ARITMA ÇAMURLARININ İŞLENMESİ
VE
BERTARAF YÖNTEMLERİ
EĞİTİM SEMİNERİ

İZMİR 17-18 Şubat 2005

ARITMA ÇAMURLARININ BERTARAFINDA KİREÇ KULLANIMI

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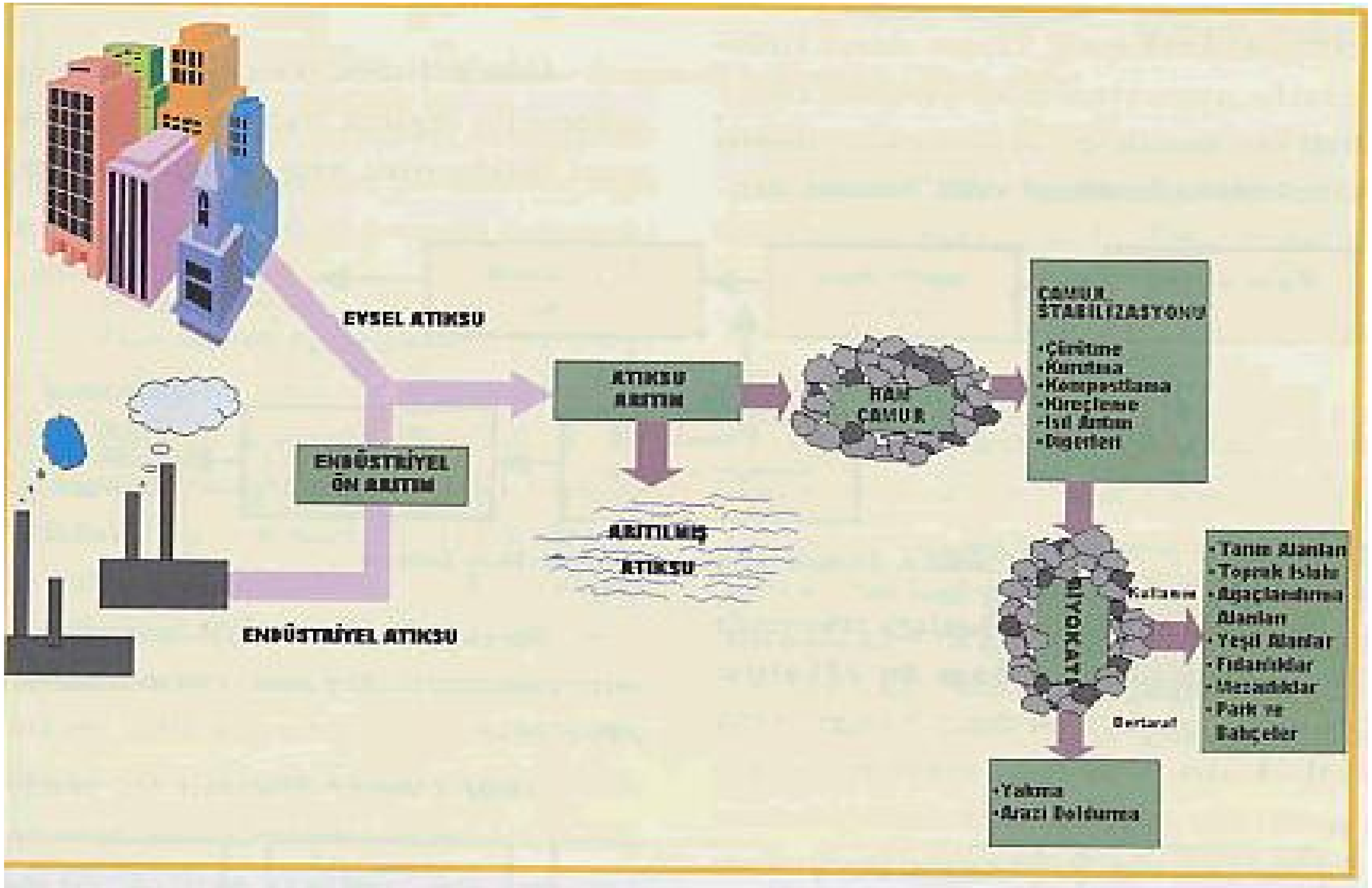
Ege Biyoteknoloji Ticaret ve Sanayi A.Ş.
Yönetim Kurulu Başkanı

GENEL

- Gün geçtikçe, “Sürdürülebilir bir kalkınma ve yaşanabilir bir çevre” için ekolojik dengenin korunması adına arıtma tesisi sayısı artmaktadır.
- Arıtma tesisi sayısı arttıkça oluşacak çamurun, sağlıklı, ekonomik bir şekilde bertarafı ve değerlendirilmesi ön plana çıkmaktadır.
- Arıtma çamurlarına sadece kurtulunması gereken bir sorun olarak bakılması bazı gerçekleri atlamak olur.
- Yüksek konsantrasyonlarda organik madde içeren bu maddeyi, “*geri değerlendirilebilir katı atık*” olarak algılamak gerekir.

BİYOKATI OLUŞUMU



KİREÇ İLE STABİLİZASYON

Temel amaç, pH değerinin istenen süreler için 12 den daha büyük kalmasının sağlanmasıdır.

Buna ek olarak sıcaklık için de belli koşulların öngörüldüğü uygulamalar da vardır.

İşlemde sönmüş kireç kullanılabileceği gibi, sönmemiş kireç de Kullanılabilir ve bu durumda, açığa çıkacak ısıdan yararlanılarak Kismi bir kurutma ve etkili bir pastörizasyon işlemi de gerçekleştirilebilir.

Uygulamada üç metot kullanılmaktadır.

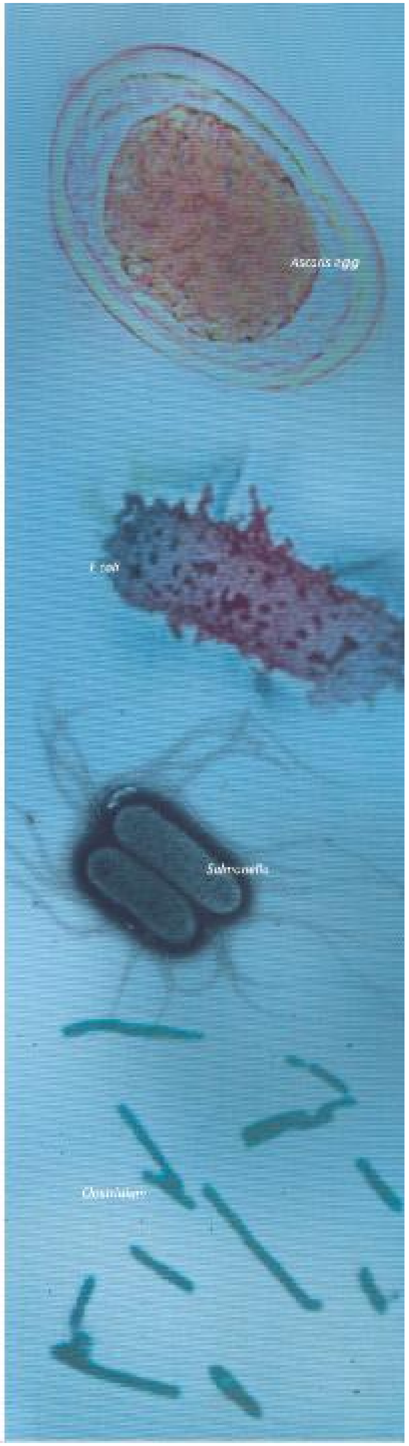
1. Susuzlaştırmadan önce çamura kireç ilavesi
   (kireç ile ön arıtım)

2. Susuzlaştırmadan sonra çamura kireç ilavesi
   (kireç ile son arıtım)

3. İleri kireç stabilizasyon teknolojileri

LIMING FOR SANITISATION

Liming : an advanced treatment for sewage sludge applied to land



European Lime Association
Association européenne de la Chaux
Europäischer Kalkverband

LIMING IS AN ADVANCED SLUDGE TREATMENT

Advanced Treatment

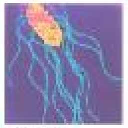
"Advanced Treatment" is a European Union designated term for the level of treatment which sanitises sludge by reducing the number of micro organisms to a negligible level.

CEN-EN 12832

Sanitized (hygienised) sludge : sludge which has been treated for inactivation of parasites and pathogens or has decreased their numbers below a specific level.

Protection of human health and the environment

The recycling of treated sludge to land is the preferred EU solution. In this context, lime treatment provides a safe and environmentally friendly material suitable for land spreading as a valuable fertiliser and soil conditioner. After advanced treatment, limed sludge may be applied as an exogenous organic matter with minimal restrictions.



Salmonella

Validation procedure

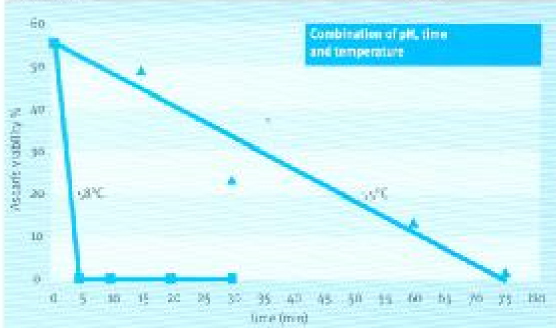
The sanitisation performance is validated when parasites (*Ascaris* eggs) and bacteria (*Salmonella*) are reduced to a negligible level.

Recent scientific research

Ascaris egg

International scientific research provides evidence that lime treatment reduces most bacteria, viruses and even one of the most resistant parasites, *Ascaris* eggs, to a negligible level. These results were based on the effects of high pH or high temperature from the lime/sludge reaction over a period of time. Recent laboratory and industrial scale research concentrated on the effects of the combination of high pH and high temperature from the quicklime/sludge reaction. It proved that at a high pH, but at a lower combination of time/temperature than earlier research had determined, *Ascaris* eggs are reduced to a negligible level.

Effect of time and temperature on the viability of Ascaris eggs in sludge treated with quicklime on an industrial scale. A pH > 12 due to the presence of the quicklime is maintained throughout the treatment.



Conclusion of scientific experts

Applying the precautionary principle, the scientific experts recommend the following operating conditions for sludge sanitisation with lime :

"Conditioning sludge with lime, reaching a homogeneous mixture at a pH of 12 or more and maintaining either a temperature of at least 55°C for 75 minutes or any other validated time/temperature equivalent"

or

"Conditioning with lime reaching and maintaining a pH of 12 or more for three months".

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Prof. Rebecca Stott - *Research Associate / Tropical Parasitology - Dept. Civil Engineering - University of Portsmouth (United Kingdom)*

THE LIME PROCESS

Principle

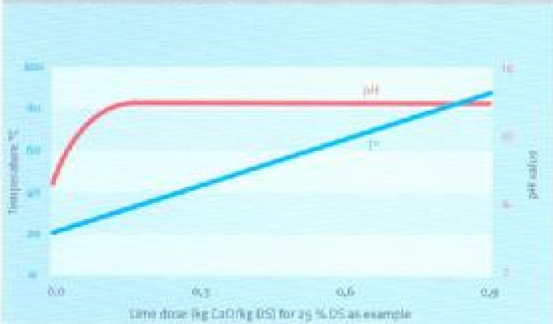
process based on:

- **temperature**
  the exothermic reaction during lime slaking
  CaO + H_2O → $Ca(OH)_2$ + 1,140 kJ/ kg CaO
  (quicklime) + (water) → (hydrated lime) + (heat)

- **pH**
  the alkalinity of $(OH)^-$ present in the hydrated lime
  1 kg of CaO generates 0.607 kg (OH)

In a homogeneous mixture, the quicklime reacts with the moisture present in the sludge. In doing so, the CaO combines with 32% of it's own weight of water thus causing a significant drying effect and a temperature increase.

Example of temperature and pH increase on addition of quicklime to sludge at 25% DS



Typical quicklime addition for advanced treatment

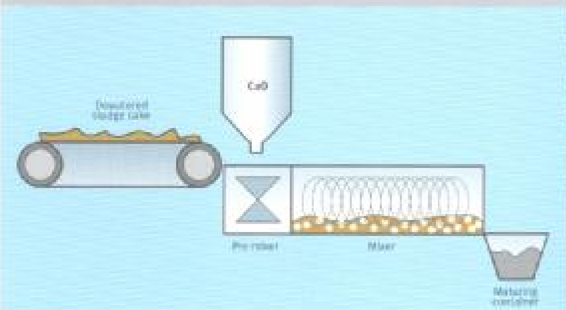
- addition of 50-90%* CaO per unit of dry solids (DS) gives a treated sludge at >55 °C and pH >12 for 75 minutes
  ** depending on DS contents*

- addition of 20-40%** CaO or equivalent quantity of $Ca(OH)_2$ per unit of dry solids (DS) gives a treated sludge at pH >12 for >3 months
  *** depending on sludge buffering capacity*

Industrial flow sheet

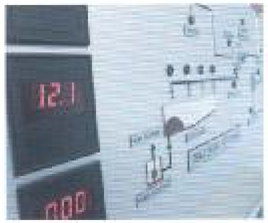
The sludge and lime shall be thoroughly mixed in order to achieve a homogeneous mixture.

Example of a typical lime treatment plant



ADVANTAGES OF LIME TREATMENT

- achieves up to 6 log reduction of pathogens
- stabilises sludge with no risk of pathogen regrowth
- eliminates odour, reduces vector attraction
- low investment costs, small area required for plant
- simple to run, easily automated, available as mobile plant
- converts sewage sludge into a biosolid product
- increases the dry solids content, improves structure, handling properties and spreadability
- adds calcium hydroxide and organic matter to improve the soil structure, enhances growth environment in the soil
- maintains nutrients bio availability



Easy to monitor

Compact plant size

Easy to spread

Improves structure and handling properties

Efficient agronomic value

Typical properties of lime treated sludge (% on dry contents)

N	P_2O_5	K_2O	CaO	MgO	O.M.*	C/N
3.3	3.3	0.3	22.3	0.6	46	5.7

* Organic Matter

Advanced treated sludge : biosolid ready for use

With compliments

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KİREÇ NEDİR?

Kireç, doğada kireçtaşı veya kalker ($CaCO_3$) olarak bulunan kayaçların - belli ebatlara indirgendikten sonra - fırınlarda yakılmasıyla elde edilir.

Kalsinasyon

Kireçtaşı + Isı —> Kireç (sönmemiş) + Karbondioksit

$CaCO_3$ + 900°C —> CaO + CO_2

(100 g) (42 400 cal) —> (56 g) (44 g)

Elde edilen sönmemiş kireç, higroskopik özelliklere sahiptir ve suyla reaksiyona sokularak toz halindeki sönmüş kireçe dönüştürülür:

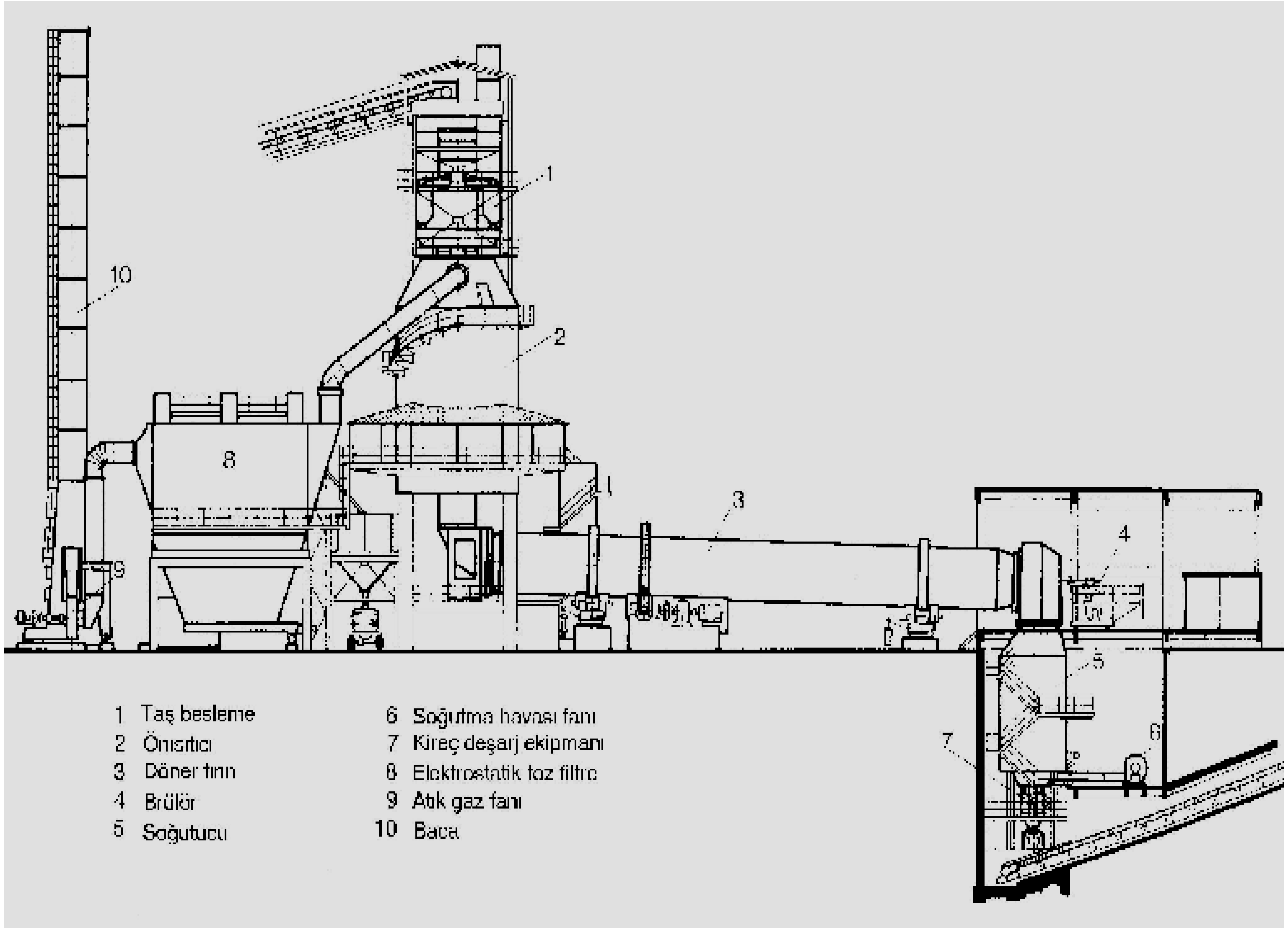
Hidratasyon

Sönmemiş Kireç + Su —> Sönmüş kireç + Isı

CaO + H20 —> $Ca(OH)_2$

(56 g) (18 g) —> (74 g) (15 456 cal)

KİREÇ FIRINI – ŞAFT ÖN ISITMA & DÖNER FIRIN



AB ÜLKELERİNDEKİ DURUM

Directive 86/278/EEC on sewage sludge

Table 5: Total sludge production and quantities used in agriculture in the reporting period 1998-2000

Member State		Sludge produced (tonnes of dry matter)			Sludge used in agriculture (tonnes of dry matter)						Surface covered (hectares)		
		1998	1999	2000	1998	%	1999	%	2000	%	1998	1999	2000
A	Austria	399 188	406 696	401 867	43 518	11%	38 698	10%	40 455	10%			
B	Wallonia Region	15 836	17 967	18 228	13 042	82%	9 504	53%	10 733	59%	-	-	-
	Flemish Region[139]	63 919	76 699	80 708	16 006	25%	5 410	7%	0	0			
D	Germany	2 228 029	2 263 843	2 297 460	842 497	38%	861 631	38%	858 801	37%	-	--	-
DK	Denmark	153 780	155 621	-	96 200	62%	95 500	61%	-		23 649 ha/ 3 years	22 920 ha/ 3 years	-
E	Spain	716 145	784 882	853 482	353 986	49%	413 738	53%	454 251	53%			
EL	Greece	59 320	60 135	66 335	0		0		0				
F	France	858 000	855 000	-	554 000	65%	552 000	65%	-		176 000 (estimate)	176 000 (estimate)	-
FIN	Finland	158 000	160 000	160 000	23 000	14%	23 000	14%	19 000	12%	-	-	-
I	Italy[140]	717 776	728 280	779 220	194 811	27%	164 698	23%	217 805	28%	12 977	5 167	15 711
IRL	Ireland	37 595	38 551	35 039	5 238	14%	8 734	23%	14 109	40%	-	-	-
L	Luxembourg	-	7 000	-	-		5 600	80%	-		-	1 870	-
NL	Netherlands[141]	220	242	-	34	15%	36	15%	45	-			
P	Portugal	121 138 (estimate)	374 147 (estimate)	238 680 (estimate)	41 413	34%	66 547	18%	37 176	16%	-	-	-
S	Sweden[142]	221 000	221 000 (estimate)	220 000 (estimate)	56 000	25%	56 000 (estimate)	25%	35 000 (estimate)	16%	13 000 (estimate)	13 000 (estimate)	8 000 (estimate)
UK	United Kingdom	1 045 150	1 105 918	1 066 176	502 200	48%	554 924	50%	584 233	55%	-	-	-

139 No sludge from urban waste water treatment plants has been used in agriculture since 1 December 1999 because it has not been possible to keep to the VLAREA requirements.

140 Data not complete for all Regions.

141 Municipal sludge has not been used in agriculture since 1995. The values given here therefore relate only to sewage sludge produced by private facilities.

142 Data on surface covered are based on the assumption that 4.3 tonnes of sludge are spread per hectare every six years, corresponding to about 120 kg P/ha every six years.

ARITMA ÇAMURLARININ KİREÇLE STABİLİZASYONU UYGULAMALARININ AB ÜLKELERİNDEKİ DURUMU

COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 11.7.2003
COM(2003) 250 final/3

CORRIGENDUM
Annule et remplace le point 3.3 (Autosuffisance en matière d'élimination des déchets - Article 5- concerne la Finlande) ainsi que le tableau 3.1 du document COM(2003)250 du 19.5.2003
Concerne toutes les versions.

REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

ON THE IMPLEMENTATION OF COMMUNITY WASTE LEGISLATION
Directive 75/442/EEC on waste,
Directive 91/689/EEC on hazardous waste,
Directive 75/439/EEC on waste oils,
Directive 86/278/EEC on sewage sludge and
Directive 94/62/EC on packaging and packaging waste

FOR THE PERIOD 1998-2000

INTRODUCTION

This report intends to inform the other Community Institutions, Member States and the interested public of the implementation of waste legislation for the period 1998 to 2000, in particular the implementation of

- Directive 75/442/EEC[1] on waste
- Directive 91/689/EEC[2] on hazardous waste (replaced Directive 78/319/EEC)
- Directive 75/439/EEC[3] on the disposal of waste oils
- Directive 86/278/EEC[4] on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture
- Directive 94/62/EC[5] on packaging and packaging waste

It has been drafted according to Article 5 of Directive 91/692/EEC[6] standardising and rationalising reports on the implementation of certain Directives relating to the environment. The Commission has already published a report on the implementation of Directives 75/442/EEC, 91/689/EEC, 75/439/EEC and 86/278/EEC for the period 1995 to 1997[7], as well as a report for the period 1990-1994[8].

Under Directive 91/692/EEC Member States are required to submit reports, drawn up on the basis of questionnaires. Questionnaires relating to Directives 75/439/EEC, 75/442/EEC and 86/278/EEC were adopted by Commission Decision 94/741/EC[9] of 24 October 1994. Questionnaires relating to Directives 91/689/EEC and 94/62/EC were adopted by Commission Decision 97/622/EC[10] of 27 May 1997.

Directive 91/692/EEC requires the Commission to publish a consolidated report. The aim of this Community report is to enable Member States and the Commission to assess the progress made in implementing the waste management Directives throughout the Community and, at the same time, provide the general public with information on the state of the environment.

The report is primarily based on information received from Member States; as such, its content depends largely on the completeness, quality and precision of the national contributions. As regards in particular the legal cases mentioned in the report, updated information has been included which is subsequent to the reporting period 1998-2000.

According to Directive 91/692/EEC Member States had to submit their reports by 30 September 2001. The reports from Austria, Germany, Denmark, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Sweden, the Netherlands and the UK were transmitted between November 2001 and February 2002. Reports from the 3 regions of Belgium were

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1 OJ L 194, 25.07.1975, p. 47 as amended by Directive 91/156/EEC (OJ L 78, 18.03.1991, p. 32)
2 OJ L 377, 31.12.1991, p. 20
3 OJ L 194, 25.07.1975, p. 31 as amended by Directive 87/101/EEC (OJ L 42, 22.12.1986, p. 43)
4 OJ L 181, 04.07.1986, p. 6
5 OJ L 365, 31.12.1994, p. 10
6 OJ L 377, 23.12.1991, p. 48
7 COM (99) 752 final of 10.01.2000
8 COM (97) 23 final of 27.02.1997
9 OJ L 296, 17.11.1994, p. 42
10 OJ L 256, 19.9.1997, p. 13

The **United Kingdom** reports 10 sites where the normal limits for all metals may be exceeded in accordance with Annex I C, footnote 1. It is generally land adjoining waste water treatment plants which was once used as a sewage farm. The total surface area of this sites (estimated) is 2 516 hectares.

3.7. Description of the technologies employed for treating sludge – Article 6

According to Article 6 (without prejudice to Article 7) sludge shall be treated before being used in agriculture. Member States may nevertheless authorise, under conditions to be laid down by them, the use of untreated sludge if it is injected or worked into the soil.

In **Austria** the treatments applied are simultaneous stabilisation, separate anaerobic stabilisation and aerobic stabilisation (not heated), mesophilic anaerobic and aerobic stabilisation, thermophilic aerobic stabilisation, liming composting and drying.

In the Wallonia Region of **Belgium** sludge is digested, aerobically stabilised, mechanically dried, thermally dried or conditioned with lime or polyelectrolites. In the Flemish Region the following technologies are employed: aerobic stabilisation, mesophilic anaerobic stabilisation, cold fermentation, thermal drying, and lime stabilisation.

In **Denmark** the following technologies are employed for treating sludge: stabilisation (anaerobic stabilisation by fermentation in heated digester or treatment in a bioreactor; aerobic stabilisation by sludge aeration and composting under conditions where the temperature is not controlled; chemical treatment by addition of lime), controlled composting (composting with daily measurement of temperature so that all material is subject to a temperature of 55°C as a minimum for two weeks), and controlled sanitisation (treatment in reactor which ensures a temperature of 70°C as a minimum for one hour).

In **Greece** only small quantities of sludge have been used in agriculture so far. Research programmes concerning the treatment of sludge and its use in agriculture are being conducted in various areas of the country. Methods for sludge treatments are being examined in these research programmes.

In **Finland** sludge undergoes anaerobic digestion, is stabilised by aeration or lime conditioning, or it is composted.

In **France** sludge is subject to prolonged aeration, aerobic or anaerobic stabilisation, lime conditioning, composting, or thermal drying.

In **Germany** different technologies are applied such as anaerobic digestion, aerobic stabilisation, lime conditioning, etc. Normally a combination of these techniques is used for sludge treatment.

In **Italy** the most common treatments are aerobic digestion (including composting), anaerobic digestion, mechanical dewatering, thermal drying, chemical treatment with alkali. Aerobic digestion is normally carried out on small sized plants up to 50,000 population equivalent (p.e.), while anaerobic digestion is for plants bigger than 50,000 p.e.

In **Ireland** sludge is either dewatered on filter tables and stored for 6 months, or undergoes anaerobic digestion.

In **Luxembourg** sludge is digested and then conditioned with lime or iron salts. Mechanical devices are used for dewatering. Polyelectrolites are added to sludge which is not conditioned with lime in order to facilitate dewatering.

In the **Netherlands** sewage sludge must be treated by biological, chemical or thermal means, by long-term storage or any other suitable methods which has killed off most of the pathogenic organisms in the sludge.

In **Portugal** the technologies employed are drying beds (drainage on sand beds and evaporation of humidity), thickening, mechanical dehydration (band filters, filter presses, vacuum filters or centrifugal machines) and various stabilisation processes.

In **Spain** anaerobic digestion, long-term storage and composting are the most widely used techniques.

In **Sweden** the following techniques are used: thickening (gravity thickening, flotation), stabilisation (anaerobic, aerobic, lime), conditioning, dewatering (centrifuge, filter belt press, air drying), thermal drying and composting.

In the **United Kingdom** the technologies employed are mesophilic and thermophilic anaerobic digestion, composting, lime stabilisation, liquid storage, dewatering and storage, thermal drying.

3.8. As regards the frequency of analysis – Annex II A, paragraph 1:

According to Article 6(b) sewage sludge producers shall regularly provide users with all the information referred to in Annex II A (sludge analysis)

In **Austria** the frequency of analysis depends on the Land. It is linked to the size of the treatment plant and varies from every two months for plants treating more than 30,000 p.e. in Styria to every three years for plants up to 500 p.e. in Carinthia.

In the Wallonia Region of **Belgium** the frequency of analysis is linked to the size of the treatment plant, i.e. one analysis per year for a plant treating less than 5 000 population equivalent (p.e.), up to one analysis per month for plants larger than 100 000 p.e. In the Flemish Region four analyses per year have to be carried out.

In **Denmark**, **Greece**, **Ireland**, **Portugal**, **Spain** and the **United Kingdom** the same requirements as in the Directive apply.

In **Finland** the frequency of analysis is linked to the size of the treatment plant, i.e. one analysis per year for a plant treating less than 200 p.e., up to one analysis per month for plants larger than 100 000 p.e. These frequencies can be relaxed when the quality of the incoming water does not change in time.

In **France** the frequency of analysis varies from twice a year for small plants to once a week for the biggest plants.