Emission requirements for installations of less than 1.5 MW_{th} output
In the case of a total thermal power of less than 1.5 MWth, it is not necessary to lay down emission requirements for total hydrocarbons and for carbon monoxide. Assuming complete combustion, it will be possible to achieve an emission concentration for carbon monoxide of less than 2000 mg/m_0^3. In the case of emission concentrations in excess of 2000 mg/m_0^3 it can be concluded that the requirement of complete combustion is not being met.

PAH emissions
As long as the conditions and/or emission requirements for CO and hydrocarbons are being met, no additional requirements are needed to limit emissions of PAHs. Moreover, in several cases no odour nuisance will occur so that additional measures to limit odour nuisance will prove unnecessary.

NO_x
Emission requirements in order to limit NO_x-emission need not be made compulsory, unless the total thermal power exceeds 2.5 MW_{th} and, in addition to this, the wood parings consist for more than 80–90% of sheet materials (particle board, etc.). In that case an emission requirement of 400 mg/m_o^3 applies. This requirement must be met by taking source-oriented measures.

Interim regulation
In the case of a total thermal power of less than 0.5 MW_{th}, the requirements of the special regulations should have been met no later than 1 June 1997, unless the installation was erected after 1 June 1987. In that case the requirements of the special regulations must be met at the latest 10 years after the time of installation.

Monitoring of emissions
In accordance with §3.7 of the NeR a detailed monitoring schedule must have been drawn up. This means that for the verification of the standards for particulate matter in most cases a monitoring schedule of type #1 will be applicable. With a view to the expected mass flows of carbon monoxide and hydrocarbons, a monitoring schedule of type #1 must also be adhered to for verifying whether these requirements are being met.
Although regular mandatory inspections in the form of separate measurements are not a feature of monitoring schedule #1, it will be necessary to demand that a system of verification has been worked out in detail.

This system must comprise the following elements:
- A maintenance schedule for the installation approved by the competent authorities. This maintenance schedule (for example in the form of a maintenance contract) must include both inspections to verify that the conditions for complete combustion are being met and checks to see whether the technology for limiting particulate emissions is functioning properly. The results of every overhaul performed on the basis of this maintenance schedule must be logged in a service report that must be submitted to the licensing authority. The service report may prompt further investigations into the emissions being released.
- In the case of a total thermal power between 1.5 MW_{th} and 5.0 MW_{th} it is recommended that after installation a measurement to ensure guaranteed performance be carried out for particulates, carbon monoxide and all hydrocarbons taken together; and in the case of a total thermal power of between 0.5 MW_{th} and 1.5 MW_{th}, a measurement to ensure guaranteed performance for particulates.
- In the case of a total thermal power of less than 0.5 MW_{th}, it should be considered taking a measurement to ensure guaranteed performance for particulates carried out after first installation.

G1 Processing of gas emissions from landfill sites, waste fermentation and anaerobic waste water treatment plants

These regulations were included in the NeR in June 1994. Unless specific requirements for emissions are explicitly mentioned in the following, the general provisions of the NeR will apply.

Landfill sites
The operator of the landfill site is required to take the measures indicated in the present regulations unless he can demonstrate that the positive effect on the environment would be negligible. In assessing whether measures are necessary, the composition and the mass of the waste being dumped must be taken into consideration, among other things. The limit mass flows quoted in §3.2 of the NeR are not applicable in this case.

Fugitive emissions
During the period in which methane is being formed on the tip, fugitive emissions of landfill gas must be controlled. When the tip is being built up, measures must be taken aimed at collecting and processing these emissions. Collecting these gases can be facilitated by, for example, building up the tip in discrete sections. As early as during the building-up of the tip, a system for extracting gas must be installed and commissioned so that the gases formed in the waste can be continuously removed and treated.

The goal here must be to put the energy content of the landfill gas to practical use.

Flare installations
If it proves impossible to put the collected gases to some practical use, the gases must be burnt using a flare installation.

Flare installations must satisfy the following requirements:
- The temperature at the point of discharge must be at least 900°C.
- The time during which the gases are exposed to the heat of the flare must be 0.3 seconds minimum.
- The flare must be of a closed design.

If the flare installation is only used during maintenance work and malfunctions of the installation normally fed with the gas in order to burn it, whereas under conditions of normal operation this gas is being utilised in an appropriate way, then a simpler type of flare (open flare) may be used.

Gases of biological origin having a non-standard composition
Oxides of sulphur
The sulphur content (H_2S + organic sulphur compounds) of gases of biological origin being burnt in a flare may not exceed 0.0050% (50 ppm). If this value is exceeded, the sulphur must be removed by gas cleaning with an efficiency of at least 98%.

Dioxins
By using a flare of a closed design in which the combustion temperature is effectively regulated and the time during which the gases are exposed to the heat of the flare is sufficiently long, the requirement to minimise emissions of dioxins as referred to in §3.2 of the NeR will be satisfied, unless the composition of the gases to be burnt as far as their halogenated hydrocarbon content is concerned differs substantially from the standard.

Halogenated hydrocarbons
For a 'typical' content of halogenated hydrocarbons in landfill gas please refer to the Guidelines for Landfill Areas (*Leidraad Storten;* in Dutch only). This document quotes values of 0–150 mg/m_0^3 as normal for landfill gas.

G2 Composting installations for vegetable waste

These regulations were included in the NeR in January 1996. These regulations were evaluated in de period 1998/1999. The adjusted regulations were included in the NeR in May 2001.
Unless specific requirements for emissions are explicitly mentioned in the following, the general provisions of the NeR will apply.

Scope
These regulations are applicable to installations for producing compost from vegetable material in the open air, excluding separately collected household organic waste.

Waste of vegetable origin
Waste of vegetable origin in this context means organic (vegetable) waste produced during planting and maintenance of public green, forests and nature reserves, and any other waste of a comparable composition such as waste from private gardens and gardening firms, waste from mowing shoulders and ditches, waste of agricultural origin and waste produced in the landscaping and maintenance of grounds belonging to institutions and corporate owners. Waste of vegetable origin consists mainly of leaves, grass like clippings, haulm and other green parts, and prunings.

Processes
For producing compost from vegetable material the following methods are commonly used:
method A: frequent turning using special machines;
method B: conventional method of turning using a grab or loader;
method C: extensive compost production without turning the heaps at all;
method D: forced aeration.

Methods
The methods for producing compost mentioned in the regulations are described in detail below:
- method A: intensive method with frequent turning. At the beginning of the process the heaps are turned approx. once every three days. The frequency of turning is reduced while the process progresses. This can be controlled by process parameters. The heaps are turned approx. ten times over a period of three months.
- method B: conventional method. After building up the heaps, they are turned at regular intervals using shovels and cranes. The heaps are turned approx. seven times over a period of six months.
- method C: extensive method for producing compost in which the heaps of compost are not turned during the process. This method of producing compost is only allowed in situations where more than 5,000 tonnes per year are being processed.

- method D: intensive method with forced aeration. The process should be done in such a way that full aerobic processing is achieved. Now and then turning the heaps will be necessary to maintain aerobic conditions in the complete heaps.

New technologies are being developed for the process employed in the various methods. New methods for producing compost can be employed. But the alternative method will have to be assessed critically in the area of odour emissions.

Admixing manure

Several facilities producing compost from vegetable matter are doing research on the possibilities of admixing manure from animals. Research in Gelderland has approved that with the mixing of 30 percent of weight of strawmanure of pigs, the emission of ammonia increased with a factor 4 to 5. Besides this some research is done with the admixing of 10 percent of volume of liquid manure of calves. These results have proved that the emission of odours does not increase much.

With the experience now got from admixing manure it is advised, when there is asked for a permit, to do a pilot first. With the results of this pilot it can be evaluated whether it will be possible that the odour nuisance will increase and if the process where is asked for can be given a permit. When from the pilots it appears that the ammonia emission will increase substantially then the sensitivity of the area for ammonia emission should be taken into account.

Nuisance level

For facilities producing compost from vegetable matter, residual odour nuisance is regarded as acceptable if the distance between the edge of the actual installation and the dwelling is more than:

Production (tonne/year)*	Method A (m)	Method B (m)	Method D (m)
0–5,000	100–200	225–300	100
5,001–10,000	200–400	300–450	100
10,001–15,000	400–600	450–600	100
15,000–20,000	600–750	600–750	100
> 20,000	> 750	> 750	200

* Tonnes of material to be composted.

For method D, in the case of an annual production of 20,000 tonnes, 100 metres has been set as distance from the site where the residual nuisance will be acceptable. The odour emissions from this method are considerably lower than from method A.

A nuisance range for method C has not been determined.

For scattered dwellings, one can deal with half of the given distances with a minimum of 100 metres.

Table of nuisance ranges

In the table of nuisance ranges, distances are given which can be considered as typical for the calculated concentrations of odours on the grounds of research carried out.

The correlation is considered valid because on the grounds of the research results and practical experience 1.5 ou_E/m^3 as 98th percentile value of the hourly averaged levels over a year has proved to be a practicable target value for which it may be assumed that the residual nuisance is acceptable. Using the presently available information, no relationship has been established between the odour concentration and the percentage of people experiencing odour nuisance, and the quoted value of 1.5 ou_E/m^3 may therefore not be taken as a fixed standard. The target value has been converted to distances on a per method basis. In the table a range of values is given for each method for producing compost which can be used as a starting point in assessing situations. Because of uncertainties in the calculations of the emissions and the influence of the prevailing wind direction on the dispersion it was decided to indicate a range rather than a fixed distance. This range defines the area where nuisance can occur. Beyond this circle it is unlikely that nuisance will occur. Within the range given nuisance is likely to occur.

For the extensive method C there is insufficient information available for determining a distance. The emission and nuisance profile of this method is very different. During the actual process of composting there are hardly any odour emissions, but during the opening up of the heap after the process has finished, a very considerable emission can take place which causes considerable nuisance over a very wide area. Whether this is acceptable depends strongly on the local conditions. The method is looked upon by many as old-fashioned.

* Compost production from waste of vegetable origin (not being household organic waste), report number 94-202 TNO; in Dutch only).

Application

On the above-mentioned grounds, quoting performance specifications in the licence permit on the basis of the industry wide investigation is not the preferred strategy. Means specifications on the basis of the measures taken are better, due to improved enforceability and monitoring options. Enforcement and verification of the correct implementation of the measures taken are the preferred route.

The distances quoted serve as an indication and for this reason they are inappropriate if used as a fixed standard to be met. It is expected that if the distances between the objects that need to be safeguarded against nuisance and the source become larger than mentioned here, no unacceptable nuisance will be experienced.

Measures related to process operation

- The process must be monitored regularly through verification of the temperature (<80°C) and moisture content (a maximum of 60%) of the heaps of compost. In this context it is necessary that a sprinkler system is present. A log of these process parameters must be kept.
- The method of building up of the heaps, their shape and height are different for each method discussed. The height should be such that efficient composting is not prevented.
- The percentage of grass in heaps of compost must be limited to 30% maximum. Besides grass, the material being processed consists of prunings, tree stumps and waste originating from public green and leaves. Under special conditions (see the explanatory note) higher percentages of dry grass are allowed.
- It is not permitted to process household waste.
- Up to approximately 10% agricultural waste can be processed without having to be concerned about a substantial increase in odour emissions. The composting of more than 10% waste of agricultural origin can be allowed when it is proved from research that this causes no disadvantages for the environment.
- The quality of the material accepted for processing must be checked; as a rule, it may not contain material that is already decomposing, because of the elevated emissions of odours this may cause. If the material is already decomposing suitable measures should be taken.
- The material accepted for processing must be processed within a maximum of three times 24 hours into a form that can be used as a raw material and be piled up in heaps for subsequent composting. In other words, no long-term storage of material accepted for processing is allowed. Coarse material (for example branches and tree stumps) are excepted from this rule because a stock of this material that can serve as a buffer is necessary to ensure efficient processing. Also grass material may be stocked for a longer period under conditions that rotting is prevented.
- Water percolated through the heaps must be collected; the pond containing such percolated water (and the associated wastewater treatment plant) must be aerated sufficiently so that anaerobic rotting is prevented. This is a hard condition if the percolated water is to be used for sprinkling.

If in the case of a given method for producing compost it is not possible using the above-mentioned standard measures to limit the nuisance to an acceptable level, consideration must be given to the option of adopting an alternative method for producing compost that generates less odours.

Waste of agricultural origin

In the present context this means vegetable waste originating from agricultural and horticultural holdings that is produced during commercial farming operations.

Conditions for composting more than a 30% of grass:

- Method D for composting should be used
- The material should be cut before it is put into the process
- No waste of agricultural origin may be added
- No 'open' fresh grass may be added

Measures

Several items mentioned in the list of standard measures affect process operations at the facility. The key here is to, through a combination of sophisticated logistics and tight control over the process, prevent situations where strong odour emissions can occur due to anaerobic conditions. How exactly the measures quoted in the permit issued to an operator are implemented depends to a large extent on the way the operation is run and is therefore difficult to specify in general terms. In some cases, for example, it may be a good idea to site the intake area for raw materials so that it is as far removed from residential areas as possible. This is, however, only relevant if the layout of the premises allows this option. Departing from the measures that deal with the process is acceptable on the condition that it is well motivated.

Existing situations

If in existing situations, after implementing the standard measures, nuisance still occurs due to the fact that the distances to the odour-sensitive objects are shorter than would be desirable, it may be possible through a change in the process to limit the odour nuisance to the residential area involved. Some improvement is often realised by changing the routine for turning the heaps. A switch to aerated compost production results in significant reductions of the odour nuisance. This, however, requires considerable investments in equipment for turning the heaps and for aerating them.

In situations in which alternative siting is impossible supplementary measures such as organisational changes in the way the operation is run can be considered, such as limiting certain activities under adverse weather conditions.

Methods of measurements

The odour concentration from facilities producing compost from vegetable matter can be researched by smelling squads. The reliability of the results can be augmented by doing more measures over several days.

Evaluation
The composting of vegetable matter is a young branch. When the original regulations were written there was not much knowledge about nuisance which could be expected and the possible measures that could be taken. In 1998 the evaluations of these regulations were started which led to these adapted regulations. As soon as developments within this branch make it necessary, but at least within 2 years, these regulations will be re-evaluated.

G3 Sewage treatment installations

These regulations were included in the NeR in January 1996. Unless specific requirements for emissions are explicitly mentioned in the following, the general provisions of the NeR will apply.

Scope
These special regulations are applicable to communal sewage water treatment installations, defined in this context as sewage treatment installations with an inflow that may partially originate from industrial operations, such that the odours emitted from the combined inflow do not differ significantly from household effluent.

Sources of odours
At various points in sewage treatment installations odour emissions are known to occur. The scale of the odour emissions depends, among other things, on how the effluent is transported to the sewage water treatment plant and on the type and capacity of the plant.
For various process steps emission factors were drawn up (report: *Bedrijfstakonderzoek stankbestrijding op rwzi's, onderzoeksresultaten en handleiding*, STOWA, Utrecht, 1996-2 (Spring 1996): Industry wide research into odour abatement measures at sewage water treatment plants: results and guidelines, STOWA, Utrecht, Spring 1996; in Dutch only).
The total odour emission from the sewage treatment installation can be calculated by adding up the calculated emissions from the individual process stages.

Dispersion
For the purpose of determining the odour concentrations in the vicinity of sewage treatment installations, nomograms were drawn up on the basis of a dispersion model, the LTFD model. This enables the authorisation body to establish the minimum distance from the source of the odours produced by the sewage water treatment plant to the location where a given odour concentration is experienced. In the case of a relatively short distance as compared to the diameter of the treatment facility this distance may cause problems.

Nuisance
For densely populated residential areas, agglomerations of buildings situated along roads or other objects sensitive to odour nuisance the following values should be adhered to for the maximum permissible immission concentration:
- 0.5 ou_E/m^3 as 98th percentile for new situations;
- 1.5 ou_E/m^3 as 98th percentile for existing situations.

In the case of scattered dwellings and residential clusters on industrial estates the following values should be adhered to for the maximum permissible immission concentration:
- 1 ou_E/m^3 as 98th percentile for new situations;
- 3.5 ou_E/m^3 as 98th percentile for existing situations.

Measures
If the calculated odour immission concentration in the vicinity of the waste water treatment plant exceeds the above mentioned values, a selection can be made from the available measures to limit the odour emissions.
On the basis of the calculated odour emission and the dispersion of these odours to the vicinity it will be possible to establish whether, in the case of the residential area lying closest by, the odour concentration values quoted in the guidelines are being exceeded.
If this is not the case then additional measures will not be required. If they are exceeded, it is possible with the aid of the nomograms (please refer to the text frames) to calculate what level of odour emission reduction must be demanded. On the basis of the odour emission levels of the individual sources it will be possible to ascertain which source must primarily be targeted in order to reduce the overall emission of odours to acceptable levels. Under typical conditions and in the case of the measures that are taken most often (covering and aerating) a reduction of 90% is normally achievable.
By entering the residual emission into the overall calculation of overall emissions it is possible, by referring to the nomograms, to check whether a sufficient reduction of emissions has been achieved.
The selection of which components of the waste water treatment plant should be covered must be geared to the specific situation, the required reduction of emissions and the costs involved.
A list of available measures is given below. For more details please refer to the STOWA manual.

Customary measures These are measures which are commonly taken first.	*Less customary measures* This concerns measures which are appropriate, but will not be considered as a first choice due to their scope and/or the costs involved.	*Unusual measures* These are measures which will normally not be considered because of their scale, the costs involved and/or the expected result.
Covering over and purification of the air emitted from the following parts of the installation: • access buffer cellar • feed conveyors • gutters for untreated effluent • distribution system for untreated effluen • grates • containers for materials removed from grates • gutters of heavy particles separation system • gutters of preliminary sedimentation tanks • aerated selector • primary sludge dewatering system • mechanical sludge dewatering system	Covering over and purification of the air emitted from the following parts of the installation: • surface of heavy particles separator • surface of preliminary sedimentation tank • conveyors for sludge being refed • dewatering system for secondary sludge • dewatering system for aerobic stabilised sludge • dewatering system for anaerobic stabilised sludge • non-aerated selector/ anaerobic tank	Covering over (with or without purification of the air emitted) of: • aeration tank • posttreatment sedimentation tanks • pumping station for effluent • effluent moat • preliminary denitrification tank
Reduction of exchange surface area: • reduction of distance over which fluids drop when going to the next basin	Reduction of exchange surface area by (floating) cover without purifying the air emitted: • preliminary sedimentation tanks • rotating aerators/ surface aerators	
In addition: • adding of ferric coagulants to influent	In addition: • adding of hydrogen peroxide to influent • recirculation of effluent	

Calculation method

The method for calculating the odour emissions is indicated below. The calculations are derived from the instruction manual (*Bedrijfstakonderzoek stankbestrijding op RWZI's, onderzoeksresultaten en handleiding*, STOWA, Utrecht, 1994-4, 1994-5: Industry wide investigation into measures to control odours from waste water purification plants, research results and instruction manual, 1994-4, 1994-5; in Dutch only). For more examples and a detailed discussion please refer to the instruction manual.

Sources of odours

The emissions originating from various stages of the process are determined with the aid of the emission factors in Tables 2, 3 and 4. In order to use these tables the information mentioned in Table 1 must be available:

Table 1 Basic information

Access system and pre-treatment: table 2	*Required data*
• supply of effluent: through sewer system with natural height gradient or through pressurised feed pipeline	the percentage of the total feed network formed by a sewer system with a natural height gradient
• addition of ferric coagulants before effluent reaches access point?	If ferric coagulants are added before the effluent enters the STP the emission factors listed in the 76–100% sewer system with natural height gradient column are always used.
• (water) surface area of all parts of the system	in m^2
• overall length of the discharge points of the heavy particles separator and of the preliminary sedimentation tanks	in metres
Water plane of STP: table 3	*Required:*
• silt content	the silt content of the effluent, expressed as kg BOD/kg d.s.d.
• (water) surface area of all parts of the system	in m^2
Sludge processing line: table 4	
• sludge quality:	
pre-dewatering system	fresh, aerobic or mixed sludge
sludge dewatering lagoon	aerobic, anaerobic or mixed sludge
perforated conveyor press	aerobic, anaerobic or mixed sludge
removal and storage	aerobic, anaerobic or mixed sludge
• surface areas of all parts of the system	in m^2

Table 2 Emission factors of access system and pre-treatment

Item	Percentage of input provided via sewer system without the aid of mechanical means:				Unit
	0-25%	26-50%	51-75%	76-100%, or in the case of added ferric coagulants	
Access system (cellar conveyors etc.)	65	46.5	28	9.5	ou_E/s per m^2
Removal of material trapped in front of grate	65	46.5	28	9.5	ou_E/s per m^2
Containers for materials removed from grates	65	46.5	28	9.5	ou_E/s per m^2
Coarse particles separator:					
• surface area	7.5	7	6	5.5	ou_E/s per m^2
• discharge point	135	48	17	6	ou_E/s per m
Coarse particles washer	135	48	17	6	ou_E/s per m^2
Distribution system	135	48	17	6	ou_E/s per m^2
Preliminary sedimentation tank					
• surface area	8.5	7.5	7	6	ou_E/s per m^2
• discharge point	18.5	16.5	15	13.5	ou_E/s per m
Anaerobic tank	5.5	5	4.6	4.15	ou_E/s per m^2
Selector:					
• aerated	6	5.5	5	4.5	ou_E/s per m^2
• non-aerated	5.5	5	4.6	4.15	ou_E/s per m^2
Preliminary denitrification tank	2.15	1.9	1.7	1.55	ou_E/s per m^2

Table 3 Emission factors of STP water plane (ou_E/s per m^2)

Item	Silt content (kg BOD/kg d.s.d.) <0.05	0.05-	0.11-0.10	0.21-0.20	>0.30 0.30
Aeration tank					
aerobic zone:					
• aeration by bubbles	0.2	0.35	0.65	1.05	1.65
• single point aeration fully covered over	0.2	0.35	0.65	1.05	1.65
• aeration using brushes fully covered over	0.2	0.35	0.65	1.05	1.65
• single point aeration without any cover	0.3	0.55	1.0	1.6	2.5
anoxic zone:					
• aeration by bubbles	0.18	0.315	0.6	0.95	1.5
• aeration using brushes	0.18	0.315	0.6	0.95	1.5
• single point aeration	0.18	0.315	0.6	0.95	1.5
Pumping station for processed sludge	0.6	1.1	2.0	3.2	5
Post-treatment sedimentation tank					
• access area	0.2	0.35	0.65	1.05	1.65
• surface area[1)]	0.16	0.28	0.5	0.85	1.3
Post-treatment nitrification	0.16	0.16	0.16	0.16	0.16
Post-treatment denitrification	0.16	0.16	0.16	0.16	0.16

[1)] The emission of the discharge point of the post-treatment sedimentation tank is not established separately.

Table 4 Emission factors for sludge processing line (ou_E/s per m^2)

Item	Sludge quality fresh	aerobic	anaerobic	mixed
Pre-dewatering system	8		3.95	8
Second stage dewatering system			3.05	
Buffer tank for fully fermented sludge			3.05	
Sludge dewatering lagoon		4.05	1.75	4.35
Filter press				
Perforated conveyor press		4.05	1.75	4.35
Centrifuge				
Removal and storage		4.05	1.75	4.35
Sedimentation tank for phosphates		3.95		
Stripper tank		3.95		
Sludge dewatering plant		3.95		
Floc tank		3.95		

Application

If the emission factor of a certain component of the water treatment purification plant is not quoted in the tables this method cannot be used without further research. Supplementary research to determine odour levels will be necessary in such a case (whether by olfactory measurements or by sending out a 'smelling squad').
By multiplying the emission factors from the Tables 2, 3 and 4 with the surface area of the source or its length (in the case of discharge points), the intensity of the source is calculated. The total emission by the sewage treatment plant (STP) is subsequently determined by adding up the emissions of the individual sources.

Example calculation of odour emission

As an example, in Table 5 the calculations required for determining the total emission resulting from treatment by using an aerating tank are indicated (these are fictional data). The key data for this STP are:

- 30% of input provided via sewer system without the aid of mechanical means;
- sludge content: 0.14 kg/ BOD;
- the entry point and the storage area for materials cleared from the grid are covered, the ventilation air is purified by passing it through a biologically active filter. The efficiency of cleaning is 90%;
- type of aeration: bubbles.

Table 5 Calculated odour emissions

Item	Water surface (m^2)	Length of discharge point (m)	Emission factor (ou_E/s per m^2 or m)	Emission (10^6 ou_E/h) for optional measures	Emission reduction resulting from measures (%)	Emission to atmosphere (10^6 ou_E/h)
Access system	40		46,50	6,70	90	0,670
Removal of materials trapped in front of grates	10		46,50	1,67	90	0,167
Containers for materials removed from grates	16		46,50	2,68		2,678
Coarse particles separator:						
• surface area	152		7,00	3,83		3,830
• discharge point	44	48,00	7,60		7,603	
Preliminary sedimentation tank:						
• surface area	1820		7,50	49,14		49,140
• discharge point		214	16,50	12,71		12,712
Selector aerated	163		5,50	3,23		3,227
Aeration tank:			0,00			
• aerobic zone	2143		1,00	7,71		7,715
Pumping station for processed sludge	40		2,00	0,29		0,288
Post-treatment sedimentation tank:						
• access area	112		0,65	0,26		0,262
• surface area + discharge point	6676		0,50	12,02		12,017
Preliminary dewatering system:						
• fresh sludge	74		8,00	2,13		2,131
• aerobic sludge	121		3,95	1,72		1,721
Second stage dewatering system for anaerobic sludge	121		3,05	1,33		1,329
Perforated conveyor press for anaerobic sludge	24		1,75	0,15		0,151
Removal and storage of anaerobic sludge	40		1,75	0,25		0,252
Total				**113**		**106**

Dispersion

It is assumed that the dispersion of the overall emission originates from a single point source. This point source emits from the subjectively weighted imaginary origin of the odours of the STP. The subjectively weighted imaginary origin of the odours is determined by averaging the values plotted on the X and Y co-ordinate axes for the parts of the process involved, taking into account the actual emissions from each. The X and Y co-ordinates of a given source (determined using a random origin) are multiplied by the contribution in per cent of the source to the total odour emissions and divided by 100. Subsequently the obtained products of co-ordinates and contributions are added up. The result of this addition yields the co-ordinates of the subjectively weighted imaginary origin of the odours. (Refer also to the example.)

With the aid of the nomograms in Figures 3 and 4 the odour concentration at a given distance from the subjectively weighted imaginary origin of the odours from the STP can be determined. The odour concentration thus determined can be considered as 'worst case scenario' as the assumptions in preparing the nomograms were deliberately unfavourable: the climatological factors, the wind direction and the roughness of the terrain were all chosen in such a way that the highest concentrations are found.

Accuracy of the immission calculations

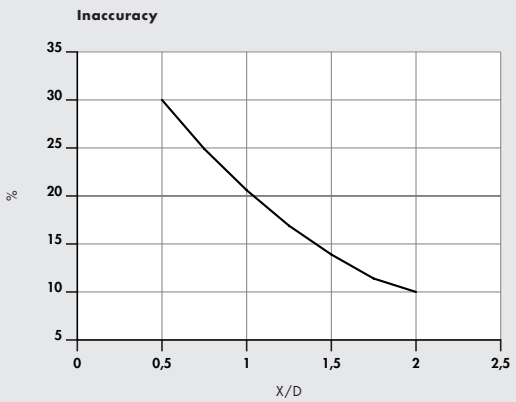
Due to the fact that the STP is assumed to be a point source it is not possible to determine the concentrations at short distances from the imaginary origin accurately using this method. In order to be able to determine the resulting inaccuracy a graph is included (Figure 2). Here the inaccuracy is given as a function of the quotient of the distance to the STP and the diameter (D) of the latter.

The diameter of the STP is determined using the formula:

$$D = \sqrt{\left(surface * \frac{4}{\pi}\right)}$$

Here the 'surface area' referred to is the total surface area of the part of the STP where the relevant sources of odours are found. If the inaccuracy determined using this method exceeds 30%, then the odour concentrations cannot be determined with the aid of the nomograms in Figure 2. In such cases a dispersion calculation specific to the situation in question must be performed, in which all sources are calculated individually.

Figure 1 Inaccuracy as a function of the ratio between the distance to the contour (X) and the diameter of the STP (D).



Example of a calculation of the inaccuracy

For the STP characterised in Table 5 (total odour emission 106*10^6 ou_E/h) the odour concentration is 1.5 ou_E/m at a distance of 550 metres from the subjectively weighted imaginary origin of the odours from the STP.

As the area of this STP is 11,300 m^2 the diameter will be 120 metres. Figure 1 reveals that for distances to the subjectively weighted imaginary origin of the odours of less than 60 metres (X/D = 120/6 = 0.5), the odour concentration cannot be determined accurately enough.

Figure 2 Distances to contour lines representing 0.5, 1, 1.5 and 3.5 ou_E/m^3 as 98th percentile in the case of various odour nuisance levels in the range 0–100 (10^6 ou_E/h)

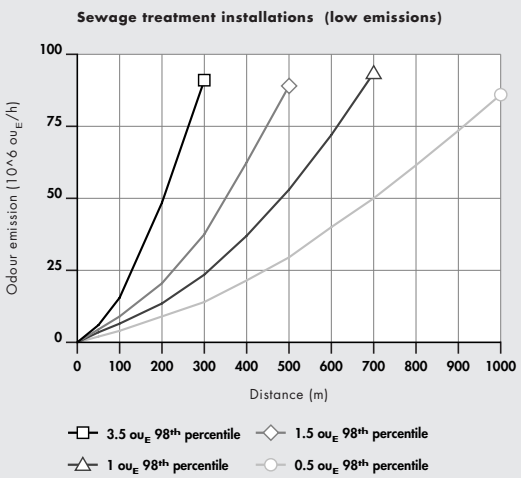
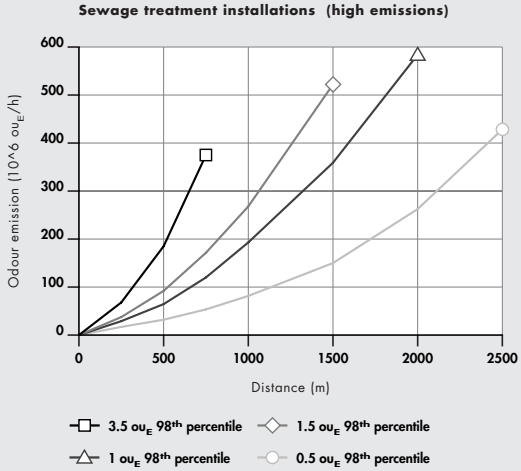


Figure 3 Distances to contour lines representing 0.5, 1, 1.5 and 3.5 ou_E/m^3 as 98th percentile in the case of various odour nuisance levels in the range 100–500 (10^6 ou_E/h)



Example of calculations for determining the subjectively weighted imaginary origin of the odours

By way of example the subjectively weighted imaginary origin of the odours will be calculated for three sources, with odour emissions of 600, 300 and 100 ou_E/s. The location of the various sources is indicated in Figure 5.

Figure 4 Example site plan of STP for determining the subjectively weighted imaginary origin of the odours

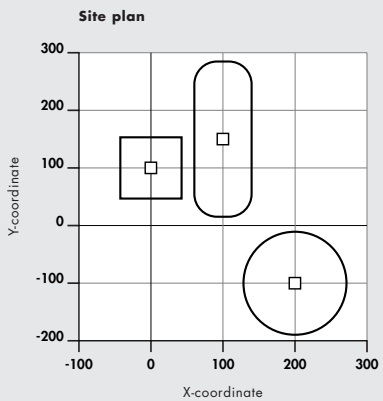


Table 6 Calculations for determining the subjectively weighted imaginary origin of the odours

Source	Emission [ou_E/s]	Coordinates (x,y)	Emission percentage	Product emission percentage/100 and coordinates
a	600	0,100	60	0, 60
b	300	100,150	30	30, 45
c	100	200, -100	10	20, -10
Total	1000		100	50, 95

The subjectively weighted imaginary origin of the odours lies on the point with co-ordinates: 50, 95.

Nuisance
By way of an elaborate industry wide poll it is has been ascertained which odour concentrations generally no longer cause complaints to be lodged. Although situations exist where at levels over 5 ou_E/m^3 no complaints are received and also situations where at levels of around 1 ou_E/m^3 complaints still continue to be reported, on the whole it was found that in the case of concentrations higher than 2.5 ou_E/m^3 the number of complaints received by STPs rose sharply. This finding was used as the basis for determining the highest acceptable concentrations.

Measures
The potential measures to be taken generally consist of covering over certain parts of the installation and treating the extracted air with an odour limiting technique. Generally biologically active filters or scrubbers are used to this end. In addition, it may be attempted to prevent components that cause nuisance from being released, by adding doses of chemicals which bind or cause conversion of the substances concerned. This concerns especially chemicals which bind or cause oxidation of H_2S. Sometimes measures are possible that reduce the surface area of the water where exchange of gases with the atmosphere can take place. Such measures may include for example reducing the distance over which fluids drop when going to the next basin and the use of floating covers. Further information on the nature and type of possible measures is available in the STOWA instruction manual. Due to the substantial differences between sewage treatment plants and differences in the local odour nuisance situation it is not possible in advance to indicate which measures should be preferred.

G4 Compost production from household organic waste

These regulations were included in the NeR in January 1996. Unless specific requirements for emissions are explicitly mentioned in the following, the general provisions of the NeR will apply.

Scope
These special regulations are applicable to facilities for producing compost from household organic waste on an industrial scale, possibly together with similar organic waste materials.

Sources of odour emissions
At nearly all processing stages at a facility for producing compost from household organic waste odours can in principle be released. The scale of the odour emissions depends, among other things, on the process, the surface area of the site, how source materials are delivered and on the quantity of (intermediate) products stored.

For the various components key emission figures were drawn up (please refer to text frame). The total odour emission from facilities for producing compost from household organic waste is calculated by adding up the emissions from the individual process stages.

Sources of odour emissions
In the table below the averaged key odour emission factors per stage of the process are given. These were obtained in the course of the industry wide investigation into odour related problems at facilities for producing compost from household organic waste, carried out by Witteveen and Bos in 1995. The difference in the key odour emission figures quoted for different processes for producing compost may be caused by variations in the air volume used per tonne of material for aeration purposes, as well as by differences in the manner of introducing the air, namely by injection or by evacuation.

Part of process	Key odour emission factor	Unit
Receipt of household organic waste		
• dumping	$15*10^{5)}$	$(ou_E/tonne)^{2)}$
• storage	$5*10^{5)}$	$(ou_E/[m^2*h])^{3)}$
Pre-processing (screening and removal of ferrous materials)	$15*10^{5)}$	$(ou_E/tonne)^{2)}$
Composting		
• composting in halls	$15*10^{5)}$	$(ou_E/[tonne*h])^{1)}$
• composting in open cells with evacuation type aeration[6)]	$1.1*10^{5)}$	$(ou_E/[tonne*h])^{1)}$
• composting in tunnels	$7*10^{5)}$	$(ou_E/[tonne*h])^{1)}$
• composting in containers	$0.65*10^{5)}$	$(ou_E/[tonne*h])^{1)}$
Post-processing 1 (of crude compost)	$10*10^{5)}$	$(ou_E/tonne)$
Maturing	$1.2*10^{5)}$	$(ou_E/[m^2*h])$
Post-processing 2[5)] (of finished compost)	$10*10^{5)}$	$(ou_E/tonne)^{2)}$
Storage of compost	Nil	n/a[2)]

1) This is the quantity of material used for composting.
2) This is the throughput, i.e. the number of tonnes dumped or processed.
3) This the number of ou_E per m^2 of stored household organic waste per hour.
4) Nil, if the material turned into compost is stored at a temperature of less than 50°C.
5) This is a conservative estimate.
6) Between the layer of material being composted and the atmosphere a layer that isolates odours is installed.

For biologically active filters an odour removing efficiency of 90% is considered typical. The efficiency under certain conditions may be lower, when the residual odour of the biofilter starts to dominate. The biologically active filter will still perform adequately as long as the residual odour is lower than 2500 ou_E/m^3. Conversely, in the case of elevated odour concentrations, it will also be possible to achieve better elimination efficiencies than 90%.
These key figures are based on measurement results obtained at current process installations. As the facilities for producing compost are still being optimised the measure of control over the process for producing compost is not perfect and as a consequence the odour emissions can fluctuate considerably.

Dispersion
To allow determination of the odour concentrations in the vicinity of facilities for producing compost from household organic waste nomograms have been drawn up (refer to Figures 1 and 2). These allow the odour immission situation around a facility to be determined on the basis of the odour emissions.

Dispersion
In order to determine the odour concentration in the vicinity of facilities for producing compost from household organic waste the odour emissions of the various sub-processes must be determined. As a number of processing stages are only carried out during the daytime (receipt, pre-processing and post-processing), and other processing stages continuously, it is necessary to distinguish between two different emission situations. In order to determine the odour emissions of the various processing stages the following procedure must be followed:

1 for the process of producing compost the key emission factors given in the table must be used;
2 depending on the location of the remaining processing operations the following emission factors are used:
   - in the open air or in an open or closed building with air exhaustion at the source without subsequent treatment of the air: key emission figures from the table;
   - in a closed building without air exhaustion: multiply the key emission factors by a factor 0.5;
   - in a closed building with air exhaustion followed by air treatment: multiply the key emission figures by a factor of 0.1 (90% efficiency of the biologically active filter).

For both emission situations subsequently the maximum emission is determined. The odour emission, corrected for a duration factor, is obtained by adding the values for both situations, again taking the duration into account. Subsequently the odour concentration can be looked up using the nomograms (Figures 1 and 2).

Figure 1 Distances to contour lines representing 0.5, 1.5, 3 and 1.5 ou_E/m^3 as 98th percentile in the case of various odour nuisance levels in the range 0–100 (10^6 ou_E/h)

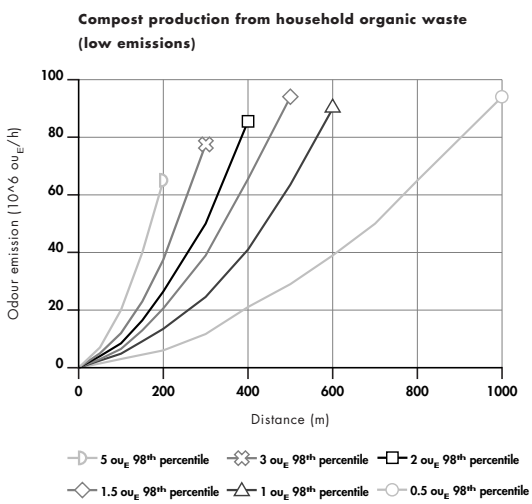
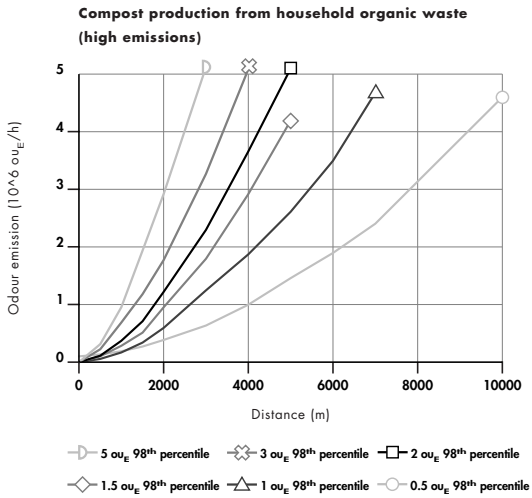


Figure 2 Distances to contour lines representing 0.5, 1.5, 3 and 1.5 ou_E/m^3 as 98th percentile in the case of various odour nuisance levels in the range 0–5 (10^9 ou_E/h)



Nuisance level
For existing facilities for producing compost the following arrangements apply:

- the odour immission concentration in the nearest residential area or other objects sensitive to odour nuisance may not exceed 3 ou_E/m^3 as 98th percentile. The standard set of measures must be implemented;
- if the odour immission concentration in the nearest residential area or other objects sensitive to odour nuisance remains between 1.5 ou_E/m^3 (as 98th percentile) and 3 $ou_E/m3$ (as 98th percentile), it must be ascertained by referring to the system used for classifying nuisance (see §3.6) whether the nuisance level (and any measures to be taken or already taken) is acceptable.

For new installations a value of 1.5 ou_E/m^3 applies (as 98th percentile) as upper limit and an intermediate range of 0.5–1.5 ou_E/m^3 (as 98th percentile).

Nuisance level
In a hedonic odour investigation carried out by the VAR it was concluded that for the VAR a target value of 3 ou_E/m^3 should apply (Report: Research into the hedonic nature of odours, Haskoning, November 1995, number13245.D1480. AO/R005/RVO/AS). Starting from the model used in the report this results in a general framework for assessing installations for producing compost based on a target value of 1.5 ou_E/m^3 (as 98th percentile). This value also corresponds with the pattern of complaints observed by the competent authorities. The difference in these target values can be attributed to characteristics of the surrounding area. As many facilities for producing compost from household organic waste are comparable to the VAR as far as their siting is concerned, a range was decided on with limit values of 3 and 1.5 ou_E/m^3 (as 98th percentile).

Measures
On the basis of a careful consideration of the odour nuisance situation in the whole sector of industry, of the technical options and the business economics consequences, a standard set of measures was decided on. These measures indicate, for household organic waste composting operators, the current Best Available Techniques for limiting odour nuisance.

1 The composting must be carried out under closed conditions.
2 The waste gases produced by the composting proper and the extracted air from the pre-processing and the post-processing of crude compost are treated in a system using biofilters. The maximum allowable emission load must be determined exactly by the competent authorising body. The efficiency of the filter is at least 90% at nominal load. Other technologies with a comparable efficiency of removing odours may also be used.
3 The household organic waste must be received in an enclosed area. The air in the reception hall must be extracted and directed through an installation capable of effectively removing odours.
4 The post-processing of the crude compost must take place under contained conditions.
5 The percolated water and the contaminated process water must be stored in such a way that no odour emissions take place.
6 Products may only leave the contained situation for maturing if the temperature of the heaps is below 50°, to be determined using the method according to Rottegrad quoted in the KIWA directive (K256/02).

Measures
Closed conditions in this context means that processing is done in an area from which the air is subject to mechanical exhaustion. Contained conditions will also exist in the event of composting in open cells such that between the composting material and the atmosphere a barrier has been installed which is impermeable to odours and where air is introduced into the compost by extracting it from inside the heap.
The air used in the various processing stages is treated at all facilities for producing compost with the aid of biologically active filters. Occasionally pre-treatment is carried out using a plain water or chemical based scrubber. A new and promising pre-treatment technology which is capable of removing both ammonia and odours effectively is with so-called bio-trickling filters.
Depending on the design, the concentrations introduced into the system and the level of maintenance, values between 90 and 99% can be achieved in practice. The biologically active filter is operated at maximum efficiency by stringent control of the temperature and the moisture content. The details for monitoring the temperature, the moisture content, the acidity and the effectiveness of an optional pre-cleaning technology are laid down in a quality system developed by the operator, and which is used as a reference that can be used by the competent authorities in order to verify whether the operator is meeting his obligations. The quality system documents quote the design performance, the frequency of verifications and the tolerances for various process parameters.

Z1 Surface treatment of metals with nitric acid

These regulations were included in the NeR in May 1992. Unless specific requirements for emissions are explicitly mentioned in the following, the general provisions of the NeR will apply.

Continuously operating etching plants
Nitric oxides
The emission concentration of nitric oxides in the waste gas may not exceed 500 mg/m_o^3.

Z2 Production of carbon anodes

These regulations were cancelled in September 2004, following the inclusion of the BREFs in the NeR.

Z3 Leather industry

These regulations were included in the NeR in January 1996. Unless specific requirements for emissions are explicitly mentioned in the following, the general provisions of the NeR will apply.

Scope
These regulations are applicable to operators that produce leather.

Sources
Odour emissions from leather manufacturing operations ensue from two main activities which can occur separately or combined, namely the processing of skins or hides in tanneries (here the stock goes through a number of processing stages to obtain chrome tanned leather) and the manufacture of patent leather (wet and dry finishing).
For these sources odour emission factors are available. Please refer to the report '*Bedrijfstakstudie Geur van de lederindustrie, geuremissiekentallen en geurreducerende maatregelen* (Industry wide investigation into odours produced by the leather industry, key odour emission figures and odour abatement measures)', PRA report number FNLE94A.5, July 1995, for details.

Dispersion
The emissions from finishing operators generally originate in a channelled manner from spraying booths. The emissions from tanneries are mainly fugitive.

Nuisance
No generally accepted odour concentration level has been established at which nuisance is experienced. Assessment whether nuisance occurs is done with the aid of the 'system used for classifying nuisance caused by odours' (§3.6).