Rolf Sjöblom
Jan-Erik Haglund
Gustav Tham
Claes Ribbing

CLASSIFICATION OF WASTE ACCORDING TO *THE EUROPEAN UNION DIRECTIVE 91/689/EEC ON HAZARDOUS WASTE* from a Swedish application perspective

Can be downloaded from www.tekedo.se/CIWM06

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Rolf Sjöblom 	Now: Consultant at Tekedo AB: materials, ash management, regulation implementation
	Formerly: Nuclear waste research programme reviewer at ***Swedish Nuclear Power Inspectorate***
Gustav Tham 	Now: Research Director at **Telge AB**: covering of domestic waste landfills using ash, haz waste disposal
	Formerly: MD **large recycling & disposal facility** at Tveta, environmental consultancy, mine geologist
Jan-Erik Haglund 	Now: Environmental Manager at **Söderenergi AB** - **large plant for recycled wood-based fuels**
	Formerly: environmental consultant, officer at ***Swedish Environmental Protection Agency***
Claes Ribbing 	Now: Manager at the Swedish Thermal Engineering Research Institute for their ash recycling programme
	Formerly: Various responsible positions in the mining industry

About Sweden

- District heating ≈ 50 % ⇔ ≈ 50 TWh/y
- Wood based (including recycled fuels, paper sludge and bark, also peat)
- => ≈ 1 Mtonne of ash
- Domestic waste ≈ 50 % incinerated ⇔ ≈ 2 Mtonnes
- => ≈ 0,4 Mtonnes residue
- <⇔>
- Ash by far largest residue

What is required? & What is getting done?

- Obligation to simultaneously
  - Protect health and environment
  - Conserve & recycle
- Little ash is utilized outside landfill
- Considerable use at landfill but utilizing only a fraction of the potential in the materials
- A lot is deposited with resource consuming protection that is unreasonably high

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S.U.W.I.C

Regulation-related reasons

- Non-existent & incomplete regulations
- Conflicting rules
- Complicated rules
- Ill-defined legal status of ”rules”
- Lack of relation to real issues
- Overprioritisation of long-term solutions
- Application to the wrong context

Example of European Union Directive 91/689/EEC on hazardous waste

- Regulates handling/management of waste
- Also acceptance of non-hazardous waste to landfill for such waste
- Owner of waste required to know and prove classification
- Illegal to arbitrarily regard as hazardous <≠> requirement on conservation & recycling

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Directive of hazardous waste

- Implemented in Swedish legislation in late 2001
- Previously hazardous waste <= name & title only
- Now overriding issue actual properties & actual content of hazardous substances
- <= Heavy reliance on regulation for labelling of chemical products

31967L0548

Rådets direktiv 67/548/EEG av den 27 juni 1967 om tillnärmning av lagar och andra författningar om klassificering, förpackning och märkning av farliga ämnen

Europeiska gemenskapernas officiella tidning nr P 196 , 16/08/1967 s. 00 - 0098
Finsk specialutgåva Område 15 Volym 1 s. 0019
DA.ES Serie I Område 1967 s. 0211
Svensk specialutgåva Område 15 Volym 1 s. 0019
Engelsk specialutgåva: Serie I Område 1967 s. 0234
"Grekisk specialutgåva; " Område 13 Volym 1 s. 0034
Spansk specialutgåva: Område 13 Volym 1 s. 0050
Portugisisk specialutgåva: Område 13 Volym 1 s. 0050

TEXT: HTML

Nummer i registret

13.30.18. *Industripolitik och den inre marknaden - Den inre marknaden: tillnärmning av lagstiftning - Farliga ämnen*

EUROVOC

tillnärmning av lagstiftning ; etikettering ; emballage ; farligt ämne

Senare ändringar

ändrad genom.. 369L0081..... ändring ANN 1 från 14/03/1969
ändrad genom.. 370L0189..... ändring ART.10.1 från 11/03/1970
ändrad genom.. 371L0144..... ändring ART.10.1 från 24/03/1971
tillämpningen utvidgad genom 172BN11/9/PT1A21.. JQ1/1/75
ändrad genom.. 373L0146..... tillägg ANN 5 från 24/05/1973

Now consolidated!

There used to be around 150 changes in an unconsolidated document

ändrad genom.. 373L0146..... tillägg ART.2.3 från 24/05/1973
ändrad genom.. 373L0146..... tillägg ART.6.4 från 24/05/1973
ändrad genom.. 373L0146..... tillägg ART.8BIS från 24/05/1973
ändrad genom.. 373L0146..... tillägg ART.8QUATER från 24/05/1973
ändrad genom.. 373L0146..... tillägg ART.8TER från 24/05/1973
ändrad genom.. 373L0146..... ändring VERS.I från 24/05/1973
ändrad genom.. 373L0146..... ersätter ANN 1 från 24/05/1973
ändrad genom.. 373L0146..... ersätter ANN 2 från 24/05/1973
ändrad genom.. 373L0146..... ersätter ANN 3 från 24/05/1973
ändrad genom.. 373L0146..... ersätter ANN 4 från 24/05/1973
ändrad genom.. 375L0409..... tillägg ART.6.2 från 27/06/1975
ändrad genom.. 375L0409..... tillägg ART.8QUINQUIES
ändrad genom.. 375L0409..... tillägg ART.8SEXIES från 27/06/1975
ändrad genom.. 375L0409..... ändring VERS.D ART.2.2
ändrad genom.. 375L0409..... ändring VERS.EN ANN 2 från 27/06/19
ändrad genom.. 375L0409..... ändring VERS.EN ANN 3 från 27/06/19
ändrad genom.. 375L0409..... ändring VERS.EN ART.2.2
ändrad genom.. 375L0409..... ändring VERS.EN ART.6.2
ändrad genom.. 375L0409..... ändring VERS.I ANN 3 från 27/06/1975
ändrad genom.. 375L0409..... ersätter ART.7 från 27/06/1975
ändrad genom.. 375L0409..... ersätter ART.8.A från 27/06/1975
ändrad genom.. 376L0907..... ändring ANN 1 från 19/07/1976
ändrad genom.. 376L0907..... ändring ANN 3 från 19/07/1976
ändrad genom.. 376L0907..... ändring ANN 4 från 19/07/1976
ändrad genom.. 179HN01/10..... ändring ART.8QUATER.2 från 01/01/1981
ändrad genom.. 379L0370..... tillägg ANN 1 från 07/02/1979
ändrad genom.. 379L0370..... tillägg ANN 2 från 07/02/1979
ändrad genom.. 379L0370..... tillägg ANN 3 från 07/02/1979
ändrad genom.. 379L0831..... ART.10DEVIENT ART.25
ändrad genom.. 379L0831..... ART.11DEVIENT ART.26
ändrad genom.. 379L0831..... ART.9DEVIENT ART.24
ändrad genom.. 379L0831..... tillägg ANN 6 från 19/09/1979
ändrad genom.. 379L0831..... tillägg ANN 7 från 19/07/1979
ändrad genom.. 379L0831..... tillägg ANN 8 från 19/07/1979
ändrad genom.. 379L0831..... tillägg ANN 9 från 19/07/1979
ändrad genom.. 379L0831..... tillägg ART.10 från 19/09/1979
ändrad genom.. 379L0831..... tillägg ART.11 från 19/09/1979
ändrad genom.. 379L0831..... tillägg ART.12 från 19/09/1979
ändrad genom.. 379L0831..... tillägg ART.13 från 19/09/1979

Classification according to the Directive of hazardous waste & harmonized regulation

- Based on European Waste Catalogue (EWC) codes
- For some codes also content of hazardous substances
- A hazardous substance has at least one hazardous property
- Properties defined with the same risk phrases as for labelling of chemical products
- Summation over various substances having a certain property
- In some cases largest value

Examples of EWC-codes

10 02	**Wastes from power stations …**
10 01 16*	fly ash from co-incineration containing dangerous substances
10 01 17	fly ash from co-incineration other than those mentioned in 10 01 16
19 01	**Wastes from incineration … of waste**
19 01 13*	Fly ash containing dangerous substances
19 01 14	Fly ash other than those mentioned in 19 01 13

The properties H4-H8, H10-H11

H4	Irritating	Summation
H5	Harmful	Summation
H6	Toxic	Summation
H7	Carcinogenic	Largest value
H8	Corrosive	Summation
H10	Toxic for reproduction	Largest value
H11	Mutagenic	Largest value

The properties H13 och H14

H13	Can give rise to another substance having any of the properties H1 – H12	E g eluate Includes diagenesis / chemical restructuring
H14	Ecotoxic	Requirement but no specification at present

Properties H1-H3, H9, H12, relevant only in certain cases

H1	Explosive
H2	Oxidizing
H3	Very flamable
H9	Contagious
H12	Releases poisonous gases

”MISSION IMPOSSIBLE”

- Djungle of rules
- Actual chemical forms very complex
- Actual substances are not represented in databases over dangerous properties
- The methodology designed to apply to chemical products where selected substances are mixed
- It is not acceptable to ”cheat” by not including substances that are dangerous albeit not represented in the data bases
- ≠ legislation for chemical products (risk phrases identical)
- Unavoidable with far-reaching interpretations

How to comply with the hazardous waste directive?

- Organic chemistry – relatively straightforward
- Inorganic chemistry of ash very complex – actual chemical forms cannot be found in data bases =>
- Necessary to identify reference substances as follows

- **Known properties with regard to health and environment**
- **Should represent relatively realistic forms for the element in question**
- **Should represent actual substances in a conservative manner**
- **Should represent the properties over time – however, initial contact with water is assumed**

How to comply with the hazardous waste directive? Continued.

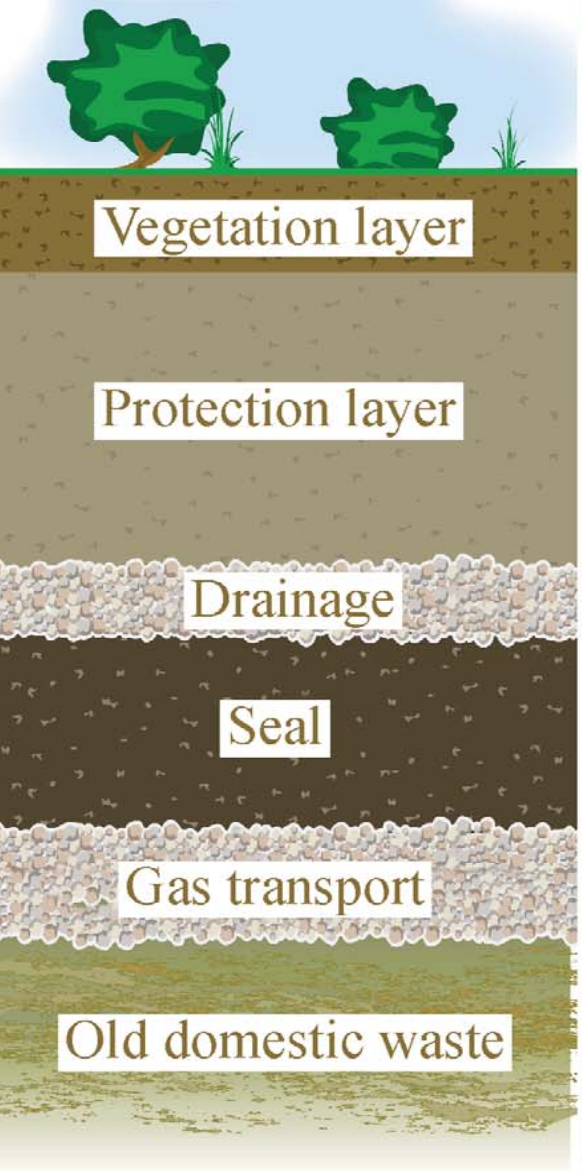
- A special methodology has been developed on commission by
  - About 20 companies / plants
  - Branch organisations for heat generation and waste management (Swedish Thermal Engineering Research Institute, Ash Programme, and Swedish Association of Waste Management – RVF)
  - The Swedish Environmental Protection Agency (and with support from the Swedish Chemicals Inspectorate)
- The methodology has been published by the branch organizations and is available to everyone (in Swedish only though)
- The methodology has been applied to > 20 plants
- Example: ash generated at Söderenergi and is used at Telge Återvinning for seals and cover over old domestic waste

Applications with Tekedo involvement

Händelöverket	Sydkraft Östvärme AB
Igelstaverket	Söderenergi AB
Tveta Återvinningsanläggning	Telge Återvinning AB
Dåvaanläggningen	Umeå Energi AB
Värmeverket i Linköping	Tekniska Verken i Linköping AB
Gärstadverket	Tekniska Verken i Linköping AB
SSAB:s stålverk i Oxelösund	Merox AB
Bravikens Pappersbruk	Holmen Paper AB
Värmeverket	Lidköpings Värmeverk AB
Hallsta Pappersbruk	Holmen Paper AB
Högdalenverket	Fortum AB
Korstaverket	Sundsvall Energi AB
Kristinehedsverket	Halmstad Renhållnings AB
Åbyverket	Sydkraft Mälarvärme
Karlskoga Kraftvärmeverk	Karlskoga Kraftvärmeverk AB
Sävenäsverket	Renova AB Göteborg
Johannes	Gävle Energi
Backelundsverket	AB Borlänge Energi
Kallhagsverket Avesta	AB Fortum Värme
Säverstaverket	Bollnäs Kommun
Hovhultverket	Uddevalla Energi AB


The ash store
Tests with covers
on old domestic waste
Test area 4 hectars
Tveta Recycling Plant
outside Södertälje near Stockholm, Sweden

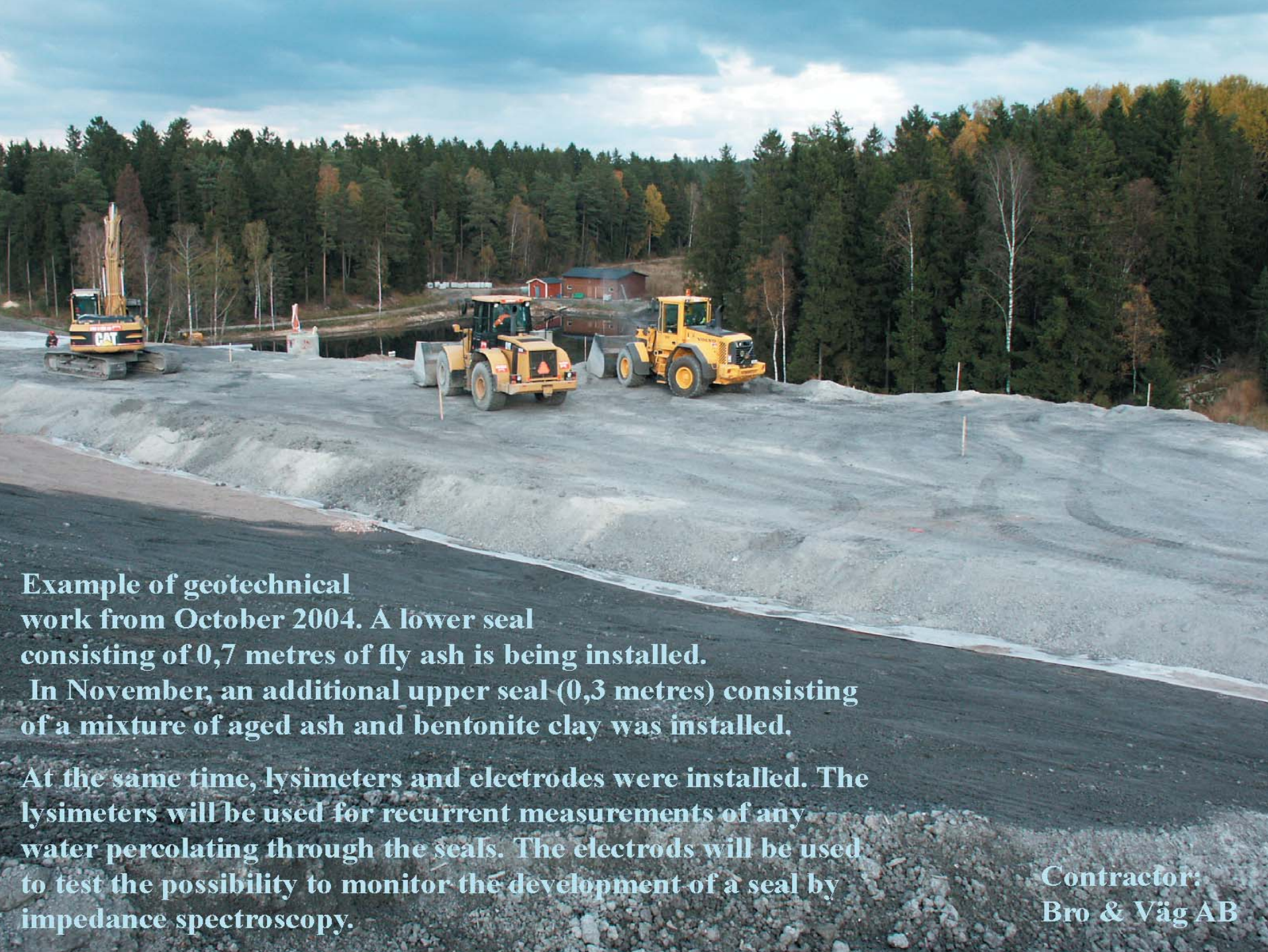
Sequence of layers in the different test covers



The present study is a part of the *Tveta Landfill Cover Project*

Basic ideas behind the *Tveta Landfill Cover Project*:

- **Utilization of recycled materials, especially ash from wood-based fuels**
- **The cover should have suitable mechanical properties with regard to differential settlements in the waste as well as slope stability**
- **The cover should have suitable chemical properties to resist undesired influences from other materials as well as to undergo continuous improvement in properties**
- **The results and conclusions should have a sound and solid scientific and technical basis, including results from tests on a sufficiently large scale**

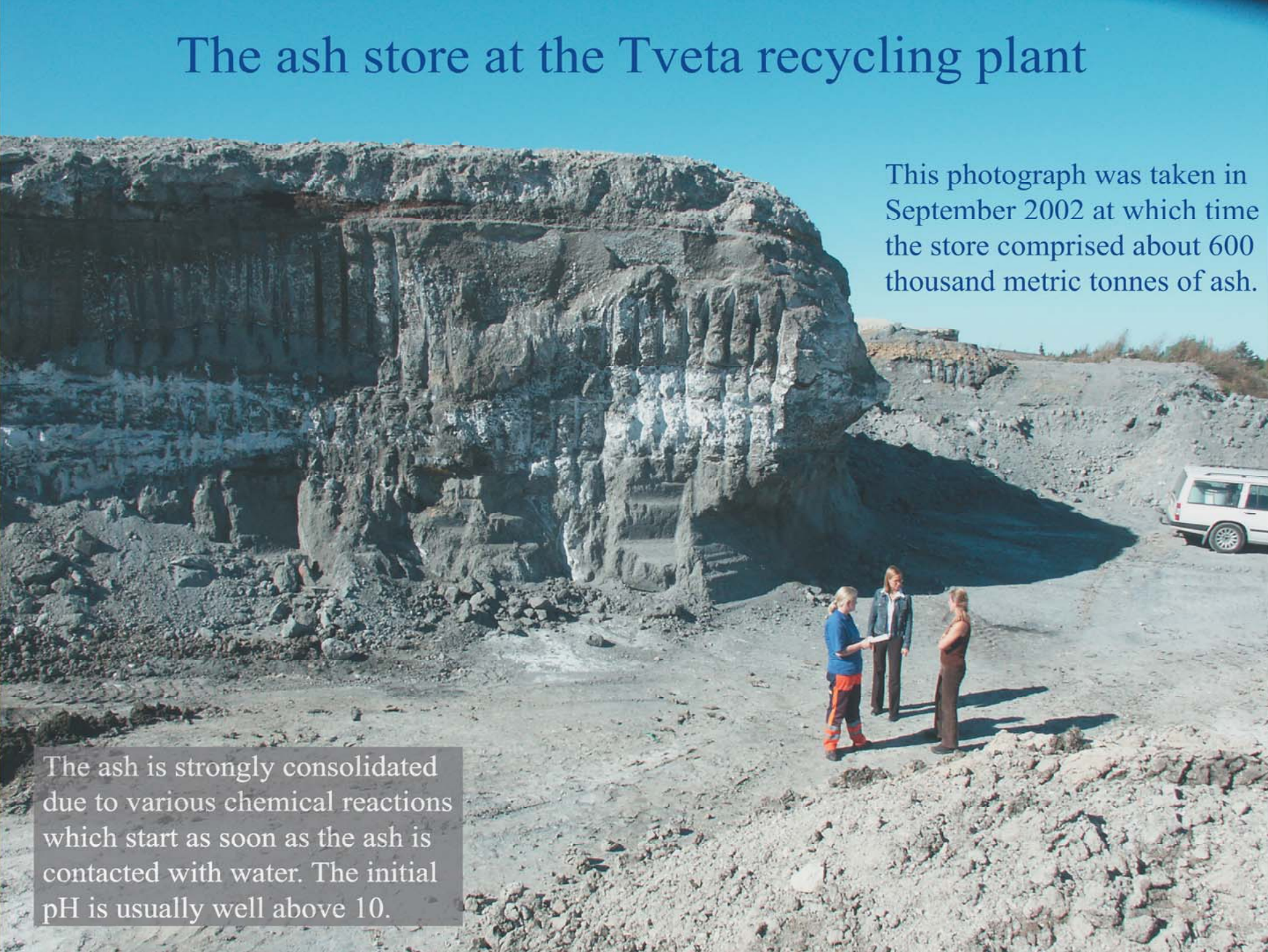


Example of geotechnical work from October 2004. A lower seal consisting of 0,7 metres of fly ash is being installed. In November, an additional upper seal (0,3 metres) consisting of a mixture of aged ash and bentonite clay was installed.

At the same time, lysimeters and electrodes were installed. The lysimeters will be used for recurrent measurements of any water percolating through the seals. The electrods will be used to test the possibility to monitor the development of a seal by impedance spectroscopy.

Contractor:
Bro & Väg AB

The ash store at the Tveta recycling plant



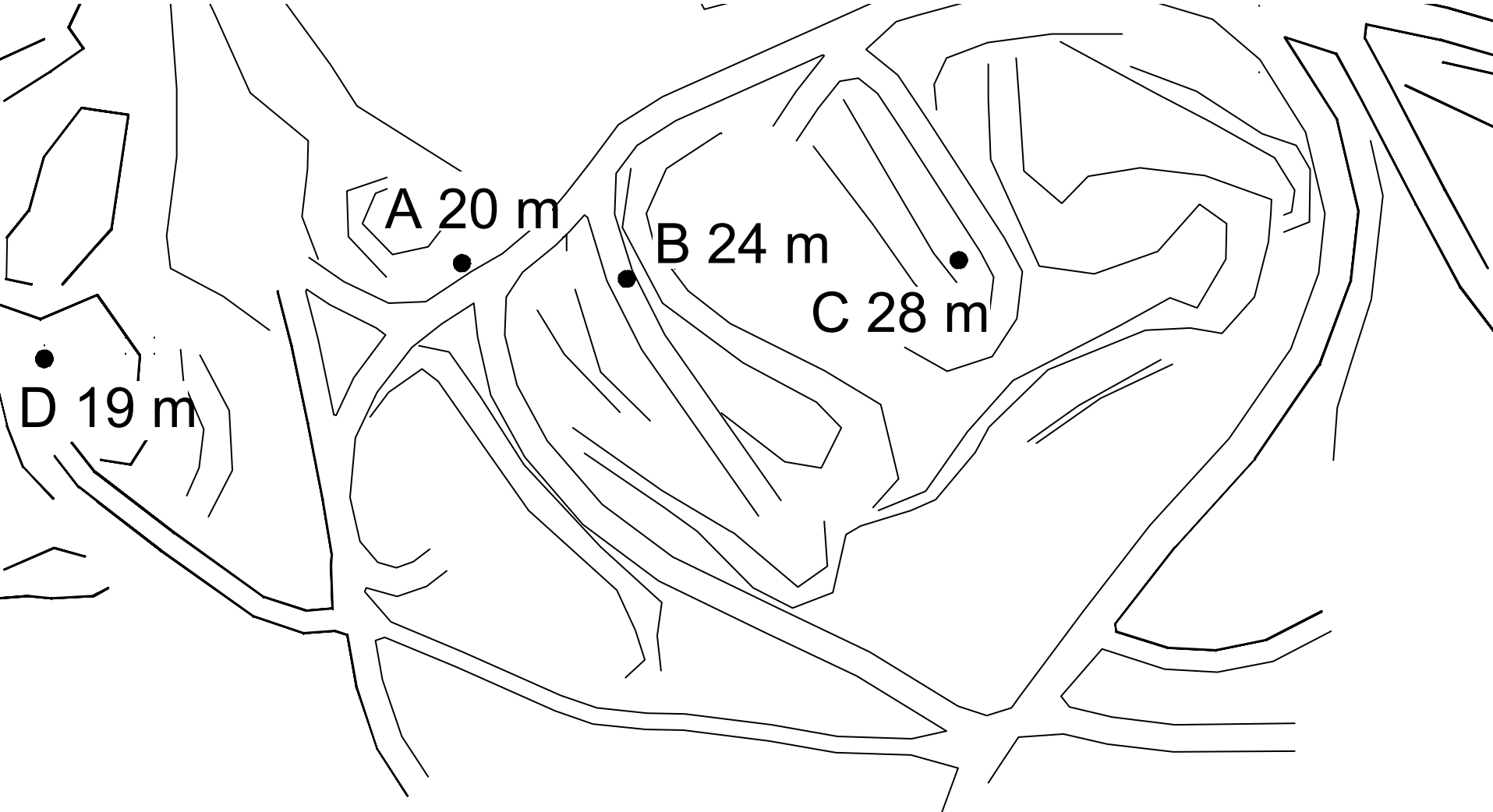
This photograph was taken in September 2002 at which time the store comprised about 600 thousand metric tonnes of ash.

The ash is strongly consolidated due to various chemical reactions which start as soon as the ash is contacted with water. The initial pH is usually well above 10.


Please note carefully the apearance of the material as it will
be concluded below that it is very impervious and monolitic

The material was collected in a drum using a cyclone. Two composite samples were taken for every meter, one of which was subsequently crushed to < 6 mm and homogenized.

Positions of the drill holes together with their total depths. Largest horizontal distance between holes 168 m.



Aged ash placed in small heaps for weathering and further ageing (*e g* absorption of carbon dioxide) before mixing with bentonite clay (cf text). Samples were taken at the positions indicated.

Examples of measurements carried out are as follows:

- moisture content
- pH of contact water
- electric conductivity of contact water
- soluble salts
- hardness
- optical microscopy
- electron microscopy
- packing properties (proctor)
- permeability
- thermogravimetry
- chemical analyses
- leach tests

Major elements in ash at the store at the Tveta Recycling Plant in % by weight figured as elements. Samples taken from drill hole A.

Ele-ment	0-1 m	2-3 m	4-5 m	6-7 m	8-9 m	11-12 m	13-14 m	15-16 m	16-17 m
SiO_2	38	31,4	30,6	36,2	42,5	37,3	35,6	38,1	40,4
Al_2O_3	15,3	16,5	15,8	15,9	14	15,5	15,9	15,2	14,4
CaO	13,2	17	14,1	13,5	7,1	11,5	14,3	15,2	13,8
Fe_2O_3	6,3	5,3	4	6,8	7,1	6,4	5,8	4,6	4,3
K_2O	1,5	1,6	1,4	1,7	1,6	1,6	1,5	1,3	1,7
MgO	2,6	2,6	2,2	2,3	1,9	2,5	2,8	1,4	1,3
MnO	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Na_2O	1,1	0,6	0,7	0,8	0,8	0,7	0,7	0,4	0,6
P_2O_5	0,3	0,4	0,3	0,4	0,3	0,2	0,2	0,3	0,2
TiO_2	0,6	0,7	0,7	0,7	0,6	0,7	0,7	0,7	0,6
Cl	0,1	0,2	0,3	0,6	0,7	1,5	1,8	1	1
S	3,4	3,9	3,9	3,7	1,8	3,2	3,4	3,4	3,9

Minor elements in ash at the store at the Tveta Recycling Plant in mg/kg (ppm by weight) figured as elements. Samples taken from drill hole A.

Ele-ment	0-1 m	2-3 m	4-5 m	6-7 m	8-9 m	11-12 m	13-14 m	15-16 m	16-17 m
Sb	7	7	8	5	3	5	6	6	6
As	28	30	28	22	10	13	13	19	19
Pb	99	119	97	72	47	81	95	105	105
Co	38	41	42	32	25	32	31	33	33
Cu	114	110	130	95	80	100	91	71	71
Cr	132	150	134	126	112	115	116	80	80
La	36	56	37	42	44	38	34	40	40
Ni	98	109	121	93	74	104	99	102	102
V	231	240	277	198	135	146	147	123	123
Zn	203	194	179	144	123	204	271	519	519
Cd	1	1	1	1	0	1	1	2	2
Hg	1	1	1	1	1	1	1	1	1

Leached fraction together with legal limit for disposal at landfill for non-hazardous waste, mg/kg

Table 2. Leached fraction in mg/kg (ppm by weight) figured as elements in mg divided by dry weight of total in kilograms. Liquid to solid rate is 10 ml/g. Method used is SS-EN 12457-3. All values are below statutory limits, cf text. Statutory limits according to the acceptance criteria for disposal at a landfill for non-hazardous waste is also shown for comparison.

Ele-ment	0-1 m	2-3 m	4-5 m	6-7 m	8-9 m	11-12 m	13-14 m	15-16 m	16-17 m	Legal limit
As	0,01	0,02	0,03	0,03	0,05	0,03	0,07	0,05	0,06	*2*
Ba	0,51	0,65	0,67	0,89	0,59	0,55	0,60	0,38	1,08	*100*
Cd	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*1*
Cr	0,02	0,07	0,05	0,02	0,01	0,03	0,01	0,01	0,01	*10*
Cu	0,03	0,02	0,01	0,01	0,01	0,01	0,01	0,02	0,34	*50*
Hg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*0,2*
Ni	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,07	*10*
Pb	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*10*
Zn	0,01	0,02	0,01	0,01	0,01	0,01	0,01	0,02	0,01	*50*

Observations

- Elemental composition resembles that of soil
- Generally very low leach rates – in contrast to that of fresh ash
- pH typically between 8 and 10 – initially typically around 12 (with $Ca(OH)_2$)
- Generally believed to be due to carbonation
- But carbonate content low

Solubility (log scale) of alumina and silica versus pH

Main elements Ca, Si, Al, Fe ⇔ high reactivity

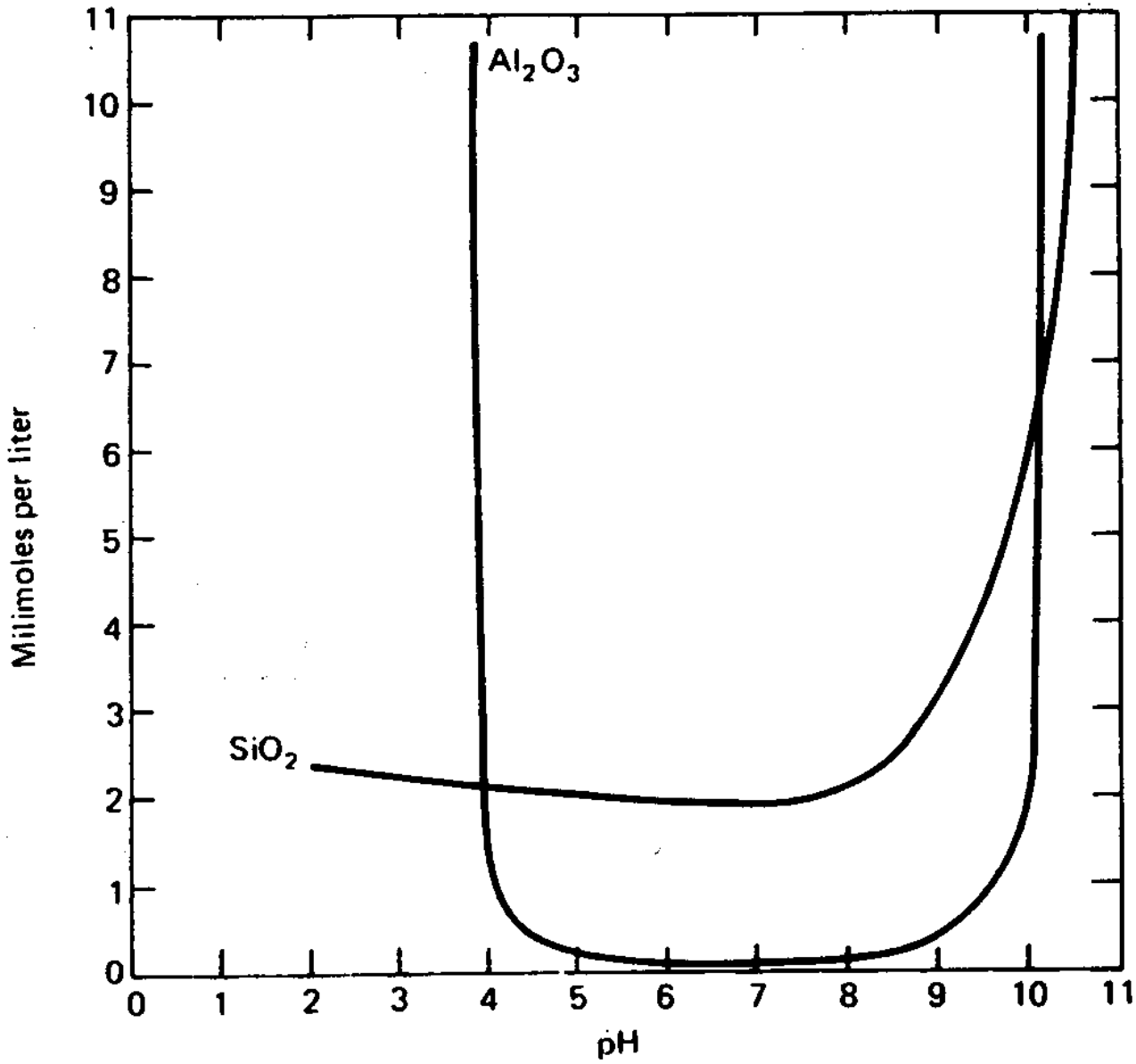


Figure 4.5 Solubility of alumina and amorphous silica in water (Keller, 1964).

Phases in ash after maturation ≠ from those formed in the furnace

Table 3. Minerals phases identified in incinerator ash after ageing [24]. Less abundant phases are labelled with italic fonts.

Silicate		**Oxide**	
Melilite	$(Ca,Na)_{2(}Al,Mg)(Si,AL)_2O_7$	Hematite	Fe_2O_3
Wollastonite	$CaSiO_3$	Magnetite	Fe_3O_4
Clinopyroxene	$(Ca,Na)(Fe,Mg,Al)(Si,Al)_2O_6$	**Carbonate**	
Plagioclas	$(Ca,Na)Al(Al,Si)Si_2O_8$	Calcite	$CaCO_3$
K-Feldspar	$(K,Na)(AlSi_3O_8)$		
Biotite	$K(Mg,Fe)_3(Al,Fe)Si_3O_{10}(OH,F)_2$	**Hydroxide**	
Muscovite	$KAl_2Si_3Al)O_{10}(OH,F)_2$	Portlandite	$Ca(OH)_2$
Montmorillonite	$(Na,Ca)_{0,3}(Al,Mg)_2SiO_{10}(OH)_2 \cdot nH_2O$	*Goethite*	*FeO(OH)*
Hydrate		*Boemite*	*AlO(OH)*
Hydrocalumite	$Ca_2Al(OH)_6[Cl_{1-x}(OH)_x] \cdot 3H_2O$	*Gibbsite*	$Al(OH)_3$
Hydrated Gehlenite	$Ca_2Al_2SiO_7 \cdot 2H_2O$	**Phosphate**	
Sulphate		Apatite	$Ca(PO4)_3$ (Cl,F,OH)
Anhydrite	$CaSO_4$		
Ettringite	$Ca_6Al_2(SO_4)_3(OH)_{12} \cdot 26H_2O$		
Gypsum	$CaSO_4 \cdot 2H_2O$		

Interpretation

- Phases formed in furnace at high temperature not stable under ambient conditons
- High pH from portlandite ($Ca(OH)_2$) => increased solubility of silicate & aluminate => reactivity
- Chemical sintering & formation of impervious structures - metamorphosis
- Sinks for heavy metals
- Formation of clay minerals

Speciation of minor elements

- Dependent on the phases of the major elements
- Incorporation into these phases
- Mixed oxides with iron (heavy metal sink)

Selection of reference substances

- Appear in data bases for hazardous substances
- Reasonably realistic
- Conservative

Table 4. Reference substances for selected metallic elements in ash

Reference substance	**Comment**
antimony(III)oxide	Valence usually III but V plausible at high pH values. III is selected because it is the most pessimistic choice.
arsenic(III)oxide	Valence usually III put V plausible at high pH values. III is selected because it is most pessimistic.
barium(II)oxide	Usually barium appears as sulphate. When level of sulphate is insufficient for this, hydroxide may form. It is selected because it is the most pessimistic choice.
lead(II)oxide	Lead oxide as well as chloride may form initially but lead oxide is formed after contact with water. Sulphate and carbonate are other reasonable forms but they have the same classification as lead oxide. Other lead compounds may form but are expected to be less soluble.
cadmium oxide	Initially formed cadmium chloride hydrolyses after contact with water.
cobalt(II,III)oxide	According to [14]
copper(II)oxide	According to [14]
50/50 Cr(VI) / Cr(III) oxides	Special analysis, *cf* text.
chromium(III)oxide	Special analysis, *cf* text.
mercury(II)chloride	All ashes are low in mercury. Chemistry complex. Chloride form most pessimistic.
lantanum(III)oxide	According to [14]
nickel(II)oxide	According to [14]
vanadium(V)oxide	According to [14] and the most pessimistic form
zinc(II)oxide	Zinc oxide as well as chloride may form initially but oxide form is formed after contact with water.

Reference substances, properties and risk phrases (H14 not shown)

Properties obtained from the data base ”Chemical Substances” version 12.0 supplied by Prevent

Class of hazard	Code of hazard	Limit %	Risk phrase	Sb-III oxide	As-III oxide	Ba-III oxide	Pb-II oxide	Cd-II oxide	Co-II oxide	Cu-II oxide	Cr-VI oxide	Cr-III oxide	Hg-II Cl2	Mo-VI oxide	Ni-II oxide	V-V oxide	Zn-II oxide
very toxic	H6 / T&T+	0,1	26 28		1			1			1		1				
toxic	H6 / T	3	23 24 25					1			1		1			1	
harmful	H5 / Xn	25	20 21 22			1	1		1	1	1			1		1	
corrosive	H8 / C	1	35														
corrosive	H8 / C	5	34		1						1		1				
irritant	H4 / Xi	10	41														
irritant	H4 / Xi	20	36 37 38											1		1	
carcin.	H7 / T	0,1	45 49		1			1			1				1		
carcin.	H7 / Xn	1	40	1					1								
reprod.	H 10 / T	0,5	60 61				1	1			1						
reprod.	H10 / Xn	5	62 63				1									1	
mutagen.	H11 / T	0,1	46					1			1						
mutagen.	H11 / Xn	1	40	1					1								

Testing against the quantified properties in the hazardous waste directive ⇔ all values below statutory limits

Type of hazard	0-1 m	2-3 m	4-5 m	6-7 m	8-9 m	11-12 m	13-14 m	15-16 m	16-17 m	Upper limit
Highly toxic	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*0,1*
Toxic	0,05	0,06	0,06	0,04	0,03	0,04	0,04	0,03	0,03	*3*
Harmful	0,19	0,23	0,21	0,21	0,15	0,18	0,19	0,17	0,15	*25*
Corrosive	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*1*
Corrosive	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*5*
Irritant	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*10*
Irritant	0,05	0,05	0,05	0,04	0,03	0,03	0,03	0,03	0,03	*20*
Carcinogenic	0,01	0,01	0,02	0,01	0,01	0,01	0,01	0,01	0,01	*0,1*
Carcinogenic	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*1*
Toxic f repr	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	*0,5*
Toxic f repr	0,04	0,04	0,05	0,04	0,02	0,03	0,03	0,02	0,02	*5*
Mutagenic	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*0,1*
Mutagenic	0,04	0,04	0,05	0,04	0,02	0,03	0,03	0,02	0,02	*1*
Highly toxic	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	*0,1*

Substance that can form another substance, H13

- Actually already considered in the selection of reference substances
- Formation of eluant remains
- Smallest volume of eluant corresponds to field capacity, i e 20 – 50 %, we use 20 %
- Practical to use already available data, i e leach data for L/S 10
- Pessimistic to convert content to volume of field capacity
- Seldom problem since leach rates (on aged ashes) usually very low

H14 Ecotoxic

- Not quantified in Directive on Hazardous waste & corresponding Swedish regulations
- Requiurement on fulfillment regardless
- Impossible to meet requirements that do not exist
- In Sweden, there exists no legal basis to request from Swedish subjects to obey other than Swedish legislation & regulation
- Exceptions exist (EU ordinances) but do not apply in the present case

What can we do about H 14 ecotoxic?

- Policy among the stake holders to protect health & environment, and to conserve resources ⇔ case for volontary assumption of responsibility
- However, not acceptable to (attempt to) issue regulations [only for competent Authorities to do]
- Possible to refer to basis legislation, e g EIS requirements in the *Environmental Code*
- Possible to make comparisons with other regulations
  - so that any classification does not become unreasonable in comparison
  - essential that differences in character are considered

Ecotoxic, H14, Analysis according to the *Environmental Code*

- According to Swedish implementation of the Directive of hazardous waste: applies mainly to handling of the waste
- Difficult to identify scenarios where handling gives rise to long-term ecotoxic effects
- ”Best” example so far is lorry accident on bridge over streaming water. However, worst effect for driver ⇔ avoided anyway.
- Difficult to make generic assessment of effects at final destination & will be done anyway on a case by case basis

Ecotoxic, H 14, comparison with regulations for chemical substances

- Quantified criteria never stricter than what gives rise to labelling with symbol of danger
- For ecotoxic => summed content of 25 g/kg
- There exists another limit for labelling with risk phrases – summed content 2,5 g/kg

- Not applied <= not reasonable to apply stricter limits for volontary & unquantified criterion compared to quantified
- *Swedish Environmental Protection Agency* has recently expressed view to the contrary when asked in a specific case

Present situation

- Knowledge available at present indicates that application of 25 g/kg limit in combination with reference substances & above methodology may well correspond to 0,25 % limit for actual substances
- <= e g much lower actual leach rates than what corresponds to reference substances
- Cannot be proven at present, however
- Dialogue between Swedish EPA and the Forestry Board since the latter request that ash returned to the forest must contain 1 – 7 g/kg zinc (figured as elementary Zn)
- Dialogue also since 2,5 g/kg limit in combination with above methodology => even most pure bioashes become hazardous waste

Present situation, continued

- International work in Europe on ecotoxic testing
- It can be feared that there may be several years before results exist & are implemented in practical use
- Work is underway in Sweden for more accurate but still conservative assessments of reference substances
- Presently unclear to what extent we are able to live up to requirements on conservation

Ongoing work

- Actual leach rate for Zn in ash << than for its present reference substance ZnO
- Franklinite, $ZnFe_2O_4$, is a more likely form presently under investigation
- Recently, also CuO became ecotoxic

=>Review of reference substances & classification methodology

Comments

- There is a need for robust assessments which can find broad acceptance
- They should not be sensitive to individual judgement
- This is especially important for ecotoxicity since there are no numerical limits in this case

=> Need for international communication, co-operation & network formation

- Anyone interested please contact any of the authors
- Their addresses & this presentation available at www.tekedo.se/CIWM06

EXEMPLE FOR US

Charles-Louis de Secondat Montesquieu, baron de la Brède et de Montesquieu

French author and political philosopher

1689 - 1755

The best is the worst enemy of the good