Department of the Environment

Code of Practice For Agriculture Use Of Sewage Sludge

CONTENTS **Page**

INTRODUCTION

This Code of Practice applies to the use of sewage sludge on agricultural land in the United Kingdom, and replaces the guidance set out in the Report of the Sub-Committee on the Disposal of Sewage Sludge to Land (DOE/NWC Report No. 20, 1981). The Code has been prepared to complement the Sludge (Use in Agriculture) Regulations 1989 (SI 1989, No. 1263) covering Great Britain, and the Sludge (Use in Agriculture) Regulations (Northern Ireland) 1990 (SR 1990, No. 245), which enforce the provisions of the EC Directive 86/278/EEC, on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture. Its recommendations are based upon the best available scientific evidence and are in conformity, where relevant, with the requirements of the Regulations.

Advice to farmers on the use of sewage sludge is available in England and Wales from ADAS and in Scotland from the Scottish Agricultural Colleges (SAC).

The main changes in this second edition of the Code of Practice are:

- A reduction in the recommended maximum concentration of zinc; and

- A reduction in the recommended maximum concentration of cadmium when sewage sludge is applied to grass managed in rotation or grown for conservation.

The changes, which are included in Tables 4 and 5, follow the recommendations of the independent Scientific Committee, which considered the soil fertility aspects of the 1989 Sludge Regulations and the first edition of this code.[1]

For the purpose of this Code of Practice sewage sludge is defined as residual sludge from sewage plants treating domestic or urban waste waters.

[1] Report of the Independent Scientific Committee, entitled 'Review of the rules for sewage sludge application to agricultural land – soil fertility aspects of potentially toxic elements' (1993) is available from MAFF Publications, London SE99 7TP. Reference PB 1561.

1. GENERAL

1.1 Objectives

The Code is designed to ensure that when sludge is used in agriculture:

a) There is no conflict with good agricultural practice;
b) The long term viability of agricultural activities is maintained;
c) Public nuisance and water pollution are avoided; and
d) Human, animal or plant health is not put at risk.

1.2 Benefits

Sewage sludge contains significant proportions of nitrogen, phosphorus and organic matter. It can supply a large part of the nitrogen or phosphorus requirements of most crops. In order to maximise the benefits of these nutrients, sludge should be applied as close as possible to the time when crops can utilise them and to an extent that takes account of the needs of the crops.

The availability to plants of the phosphorus content of sewage sludge in the year of application is about 50% and is independent of any treatment process to which the sludge has been subjected.

Availability of the nitrogen in sewage sludge is more dependent on treatment process. Untreated liquid sludge and dewatered treated sludge release nitrogen slowly and the benefits to crops are realised over a relatively long period. Liquid anaerobically digested sludge has a high ammoniacal nitrogen content, which is readily available to plants and can be of particular benefit to grassland.

The organic matter content of sludge can improve the water retaining capacity and structure of some soils, particularly when applied in the form of dewatered sludge cake.

1.3 Constraints

Sewage sludge is the residue collected after treatment of the contents of urban drainage systems. The bulk of its content derives mainly from human wastes, but there are significant contributions from discharges to sewer of industrial effluents and animal or vegetable processing wastes as well as from run-off of storm water from roads and other paved areas. In addition to organic waste material sludge therefore contains traces of many of the contaminating substances used in our modern society. Some of these substances can be phytotoxic and some toxic to humans or animals at certain concentrations in the soil or in food. Where sludge is used in agriculture, it is therefore necessary to monitor and control the concentrations in the soil of these potentially toxic elements (PTE), and their rate of application to the soil, so as to preserve the yield of crops and to ensure that animal or human health is not put at risk through the food chain. For fluoride and lead, concentrations in the sludge must also be limited, so that grazing animals are not adversely affected by its ingestion.

Sludge also contains pathogenic bacteria, viruses and protozoa together with other parasites which could creates a potential hazard to the health of humans, animals and plants. The numbers of pathogenic organisms in sludge can be substantially reduced before application to the land by appropriate sludge treatment processes (see Section 2) and the potential health hazard is further reduced by the effects of the weather and soil micro-organisms after the sludge is applied to the soil. For certain crops further constraints on planting, grazing and harvesting may be necessary (see Section 5).

Potential land operational and environmental problems should be identified and current or proposed agricultural operations appraised before sludge is used in agriculture. Caution should be exercised where there are unresolved animal health problems or where there is significant mineral imbalance in soil, crops or livestock. Dewatered sludge should not be considered for use on the surface of grassland unless it has been composted or stored long enough to break down to a finely divided material which when spread is not readily available for direct ingestion by livestock. Care must be taken to ensure that there is no risk of pollution of ground or surface waters as a result of spreading sludge on agricultural land.

Other matters to be taken into account are local road conditions, prevailing weather and soil type so that public nuisance from smell or heavy traffic is minimised and there is no risk of damage to soil structure by untimely application or use of unsuitable spreading equipment.

2. SLUDGE TREATMENT

2.1 General

Except when it is to be injected or otherwise worked into the soil so as not to cause nuisance, sludge must be subjected to biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use before being used in agriculture. Examples of treatment processes which will satisfy these requirements are listed in Table 1. In this context the contents of septic tanks and sludges from secondary biological treatment such as humus sludge, surplus activated sludge and residual sludge from extended aeration plants, cannot be considered to be biologically treated.

2.2 Pathogens

Amongst organisms of most concern to be found in sludge are salmonellae, the eggs of the beef tapeworm *Taenia saginate*, potato cyst nematodes and a range of viruses. Treatment of sludge by the processes listed in Table 1 will significantly reduce the potential health hazard posed by the first three types and that of many of the viruses, which can be present in sludge.

Table 1. Examples of effective sludge treatment processes

Process	Descriptions
Sludge Pasteurisation	Minimum of 30 minutes at 70°C or minimum of 4 hours at 55°C (or appropriate intermediate conditions), followed in all cases by primary mesophilic anaerobic digestion.
Mesophilic Anaerobic Digestion	Mean retention period of at least 12 days primary digestion in temperature range 35°C±3°C or of at least 20 days primary digestion in temperature 25°C±3°C followed in each case by a secondary stage which provides a mean retention period of at least 14 days.
Thermophilic Aerobic Digestion	Mean retention period of at least 7 days digestion. All sludge to be subject to a minimum of 55°C for a period of at least 4 hours.
Composting (Windrows or Aerated Piles)	The compost must be maintained at 40°C for at least 5 days and for 4 hours during this period at a minimum of 55°C within the body of the pile followed by a period of maturation adequate to ensure that the compost reaction process is substantially complete.
Lime Stabilisation of Liquid Sludge	Addition of lime to raise pH to greater than 12.0 and sufficient to ensure that the pH is not less than 12 for a minimum period of 2 hours. The sludge can then be used directly.
Liquid Storage	Storage of untreated liquid sludge for a minimum period of 3 months.
Dewatering and Storage	Conditioning of untreated sludge with lime or other coagulants followed by dewatering and storage of the cake for a minimum period of 3 months. If sludge has been subject to primary mesophilic anaerobic digestion, storage to be for a minimum period of 14 days.

3. MONITORING OF SLUDGE AND SOIL QUALITY

3.1 Sludge Quality

The effects on sludge quality of current trade effluent inputs to sewer should be taken into account. The impact of new trade effluent discharges on sludge quality should be assessed before trade effluent consents are granted. Trade effluents from metal finishing, electronics and similar industries can make a substantial contribution to the PTE content of sludge. Abattoirs and other animal processing plants are likely to be significant sources of pathogens. Industries such as those producing chemicals or treating carpet materials are examples of potential sources of organic contaminants.

For routine monitoring purposes it is not practicable to set numerical limits for the microbiological quality of sludge. However, where there are significant discharges to sewer of wastes from animal or poultry processing plants, on veterinary advice it may be necessary as an added safety measure to analyse such sludge periodically (after treatment) in respect of its microbiological quality. It is essential that the physical parameters relevant to control of sludge treatment processes such as described in Table 1 be carefully monitored to ensure that the processes are operating efficiently.

Where there are discharges to sewer of industrial wastes containing significant quantities of synthetic organic contaminants, or resulting from the processing of hides imported from countries where anthrax is endemic, the sludge should not be used in agriculture before the sludge producer has obtained specialist advice.

3.2 Sludge Sampling and Analysis

Sludge must be regularly analysed for the parameters listed in Table 2. It is necessary to do this in respect of those parameters subject to the provisions of Directive 86/278/EEC at least once every 6 months and every time significant changes occur in the quality of the sewage treated at the works. The frequency of analysis in respect of the remaining parameters may be reduced to not less than once in five years provided that their concentrations in the sludge are consistently no greater than the reference concentrations listed in Column 3 of Table 2. Recommended methods of sampling and analysis for the parameters in Table 2 are listed in the Appendix.

Table 2 Sludge analysis parameters

Parameter	Methods of analysis SCA No (see Appendix)	Reference concentrations
Dry matter (%)	-	
Organic matter (% dry solids)	83	
pH	7	
Nitrogen total and ammoniacal (% dry solids)	91	
Phosphorus total (% dry solids)	91	
Zinc (mg/kg dry solids)	93	
Copper (mg/kg dry solids)	93	
Nickel (mg/kg dry solids)	93	
Cadmium (mg/kg dry solids)	93	
Lead (mg/kg dry solids)	93	
Mercury (mg/kg dry solids)	10,92	
Chromium (mg/kg dry solids)	93	
*Molybdenum (mg/kg dry solids)	70	3
*Selenium (mg/kg dry solids)	99	2
*Arsenic (mg/kg dry solids)	99	2
**Fluoride (mg/kg dry solids)	62	200

*These parameters are not subject to the provisions of Directive 86/278/EEC

3.3 Soil Sampling and Analysis

Before first use of sludge on agricultural land and at least every twentieth year while sludge is being used on the site, the soil on the site must be sampled and analysed to determine its pH value and the concentrations of the elements listed in Table 3. The samples for analysis should be representative of the soil on the site and at least one sample must be prepared for every 5 hectares of the site. In order to comply with the Sludge (Use in Agriculture) Regulations 1989 these samples must be taken to a depth of 25 cm or to the depth of the soil if less. Where sludge has been used on a site prior to the coming into force of these Regulations sludge applications may be continued without taking a 25 cm deep sample provided adequate scientific information is available to estimate for the soil the value of the parameters listed in Table 3 (i.e. the quality of the soil and of the added sludge have previously been monitored and recorded). However the soil must be sampled to 25 cm for analysis

not later than 31 December 1991 if sludge applications are to continue after that date. Recommended methods of sampling and analysis are listed in the Appendix.

In the UK, the normal depth of cultivation of arable soils is 20 cm, and it is agricultural practice when assessing soil quality to take samples to a depth of 15 cm, except in grassland, where 7.5 cm deep samples are taken. For operational purposes monitoring samples subsequent to the first statutory sample should be taken in accordance with this practice, except when additional samples are required for statutory purposes. Where sludge is applied by injection, sampling should be carried out to the depth of injection. Subject to the overriding statutory requirements, the frequency of subsequent sampling and the range of elements for which analysis is needed should take account of the initial concentrations of PTE in the soil, the quality and quantity of sludge applied and other relevant factors. In this connection it is essential that account be taken by the sludge producer of the quantity and quality of materials other than the producer's sludge, which have been used on the site by the farmer.

Table 3 Soil analysis parameters

Parameter		**Methods of analysis SCA No (see Appendix)**
pH		7
Zinc	(mg/kg dry solids)	93
Copper	(mg/kg dry solids)	93
Nickel	(mg/kg dry solids)	93
Cadmium	(mg/kg dry solids)	93
Lead	(mg/kg dry solids)	93
Mercury	(mg/kg dry solids)	10,92
Chromium	(mg/kg dry solids)	93
*Molybdenum	(mg/kg dry solids)	70
*Selenium	(mg/kg dry solids)	99
*Arsenic	(mg/kg dry solids)	99
**Fluoride	(mg/kg dry solids)	62

* These parameters are not subject to the provisions of Directive 86/278/EEC)

4. POTENTIALLY TOXIC ELEMENTS

4.1 Soil Limits and Permitted Rates of Application

Except for dedicated sites (see 4.5) the PTE concentrations in arable soils sampled at 15 cms or 25 cms depth as set out in section 3.3 must not exceed the limits in Table 4 as a result of sludge applications, and no sludge should be applied to any site where the soil concentration of any of the elements, with the exception of molybdenum, is at or above these values. In addition, the ten-year average annual rates of application of these elements in sludge must not exceed those set out in Table 4.

Table 4 - Maximum permissible concentrations of potentially toxic elements in soil after application of sewage sludge and maximum annual rates of addition

PTE	Maximum permissible concentration of PTE in soil (mg/kg dry solids)				Maximum permissible average annual rate of PTE addition over a 10 year period (kg/ha)(2)
	pH 5.0<5.5	pH 5.5<6.0	pH 6.0-7.0	PH(3) >7.0	
Zinc (1)	200	200	200	300	15
Copper (1)	80	100	135	200	7.5
Nickel	50	60	75	110	3
	For pH 5.0 and above				
Cadmium(1)	3				0.15
Lead (1)	300				15
Mercury	1				0.1
*Chromium	400				15
*Molybdenum(4)	4				0.2
*Selenium	3				0.15
*Arsenic	50				0.7
*Fluoride	500				20

* These parameters are not subject to the provisions of Directive 86/278/EEC. (In 1993 the European Commission withdrew its 1988 proposal to set limits for addition of chromium from sewage sludge to agricultural land).

(1) The permitted concentrations of zinc, copper, cadmium and lead are provisional and will be reviewed when current research into their effects on soil fertility and livestock is completed. The pH qualification of limits will also be reviewed with the aim of setting one limit value for copper and one for nickel across pH range 5.0<7.0 and therefore ensuring consistency with the approach adopted for zinc in response to the recommendations from the Independent Scientific Committee (MAFF/DOE 1993).

(2) The annual rate of application of PTE to any site shall be determined by averaging over the 10-year period ending with the year of calculation.

(3) The increased permissible PTE concentrations in soils of pH greater than 7.0 apply only to soils containing more than 5% calcium carbonate.

(4) The accepted safe level of molybdenum in agricultural soils is 4mg/kg. However there are some areas in UK where, for geological reasons, the natural concentration of this element in the soil exceeds this level. In such cases there may be no additional problems as a result of applying sludge, but this should not be done except in accordance with expert advice. This advice will take into account the molybdenum content of the sludge, existing soil molybdenum levels and current arrangements to provide copper supplements to livestock.

4.2 Application to Grassland

When sludge is applied to the surface of grassland, soil concentrations of PTE should be determined for representative samples taken to 7.5 cm depth. Except for dedicated sites and subject to the relaxation in respect of molybdenum these concentrations must not exceed the limits set out in Table 5 as a result of sludge application. The ten-year average annual rates of application of these elements must not exceed those set out in Table 4.

In order to minimise direct ingestion by livestock of lead, cadmium and fluoride, the addition of these elements in sludge to the surface of grassland in any year should not exceed three times the ten-year average annual rates specified in Table 4.

Care must be taken to ensure that increases in PTE concentrations in the top 7.5 cm layer of grassland soils do not result in concentrations in 15 cm or 25 cm deep samples in excess of the permitted limits set out in Table 4 (i.e. where natural soil concentrations of PTE are relatively high or there have been past metal additions to the soil.

Table 5: Maximum permissible concentrations of potentially toxic elements in soil under grass after application of sewage sludge when samples taken to a depth of 7.5 cm.

PTE	Maximum permissible concentration of PTE in soil (mg/kg dry solids)			
	pH 5.0<5.5	pH 5.5<6.0	pH 6.0-7.0	pH[2] >7.0
Zinc[1]	200	200	200	300
Copper[1]	130	170	225	330
Nickel	80	100	125	180
	For pH 5.0 and above			
Cadmium[1]	3			
Lead [1]	300			
Mercury	1.5			
• Chromium	600			
• Molybdenum[3]	4			
• Selenium	5			
• Arsenic	50			
• Fluoride	500			

*These parameters are not subject to the provisions of Directive 86/27/EEC. (In 1993 the European Commission withdrew its 1988 proposal to set limits for addition of chromium from sewage sludge to agricultural land.)

[1] The permitted concentrations of zinc, copper, cadmium and lead are provisional and will be reviewed when current research into their effects on soil fertility and livestock is completed. Until the research is completed, in cases where there is doubt about the practicality of ploughing or otherwise cultivating grassland, no sludge applications which would cause these concentrations to exceed the permitted levels specified in Table 4 should be made except in accordance with specialist agricultural advice. The pH qualification of limits will also be reviewed with the aim of setting one limit value for copper and one for nickel across pH range 5.0<7.0 and therefore ensuring consistency with the

approach adopted for zinc in response to the recommendations from the independent Scientific Committee (MAFF/DOE 1993).

(2) The increased permissible PTE concentrations in soils of pH greater than 7.0 apply only to soils containing more than 5% calcium carbonate.

(3)The accepted safe level of molybdenum in agricultural soils is 4 mg/kg. However there are some areas in UK where, for geological reasons, the natural concentration of this element in the soil exceeds this level. In such cases there may be no additional problems as a result of applying sludge, but this should not be done except in accordance with expert advice. This advice will take into account the molybdenum contents of the sludge, existing soil molybdenum levels and current arrangements to provide copper supplements to livestock.

4.3 Soil pH

Soil pH is a major factor affecting the availability of elements to plants. Crop damage from phytotoxic elements is more likely to occur on acid soils. The PTE in Tables 4 and 5 generally become less available to plants as soil pH increases except selenium and molybdenum whose availability increases with pH.

In order to ensure that plants are not adversely affected by zinc, copper and nickel in soils managed below pH 6.0, lower permissible soil concentrations are set in Tables 4 and 5 for these metals. In calcareous soils, defined as having pH greater than 7.0 and containing more than 5% calcium carbonate, the availability of these PTE to plants is lower and therefore higher soil concentrations are permitted. Sludge must not be applied to land which is managed with a pH less than 5.0.

For soils where the pH value determined for a representative sample is less than 5.2, the sludge producer should seek specialist agricultural advice before making sludge applications and thereafter should apply sludge only in accordance with that advice.

4.4 Sludge Concentration Limits

Except for applications to grassland no limits have been set for PTE concentrations in sludge used in agriculture. Sludge to be surface applied to grassland should not contain lead or fluoride individually in excess of 1200 and 1000 mg/kg dry solids respectively.

4.5 Dedicated Sites

The constraints on sludge applications expressed by the limitations specified in Tables 4 and 5 do not apply to sites which on 17 June 1986 were primarily dedicated to the disposal of sludge, but at the same time being used for commercial agricultural purposes. Where soil concentrations of PTE on such sites are above the relevant limits permitted in Tables 4 or 5 or rates of application of PTE are greater than specified in Table 4, the sites must be used only for the production of crops exclusively for animal consumption if sludge applications are to continue.

In such cases sludge can be applied only in accordance with advice from the Minister of Agriculture, Fisheries and Food (in Wales and Scotland the Secretary of State), which may include conditions in respect of monitoring the quality of the soils and crops (including livestock) produced on the sites. When such sites are taken out

of use for sludge disposal purposes they must not be returned to normal agricultural use except in accordance with advice from the same authorities.

5. PLANTING, GRAZING AND HARVESTING CONSTRAINTS

5.1 General

In order to enable appropriate measures to be taken to minimise the risk to health of humans, animals and plants, it is necessary to co-ordinate sludge applications in time with planting, grazing or harvesting operations. Sludge must not be applied to growing fruit and vegetable crops nor used where crops are grown under permanent glass or plastic structures. Untreated sludge must not be used in orchards or on land used for growing nursery stock (including bulbs). Further constraints which must be taken into account are set out in Tables 6 and 7.

Table 6: Acceptable uses of treated sludge in agriculture

When applied to growing crops	When applied before planting crops
Cereals, oil seed rape Grass [1] Turf[2] Fruit Trees [3]	Cereals, grass, fodder, sugar beet, oil, seed rape, etc. Fruit trees Soft fruit [3] Vegetables [4] Potatoes [4], [5] Nursery Stock [6]

(1) No grazing or harvesting within 3 weeks of application.

(2) Not to be applied within 3 months before harvest.

(3) Not to be applied within 10 months before harvest.

(4) Not to be applied within 10 moths before harvest if crops are normally in direct contact with soil and may be eaten raw.

(5) Not to be applied to land used or to be used for a cropping rotation that includes the following:

a) basic seed potatoes
b) seed potatoes for export

(6) Not to be applied to land used or to be used for a cropping rotation that includes the following:

a) basic nursery stock
b) nursery stock (including bulbs) for export.

Table 7: Acceptable uses of untreated sludge in agriculture

When applied to growing crops by injection	When cultivated or injected* soil before planting crops
Grass (1) Turf(2)	Cereals, grass, fodder, sugar beet, oil, seed rape, etc. Fruit trees Soft fruit (3) Vegetables (3) Potatoes (3), (4)

(1) No grazing or harvesting within 2 weeks of application.

(2) Not to be applied within 6 months before harvest.

(3) Not to be applied within 10 months before planting if crops are normally in direct contact with soil and may be eaten raw.

(4) Not to be applied to land used or to be used for a cropping rotation that includes seed potatoes.

*Injection carried out in accordance with WRc publication FR 008 1989, "Soil Injection of Sewage Sludge – A Manual of Good Practice (2nd Edition)".

5.2 Transmission of Weeds

Sludge may contain viable weed seeds but any which germinate will usually be controlled by normal farming practices, such as livestock grazing and use of herbicides. However, tomato seeds are particularly hardy and adult plants can be toxic to livestock. Where it is proposed that kale or any similar crop is to be grown and fed directly to livestock before winter frosts, sludge should not be applied between March and August of the year the crop is to be planted.

6. RECORDS

6.1 General

In order to monitor the application of sludge to agricultural land (including dedicated sites), it is necessary to keep records of sampling and analysis of sludges and soils and of the quantities of sludge applied to each site.

Up-date records which register the following must be maintained:-

(a) The quantities of sludge produced and the quantities supplied for use in agriculture.

(b) Sludge analyses.

(c) Type of sludge treatment.

(d) Soil analyses (for any 15 cm deep or 7.5 cm deep monitoring samples as well as for statutory samples).

(e) Estimates of soil metal concentrations prepared for sites where 25 cm samples have not yet been taken.

(f) The names and address of recipients of the sludge, the location of each site where sludge is applied and the quantity and quality of sludge supplied. These figures should include the quantity and quality of other sludges (if any) used by the farmer but not supplied by the sludge producer concerned. In such cases the sewage sludge producers involved should agree among themselves which of them is to take overall responsibility for monitoring the particular site.

(g) Written advice given by the relevant government Minister in respect of sludge use on dedicated sites together with any analyses made of soil or crops as a result of that advice.

All information obtained to monitor the use of sludge in agriculture should be recorded for each source works so that a permanent running of the operation exists. A site should be regarded as a field or part of a field to which sludge has been applied.

In order that they can properly utilise sludge it is necessary for the farmers to be provided with an analysis of the sludge received which should include the parameters identified in Table 2. Results of all soil analyses should also be provided together with the quantity of sludge supplied to each site.

7. ENVIRONMENTAL PROTECTION

7.1 General

The use of sludge in agriculture, unless properly, can be offensive to the public, can present a pollution threat to water and cause general harm to the environment. In particular, care must be taken to ensure, as far as is practicable, that non-degradable material such as plastics is screened out of the sludge before it is spread on farmland. It is in the sludge disposal authorities' interests that liaison with local authorities is established to discuss local considerations such as transport routes, location of sludge applications and methods of delivery and spreading. Each site for application of sludge should be inspected beforehand to identify any likely problems so that measures can be taken to deal with them.

7.2 Transport

The movement of sludge by road tankers from sewage works to agricultural land can lead to complaints of noise and smell in built-up areas and cause serious traffic problems in country lanes. To minimise the risk of creating a nuisance the type and

size of vehicle should be suitable for the planned tasks. All sludge loads should be adequately contained of covered to avoid odour nuisance. Care should be taken to ensure that vehicles used to carry untreated sludge do not cross contaminate subsequent loads of treated sludge. The routes should be carefully chosen to minimise inconvenience to the public.

Spillage of sludge should be cleared up immediately in a manner that avoids pollution of watercourses.

7.3 Field Access

The points at which access is gained to field should be such that a traffic hazard is not created. Transfer of sludge from vehicles on the roadside should only be undertaken after consultation with the highway authority. Where vehicles traverse wet field or tracks, special care is needed to avoid carrying mud on to the highway.

7.4 Odour Control

The most effective control is that provided by adequate treatment of the sludge or injection/incorporation into the soil as soon as possible. Proximity to domestic, recreational and industrial properties, wind direction, sludge treatment and application techniques are key factors. Treatment processes reduce odours but some treated sludges can still be offensive.

The discharge points for sludge from vehicles or irrigators should be as near to the ground as is practicable and the trajectory of liquid sludge should be kept low so as to minimise spray drift and visual impact. The use of high trajectory spray guns is undesirable as they can give rise to a potential hazard due to aerosol drift. If however, owing to special circumstances, their use is essential, the relevant local authority environmental health officers should be notified and protective measures taken as necessary.

7.5 Surface Run-off

Whenever liquid sludge is applied care must be taken to ensure that sludge does not run off into roads or onto adjacent land. This will depend on topography, application rates and prevailing soil and weather conditions. It may be that certain locations are not acceptable for these reasons and on some sites it may be necessary to curtail an operation if conditions change adversely.

7.6 Water Pollution

On sloping land there is a risk of run off to water of liquid sludge or of rain falling on recently sludged ground. If the soil is frozen or water logged run off may occur from shallow gradients. Very dry ground may also be a problem but the risk is smaller. Application rates must be modified according to the circumstances and spreading may have to be discontinued.

In addition to run off, pollution may arise from the percolation of liquid sludge into land drains, particularly when these are covered by permeable fill. There is a

particular risk with soil injection or surface applications of liquid sludge to dry cracked soils. Special care should also be taken on clay soils or at near field capacity when rapid flow to drains can occur.

Where water sources might be affected the potential for pollution by pathogenic organisms and by nitrate should be taken into account before sludge is applied. Sludge must not be stored on or applied to land in the immediate vicinity of water supply sources. In areas designated by the pollution control authority as particularly sensitive, sludge should be used only in accordance with conditions laid down by that authority. In accord with good farming practice the timing and rate of application should be adjusted according to the nitrogen demands of the crop in keeping with the fertilizer and cropping programme. The optimum period of application is dependent on the type of sludge.

7.7 Farm Storage of Sludge

The opportunity to improve efficiency can be provided by farm storage, which can maximise utilisation of transport and optimise timing of sludge application. However care should be exercised in locating and operating sludge storage facilities to avoid public nuisance and water pollution. Such storage units must be designed and constructed so that as far as practicable sludge cannot escape from them and members of the public cannot have access to the sludge stored within them.

APPENDIX

STANDING COMMITTEE OF ANALYSTS:

METHODS FOR THE EXAMINATION OF WATERS AND ASSOCIATED MATERIALS

SCA NO:

7 Determination of the pH Value of Sludge, Soil, Mud and Sediment; and Lime Requirement of Soil, 1977.

10 Mercury in Waters, Effluents and Sludges by Flameless Atomic Absorption Spectrophotometry, 1978.

49 Cadmium, Chromium, Copper, Lead, Nickel and Zinc in sewage sludges by Nitric Acid/Atomic Absorption Spectrophotometry, 1981.

62 Fluoride in Waters, Effluents, Plants and Soils, 1982.

70 Molybdenum (especially in sludges and soils) by Spectrophotometry, 1982.

83 The Conditionability, Filterability, Settleability and Solids Content of Sludge 1984. A Compendium of Methods and Tests.

89 The Sampling and Initial Preparation of Sewage and Waterworks Sludges, Soils, Sediments, Plant Materials and Contaminated Wild Life Prior to Analysis, 1986 (2nd Edition).

91 Total Nitrogen and Total Phosphorus in Sewage Sludge, 1985.

92 Mercury in Waters, Effluents, Solids and Sediments etc, additional methods, 1985

93 Methods for the Determination of Metals in Soils, Sediments and Sewage Sludge and Plants by Hydrochloric-Nitric Acid Digestions, with a note on the Determination of the Insoluble Metal Contents, 1986.

99 Selenium in Waters, 1984. Selenium and Arsenic in Sludges, Soils and Related Materials 1985. A note on the Use of Hydride and Generator kits, 1987.

143 General Principles of Sampling Water and Associated Materials (second edition) 1995; Estimation of Flow and Load, 1995.

149 Determination of the pH Value of Sludge, Soil, Mud and Sediment and the Lime Requirement of Soil (Second Edition), 1992.

Methods as listed in “Index of Methods for the Examination of Waters and Associated Materials 1976-1992” (ISBN 011752669X).