in cement plants is permitted either on ecological grounds, to ensure safe use, or owing to a lack of other suitable treatment plants.

SAEFL will periodically scrutinise the positive list to establish whether certain types of waste should be removed or if new types should be added. To this end, SAEFL appoints an expert group comprising representatives of the cantons, the cement industry and the waste processing industry. The expert group convenes at regular intervals, at least once per year.

The expert group suggests to SAEFL any changes in the Guidelines that may seem necessary.



## Positive list / A) Alternative fuels

Appendix I 1/6  
Status: March 1998

No.	OMS W Code	Description of waste	Remarks / Requirements	Supplement	Standard value <sup>11</sup>
A1	1440 1460	Hydraulic oils Non-chlorinated insulating oils	These shall comply with the standard values in Table 1, column A, if not otherwise permitted in the supplement	organic halogen compounds PCB/PCT	1% p.wt. 50 mg/kg
A2	1470 1480 1481	Motor and gearbox oils Mineral oil mixtures Other lubricating oils	These shall comply with the standard values in Table 1, column A, if not otherwise permitted in the supplement	Lead Zinc organic halogen compounds PCB/PCT	Pb 800 mg/kg Zn 1000 mg/kg 1% p.wt. 50 mg /kg
A3	-	Used wood	Used wood, for example from building sites, building demolition, conversions, renovation, furniture and packagings, from which metals and bulk contaminants have been removed. Independent of fulfilment of the standard values in Table 1, determination of the pollutant content of the clinker and flue gas emission shall be assured based on appropriate sampling and analysis.		---
A4	-	Sewage sludge from municipal effluent treatment plants	Disposal independent of compliance with standard values in Table 1. Throughput is dependent, among other things, on maintenance of quality in clinker and cement (Table 2 of the Guidelines). The prohibition on topping up (no significant increase) for the relevant pollutants must be observed.		---
A5	-	Car tyres and other rubber waste	Tyres and industrial rubber waste such as used conveyor belts, buffers and escalator belts can be disposed of, but not chlorinated rubber or other chlorinated polymer compounds or sportsground coverings containing Hg. The throughput depends, among other things, on compliance with clinker quality (Table 2 of the Guidelines). Car tyres contain, among other things, zinc compounds. The standard value for zinc in clinker limits the quantity that may be used.		---
A6	-	Paper, cardboard	Only paper and cardboard fractions from separate collections and industrial paper waste that owing to its poor quality or market saturation cannot be recycled. Available data indicate that the pollutant content of used paper and cardboard complies with the standard values in Table 1. In justified cases, the cantonal agency responsible can require analyses to be carried out and, if necessary, restrict the quantity incinerated.		---

<sup>11</sup> Cf. intended Appendix III

## Positive list / A) Alternative fuels

Appendix I 2/6  
Status: March, 1998

A7	-	Petroleum coke	Like coal, petroleum coke has been used for many years as a fuel in cement plants. It has been included in the positive list owing to its specific contamination with vanadium and nickel. For these elements, the standard values opposite apply:	Vanadium Nickel	V Ni	1000 mg/kg 300 mg/kg
A8	-	Paper sludge (incl. that from used paper)	May be used in cement plants if the standard values opposite and the values of the remaining pollutants in Table 1, column A, are fulfilled. The throughput depends, among other things, on compliance with clinker quality (Table 1 of the Guidelines). Suitable technical measures shall be taken to limit mercury emission to max. 0.1 mg Hg/Nm <sup>3</sup> flue gas. The prohibition on topping up (no significant increase) for the relevant pollutants must be observed.	Lead Cadmium Chromium Cobalt Copper Molybdenum Nickel Mercury Zinc	Pb Cd Cr Co Cu Mo Ni Hg Zn	500 mg/kg 5 mg/kg 500 mg/kg 60 mg/kg 600 mg/kg 20 mg/kg 80 mg/kg 5 mg/kg 2000 mg/kg
A9	-	Plastics (graded and mixtures)	Clean plastics waste from separate collection, i.e. not mixed with household waste, or homogeneous plastics fractions from industry and agriculture, if these cannot be recycled. Plastics waste shall fulfil the standard value based on calorific value in Table 1, column A.		---	
A10	-	Polyester, PET	Homogeneous polyester waste from industry or from return systems/separate collection, that cannot be recycled. Polyester waste must fulfil the standard values in Table 1, column A, if not otherwise specified in the supplement <sup>12</sup>	Antimony Cadmium organically compounded chlorine	Sb Cd Cl	800 mg/kg 10 mg/kg 2% p.wt.
A11	-	Polyurethane, PUR foam	Compacted residue from disposal of cooling equipment (i.e. foamed CFC insulating materials). Polyurethane waste must fulfil the standard values in Table 1 excepting those in the supplement <sup>2</sup>	Zinc	Zn	1500 mg/kg

<sup>12</sup> Antimony compounds are used as additives (scintillation agents) in PET production, and thus an increase in the standard value for this element is indicated. The value of 10 ppm for cadmium permits any plastics fractions containing cadmium to be excluded even when less sensitive analytical methods are adopted. As experience shows, this is sufficient to distinguish PET fractions containing cadmium from those without.

## Positive List / B) Alternative raw materials

Appendix I 3/6  
Status: March, 1998

No.	OMS W Code	Waste description	Remarks / Requirements	Supplement	Standard value
B1		Ash from incineration of paper sludge	Ash from paper sludge incineration plant must comply with the standard values in Table 1, column B, if not otherwise specified in the supplement.	Lead Cadmium Copper Zinc PCDD/PCDF	Pb 250 mg/kg Cd 5 mg/kg Cu 250 mg/kg Zn 2000 mg/kg 10 ng TEQ/kg
B2		Waste from smelting works, i.e. sands, dust, slag and furnace linings, provided the waste in question is not special waste under OMSW	Must comply with the standard values in Table 1, column B, unless stipulated otherwise in the supplement. The prohibition on topping up (no significant increase) for the relevant pollutants must be observed.	Lead Chromium Cobalt Copper Nickel Annealing loss TOC	Pb 200 mg/kg Cr 600 mg/kg <sup>13</sup> Co 150 mg/kg Cu 200 mg/kg Ni 150 mg/kg max. 8% max. 1%
B3	9100	Waste from road cleaning	Sludges of refuse dumps and other waste from road maintenance following allocation by the canton and after consultation with the cement plant concerned is independent of the standard values.		---
B4	2430	Contaminated calcium residues from tin recycling	This residue may be disposed of provided the standard values for waste in Table 1, column B, are complied with and unless otherwise specified in the supplement.	Lead Cadmium Chromium Zinc Tin	Pb 100 mg/kg Cd 5 mg/kg Cr 400 mg/kg Zn 1'500 mg/kg Sn 100 mg/kg
B5	3041 and 3042	Residue from soil cleaning equipment and soil, concrete and mixed demolition waste, mainly contaminated with organic substances	For this waste ( <b>OMSW Code 3041 and 3042</b> ), separate regulations apply. The substances concerned are residues from rehabilitation of polluted sites. The authority concerned must decide in each individual case whether disposal in cement plants is permissible. In general, residues from soil washing and preparation plant that are contaminated with organic components may be disposed of in cement plants if the organic components are burned as completely as possible and the cement plant has flue gas filtration equipment suitable for organic substances (e.g. active carbon filters). The waste must comply with the requirements for alternative raw materials (pollutant concentrations in Table 1, column B), where the following supplement applies:		see page 4/6

<sup>13</sup> Use of this waste must not lead to a significant increase in the chromate content in the clinker.

Positive List / B) Alternative raw materials

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No.	OMS W Code	Waste description	Remarks / Requirements	Supplement	Standard value
	3041 and 3042	Residue from soil washing plant and soil, concrete and mixed demolition waste, mainly contaminated with organic compounds	<p>Exceptions are specified to the standard values in Table 1, column B, for a series of heavy metals (see supplement). <b>A maximum of three of these exceptions may be invoked in any individual case.</b> Should the content of four or more heavy metals exceed the standard values in Table 1, column B, then disposal in cement plants is not permissible.</p> <p>The same requirements also apply to contaminated materials that for technical reasons cannot be recycled or whose recycling is not beneficial for environmental reasons, and which (e.g. contaminated concrete) are therefore passed on to a cement plant with appropriate exhaust filtration. When contaminated soil is to be disposed of in cement plants without prior preparation, its pollutant content must be determined relative to the fine particle fraction (particles less than 63 micrometer). Thus, for example, sandy soil with 50% fine particle fraction and an effective chromium content of 90 ppm has a chromium content relative to the fine particle fraction of 180 ppm (100/50 x 90). The pollutant content based on the fine particle fraction calculated in this way must fulfil the above regulations on pollutant content.</p>	Lead Cadmium Chromium Cobalt Copper Nickel Mercury Zinc PCDD/PCDF PCB	Pb 500 mg/kg Cd 5 mg/kg Cr 500 mg/kg Co 100 mg/kg Cu 500 mg/kg Ni 500 mg/kg Hg 2 mg/kg Zn 1.500 mg/kg 10 mg TEQ/kg 50 mg/kg

## Positive list / C) Materials added at the grinding stage

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Status: March, 1998

No.	OMS W Code	Waste description	Remarks / Requirements	Supplement	Standard value
C1		Ash from incineration of paper sludge	Ash from paper sludge incineration plant used as grinding additive must comply with the standard value in Table 1, column C, unless otherwise permitted in the supplement.	Barium Lead Cadmium Copper Zinc	Ba not specified Pb 250 mg/kg Cd 5 mg/kg Cu 250 mg/kg Zn 2000 mg/kg
C2	2440	Gypsum from sulphate precipitation in flue gas desulphurisation plant (REA gypsum)	The gypsum waste used must fulfil the standard values in Table 1, column C, with the addition in the supplement.	Selenium	Se 20 mg/kg
C3		Glassy molten fractions from high-temperature waste treatment	Slag from high-temperature processes, such as for example DEGLOR, HSR, Thermoselect, Seiler, Plasmox: The standard values in Table 1, column C, must be complied with if not otherwise permitted in the supplement.	Chromium Copper Cr-VI in the eluate, according to TOW Test 2	Cr 2.000 mg/kg Cu 600 mg/kg 0.01 mg/l in the eluate

Positive list / C) Materials added at the grinding stage

No.	OMS W Code	Waste description	Remarks / Requirements	Supplement (Exceptions)	Standard value
D1		Waste containing ammonia	Certain aqueous waste can be valorised by use as DeNOx agent or for flame temperature regulation in the cement production process (injection in the temperature range 900-950°C). No entry is made in Table 1 of the Guidelines for process materials. These are treated as individual cases in the positive list. The permissible level of heavy metal contamination is based on the standard values in the current Ordinance on Effluent Release SR 814.225.21. Specifically, this applies to: effluent containing ammonia, e.g. from the ammonia stripping process in effluent treatment plant.	Arsenic As 0.1 mg/l Lead Pb 0.5 mg/l Cadmium Cd 0.1 mg/l Chromium-VI CrVI 0.1 mg/l Chromium III CrIII 2.0 mg/l Cobalt Co 0.5 mg/l Copper Cu 0.5 mg/l Nickel Ni 2.0 mg/l Mercury Hg 0.01 mg/l Silver Ag 0.1 mg/l Zinc Zn 2.0 mg/l Tin Sn 2.0 mg/l  TOC not specified	
D2	1240	Aqueous waste not contaminated with halogenated solvents	This is permitted as DeNOx agent (flame cooling, with direct injection). With two exceptions, the standard values in D1 apply to heavy metals. The exceptions and additions are given in the standard values opposite:  The heavy metal fraction in clinker shall not exceed 10% of clinker content (excl. waste).	Chromium VI CrVI 0.5 mg/l Copper Cu 1.0 mg/l  Organic halon compounds e.g. halog. solvents PCB 50 ppm relative to TOC TOC 250 mg Cl/l not specified	
D3	1084 1087	Developer baths (photographic and reproduction developers, bleach, fixative and sensitising baths and mixed photographic effluent)	These are permitted as DeNOx agents (flame cooling, with direct injection). With three exceptions, the standard values in D1 apply to heavy metals. Heavy metal fractions in clinker must not exceed 10% of the remaining heavy metal fractions in clinker. The exceptions and additions mentioned are given in the supplement opposite:	TOC not specified Copper Cu 1.0 mg/l Silver Ag 5 mg/l Chromium VI CrVI 0.5 mg/l Organic halon compounds e.g. halog. solvents PCB 1 mg Cl/l	

## Appendix II

### Requirements for the disposal of special wastes in the form of alternative solid fuels (Combustibles solides de substitution, CSS)

#### 1. Introductory remarks

This Appendix contains special requirements for preparation and use of CSS mentioned in Chapter 6 of the Guidelines. Unless otherwise specified in this Appendix, the general provisions of the Guidelines apply.

#### 2. Requirements for CSS

##### a) Annual load

As CSS is produced intentionally, its components may be manipulated. The requirements for CSS limit the permissible annual load of certain heavy metals and other pollutants. So that modification of the plant and its mode of operation can comply with the new standard values, the permissible annual load is reduced in two steps according to Table A II/1. For heavy metals not specified there, the standard values in Section 3.2, Table 1, column A, of the Guidelines apply.

**Tab. AII/1: Permissible pollutant loads in CSS (basis: 15.000 t CSS per year)**

Pollutant		Max. annual load in t/a			Content in ppm		
		to 2000	to 2004	after 2004	to 2000	to 2004	after 2004
Lead	Pb	12.0	9.0	6.0	800	600	400
Cadmium	Cd	0.15	0.075	0.075	10	5	5
Chromium	Cr	7.5	4.5	4.5	500	300	300
Copper	Cu	15.0	7.5	6.0	1000	500	400
Nickel	Ni	4.5	3.0	3.0	300	200	200
Zinc	Zn	75.0	60.0	30.0	5000	4000	2000
Halogenated organic compounds in [% by weight]					< 0.5 % from now		
Poorly degradable toxic halogenated organic compounds (e.g. PCB) in [ppm]					< 10 ppm from now		

Assuming Cridec produces less than 15.000 t CSS a year, the annual loads in [t/a] diminish in proportion to the quantity of CSS produced. The quantity specifications are to be regarded as nominal values. They are intended for monitoring individual deliveries.

#### b) **Quality control**

Quality control is intended to ensure first, that the annual pollutant loads in the alternative fuels produced do not exceed the values given in Table A II/1 and, second, that the cement plant complies with the specified exhaust values and the standard values for clinker. The quality of the individual CSS deliveries to the cement plants must be documented in an appropriate form and samples retained to enable the annual loads subsequently to be checked on the basis of the documents and (if necessary) further analysis. The average monthly values of the individual pollutant loads must be checked periodically, and at least once every six months, by the canton responsible.

### 3. Requirements for waste allowed in CSS production

#### a) **Basic principles**

Waste for conversion to CSS must in general have the following properties: have low heavy-metal content, be largely free of halons, have only traces of poorly degradable halogenated organic compounds such as PCB, have low VOC content (volatile organic compounds such as solvents), be non self-igniting, have high ignition temperature, and be acceptable from the point of view of toxicity and workplace hygiene. In general, only waste that because of its physical properties cannot be fed directly to the burner without excessive effort, should be converted to CSS.

#### b) **Permitted waste**

Only special waste specified in Table A II/4 may be used for the production of CSS. Additionally, the general restrictions in Tables AII/2 and AII/3 apply.

**Tab. AII/2: General restrictions for problematic substances in special waste used for the production of CSS**

Halogenated organic compounds	max. 1% per weight
Poorly degradable halogenated organic compounds (e.g. PCB)	max. 50 ppm
Solvent content	below 15%
Ignition point	above 55 °C
The special waste shall not derive from production, preparation, distribution or use of highly active or biologically active substances, or otherwise be problematical from the point of view of workplace hygiene.	

**Tab. AII/3: Standard values for maximum tolerable heavy metal content in waste permitted for production of CSS.**

Designation		Standard value in [mg/kg]
Lead	Pb	600
Cadmium	Cd	10
Chromium	Cr	400
Copper	Cu	500
Nickel	Ni	300
Zinc	Zn	4.000
all other heavy metals	according to Table 1 of the Guidelines	

For the waste designated \* in Table AII/4, the above standard values will apply from 1 January, 2004 onwards.

Quality controls according to Chapter 2, section B, must be carried out to ensure that the permitted annual loads in Table A II/1 are not exceeded.

#### **4. Requirements for production and use of CSS**

##### **a) State of the art**

Processes must comply with the regulations concerning water protection, clean air (e.g. emission of organic substances) and safety (e.g. explosion protection), both in converting special waste to CSS and for temporary storage by the CSS producer and at the cement plants. Open shredding and mixing without exhaust treatment is, for example, not state of the art.

**b) Acceptance controls, inclusive of the necessary chemical analyses,** must ensure that only permitted special waste is converted to CSS, and that problematical, heavily polluted waste or waste fractions that are unsuitable for other reasons are delivered to appropriate special waste incineration plants.

##### **c) Acceptance of premixed waste**

Waste premixed with sawdust is only permitted when the waste used, as well as the production and composition of the premixture, satisfy the present regulations. Waste containing solvents is, however, excepted. The waste codes 1260, 1620, 1640 and 1641 are not, therefore, permitted for the production of premixtures. Copies of the consignment document of the "original waste" shall be attached to the consignment on delivery of the premixtures. To protect the client, the address and the identification number of the "original consignor" may be concealed.

##### **d) Use**

CSS shall be introduced directly to the main burner of the cement kiln.

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**Tab. AII/4: Special waste permitted in the production of CSS**

OMSW Codes	Designation	Restrictions
1260	Unhalogenated non-aqueous distillation residues, originating from solvent regeneration operations; see also category 8	<p>Waste containing solvents (solvent content max. 15%)</p> <p>are permitted provided the peripheral plant at the cement works (e.g. temporary storage, charging systems including transport to the cement plants) complies with the regulations in OAPC and with the state of the art regarding safety.</p> <p>For existing plant not complying with these requirements the canton responsible specifies a reasonable rehabilitation period, <b>not however extending beyond the end of 1999.</b></p> <p>See below for explanation of (*)</p> <p>The restrictions in Chapter 4 apply to the production of premixtures</p>
1472	Residuals from oil or petrol gasoline separators; tank cleaning sludges and oily sludges	
1473	Tank cleaning and oil sludge	
1610*	Paint, varnish and glue wastes having an aqueous phase (emulsions)	
1620*	Paint, varnish and glue wastes having an organic phase (solvents)	
1630*	Paint, varnish and glue wastes without a liquid phase	
1631*	Paints in powder form	
1632*	Hardened paints and pastes	
1640*	Waste of printing ink or coloring media having an organic phase (solvents)	
1641*	Old paints and pigments	
1650*	Waste of printing ink or coloring media without an organic phase (without solvents)	
1740	Soaps, fats, lubricating oils or films of vegetable or animal origin	
2231	Solid distillation residues	
2240	Residues from coking, tar-containing wastes (except the wastes covered by codes 2870 and 2871)	
2840*	Settling, filtration and centrifuging residues (except the wastes covered by codes 1500, 2450, 2810-2821, 3020 and 3030)	
3050	Contaminated packages and containers which have contained special waste unless they are used again for the transport of wastes of the same nature	

\* Heavy metal fractions (e.g. anti-corrosive paints or workshop sludge possibly classified under code 2840) must be eliminated by means of separation, and disposed of in a special waste incineration plant, or, if possible, recycled. The supplier must be kept informed. The specified annual pollutant loads should not be exceeded. Separation must be performed in compliance with the heavy metal loads (distributed over time) in Tab. AII/1.