*Enforceability and implementation of the regulations*
The figures quoted as standards in the permit must preferably be validated by recalculation on the basis of changed (annual) production statistics using the 'geurnorm 3.0' software. Verification of the presence of and adherence to the instructions for the use of end-of-pipe technology (where applicable) can be carried out at the same time. The standard to be met must preferably be specified in the form of the distance from the facility at which the 1 $ou_E/m^3$ contour can be drawn.

**Interpretation of the regulation**
For additional information (for example in the case of lack of clarity as regards the interpretation of the regulation) InfoMil can be consulted. Feed compounders can also contact the study group *Milieu Overlegplatform Mengvoederindustrie* (MOM) of the *Federatief OverlegOrgaan Mengvoederindustrie* (FOOM) based in Rotterdam.

## B1 Sugar factories

*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.*

*Particulates*
The concentration of particulates in emissions from the multi-cyclones of the pulp-drying plant may not exceed 75 $mg/m_o^3$.
When existing pulp-drying plants are renewed, steam drying can be considered as an alternative to the present method of pulp drying, notably in the light of measures to limit odour emissions and on energy grounds.
Where steam drying is used, the general standards for particulates apply.

*Ammonia*
On the basis of the findings of research already underway into the removal of ammonia from the waste gases of the carbonation process, the most efficient treatment system will have to be implemented for the situation in question at the appropriate time.
It concerns the following technologies:
- use of the relevant air flows as combustion air for the pulp dryers and for the boiler house; and
- process integrated nitrification/denitrification of the relevant process flows.

## B2 Production of starch and starch derivatives

*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.*

*Particulates*
The concentration of dust in emissions from the starch-drying plant should be between 50 and a maximum of 100 $mg/m_o^3$.*
The value stipulated in the licence will depend on the nature of the particulates and will need to be fixed on a case by case basis.
The aim should be to comply with the general standards.

**Production of modified starch**
The general standards of the NeR are applicable to emissions from the raw materials and additives used in the production of modified starch.

*Production of nylgum*
Ammonia emission in the production of nylgum must be reduced with an efficiency of at least 95%.**

* When potato starch is used, 50 $mg/m_o^3$ is feasible. For maize starch, 100 $mg/m_o^3$ is a realistic value.
** The feasibility of this standard is still the subject of consultations and research.

## B3 Large bakeries

*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*
This regulation only applies to bread bakeries requiring a permit that produce an average range of products. It concerns operators who are registered with the Industrial Board for the bakery trade (Bedrijfschap voor het Bakkersbedrijf) and who do not fall under a GAO in pursuance of Article 8.40 of Wm (Environmental Protection Act). This includes both operators who manufacture their products in a traditional manner and operators who produce on an industrial scale.

**Scope**
The regulations apply exclusively to larger bakeries where bread and a limited variety of other products are baked, which do not fall under the Decree on environmental control of the retail trade and crafts. It concerns approximately 400 large and medium-sized bakeries (state of affairs as of 1995). These bakeries mainly bake bread, but also produce, among other things, buns and rolls, fruit loafs, sausage rolls, cheese-and-onion baguettes, apple jacks, cake, etc. Research has shown that when up to 35% of the total amount of flour is processed into buns and rolls a single key emission factor can be used.

*Sources of emissions*
Sources are the waste gases (flue gases and fumes produced by the products, with a high moisture content) from the oven and the air vented from the oven rooms and bread cooling areas for ventilation purposes. The odours produced by the various sources is of a comparable nature.

**Sources of emissions**
For the total odour emissions from bakeries a key emission figure has been established on the basis of research*. This number is expressed as millions of Dutch odour units per sack of flour.
The research has also shown that variability of process variables and types of bread, including special products that are part of a typical range, has no demonstrable impact on the scale of the odour emissions, with the exception of the percentage of buns and rolls that is being baked.

* 'Industry-wide investigation into odour emissions from bread bakeries', performed under the authority of NBS by DHV Milieu & Infrastructuur, January 1995, MT-RE944418 and 'Results of research by telephone into living conditions (TLO) performed in the vicinity of bread bakeries', August 1995, MT/RE950059 (can be ordered from Nederlandse Bakkerij Stichting, The Hague). (In Dutch only.)

*Nuisance level and limit values*
In these regulations no maximum odour concentration level is specified. The reason is that no correlation could be established between actual odour concentrations and the percentage of people experiencing of odour nuisance.
Quantitative verification of the emission or immission within the framework of issuing permits is therefore not a good idea.
Nuisance caused by odours produced by bakeries is rarely reported. As a rule acceptable nuisance levels will not be exceeded if the measures indicated in these regulations are implemented.

**Nuisance level and verifying compliance with standards**
In these regulations no numerical specifications for odour levels are included. The main reason is that no clear correlation could be established between actual odour concentrations and the percentage of people complaining of odour nuisance. From the research by telephone into living conditions (TLO) that was carried out in the vicinity of eight bakeries it was found that in the case of an exposure to more than 8 $ou_E/m^3$ as 98$^{th}$ percentile, not more than 8% of respondents reported experiencing nuisance. This group was exposed to concentrations between 16 and (an indicative maximum of) 55 $ou_E/m^3$. None of the respondents indicated that they experienced major odour nuisance due to the bakeries. Around the 8 bakeries there were never more than 12% people complaining of odour nuisance. The arrangements as regards the nuisance situation are based on the TLO carried out in August 1995. It is found under the actual conditions, too, that problems with odour nuisance are relatively rare within this branch of industry.
Considering the above a qualitative assessment is considered to suffice.
Implementing the measures indicated will not result in complete prevention of odours. But the fact alone that odours produced by bakeries are noticeable does not necessarily mean that anyone will experience nuisance.

*Measures*
The set of measures and facilities relevant in the case of bakeries consists of:
- Extraction by mechanical means or through natural draught of vapours by means of an extractor placed over the point where the finished product leaves the oven. Both the vapours and the flue gases must be vented to the atmosphere through a suitable ventilation shaft/stack and dispersion in the bakery must be prevented.
- Letting bread cool down must always be done indoors.
- The emission point of vapours and oven flue gases must extend a minimum of 1 metre above the highest rooftop found within 25 metres of the emission point, unless it is expected that no relevant influence on the dispersion will occur due to adjacent buildings.

Where objects sensitive to odour nuisance are found within 50 metres of the emission point:
- every rain hood must be constructed in such a way that the vertical outflow of gases is not restricted; when existing emission points are replaced, unobstructed vertical outflow must be ensured under all circumstances;
- all emissions of ventilation air from baking and cooling areas must occur above roof level.

**Measures**
The Special Regulations specify measures which can be made obligatory if nuisance occurs or is expected. Almost 80% of total odour emissions originate from the ovens. For this reason an effective dispersion of vapours and oven flue gases into the surrounding area should be the first line of approach. Only in situations where the odour nuisance occurs close to the bakeries dispersion of ventilation air from the production areas deserves further attention.
Influx of air through open windows or doors or ventilation openings in the outer walls of the building does not have any impact on the dispersion of odours.

Effective dispersion of the emissions is a key consideration in deciding whether an emission point must extend to above the buildings in the vicinity. In the case of certain buildings, extensions or superstructures such as for example a silo park it may reasonably be expected that they have a limited impact on the dispersion. The local situation will be the deciding factor in your considerations.
In certain especially problematic situations extension of the emission point (to more than 1 metre above roof level) can be considered within the framework of the ALARA principle.
End-of-pipe technology is not used under the actual conditions to our knowledge.

## B4 Rusk and pastry bakeries

*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 appertain to existing operations and extensions thereof which produce rusks and pastries on an industrial scale and do not fall under a GAO pursuant to Article 8.40 of the Wm (Environmental Protection Act).

*Sources*
Odour emissions from rusk and pastry bakeries originate from the ovens and building ventilation. Industry-wide research into odour* has yielded key emission figures for both sources for various categories of products (please refer to table 1).

**Table 1 Key emission figures per product group ($10^6$ $ou_E$/tonne)**

| Product group | Ovens | Ventilation air of production areas | Total |
|---|---|---|---|
| Pastries with a high moisture content | 15 | 12.5 | 27.5 |
| Confectionery | 35 | 12.5 | 47.5 |
| Cake loaf | 42.5 | 7.5 | 50 |
| Non-sweet pastries | 62.5 | 5 | 67.5 |
| Waffles | 120 | 20 | 140 |
| Biscuits | 30 | 25 | 55 |
| Rusks | 175 | 135 | 310 |

The scale of the odour emissions per hour can be calculated by multiplying the production per unit of time (in tonnes per hour) with the key emission figure per product group. In this context the values found and averaged over time (weighed by time of day) of the periods during which emissions occur are considered as relevant (please refer to the calculation example for the method of taking the operating period into account).

**Categories of products**
The categories of products produced in the industry are the basis on which the listing below is based. Various products not explicitly mentioned can easily be assigned to one of the categories mentioned.

- *Pastries with a high moisture content (fresh and deep frozen):* choux pastry (with various types of icing), cream slices, apple dumplings/fritters, cream-filled cakes, puff pastry with various fillings, sponge cakes with fruit toppings, fruit tarts, cake based pastries, apple pie, etc.
- *Confectionery (cookies and remaining types of pastry):* short biscuits, shortbread/shortcake, (puff) pastry with or without almond paste, meringues, sponges, cookies with mixed spices, etc.
- *Cake loaf (and gingerbread):* various types of ginger loaf (with spices, ginger, dried fruits), gingerbread, etc.
- *Non-sweet pastries (cookies and remaining types of pastry):* cheese sticks, savoury sticks, puff pastry shells and other products, semi-finished products, etc.
- *Waffles:* oublie waffles, treacle waffles, filled waffles, etc.
- *Biscuits:* petit beurre, tea biscuits, digestives, Marie biscuits, chocolate covered biscuits, army biscuits, health and lifestyle biscuits, filled biscuits, biscuits with (desiccated) coconut, etc.
- *Rusks (and toast):* rusk rolls, rusks, wholemeal rusks, etc.

*Dispersion*
On the basis of the average odour emission level (in $ou_E$ per hour) and the effective level of discharge it is possible to determine the distance at which a certain concentration occurs in the surrounding area.

To this end the nomograms in Figures 1 through 4, which are derived from the LTFD model, can be used. For operating situations with multiple emission points the height and location of the individual emission points can be averaged.

*Nuisance*
A level of 5 $ou_E/m^3$ as 98$^{th}$ percentile in the built-up areas or other objects sensitive to odour involved must be used as a target not to be exceeded.

* Industry-wide investigation into odour emissions from pastry bakeries, TNO report 91-363, can be ordered from Verbisko, The Hague (in Dutch only).

**Nuisance**

The correlation between odour concentration and nuisance has been determined at a single operator in the sector of industry involved*, among other reasons because not many situations exist where the limiting conditions for a TLO are met. The results of this TLO indicate that in the situation considered at the time the level of 12% people complaining of odour nuisance occurred in the case of an emission level of 5 $ou_E/m^3$ as 98th percentile.

In adopting the value of 5 $ou_E/m^3$ as 98th percentile as a target, the technically feasible measures and a number of economic data were taken into consideration, in addition to the nature of the odours and the complaint situations on record. It is a value to which exceptions can be made in rare cases and on duly stated grounds, on the grounds of local considerations and of a weighing of the aimed for results against the business economics consequences.

* Nuisance poll on the pastry manufacturing industry, TNO R95-224, can be ordered from Verbisco, The Hague (in Dutch only).

*Measures*

Potential measures to be taken in the case of reported nuisance are:

For the ovens:

- raising the emission points of the ovens, a measure which has its limits due to technical aspects related to the construction of the ovens; where the effect of raising individual emission points is expected to be insufficient the waste gases can (partially) be vented via a common waste gas duct to a central, elevated emission point.

For ventilation air:

- use of forced exhaustion of the air in the production halls and reducing the possibility of fugitive dispersion; such measures are especially effective if the distance to the objects sensitive to odour nuisance is less than 100 metres.

Generally speaking, the LTFD model has not been validated for distances under 100 m. It has been found, though, that when the emission points are raised to an effective height of between 10 and 25 metres the odour concentration at distances of less than 100 metres from the source will drop to under 5 $ou_E/m^3$.

**Measures**

Raising the emission points of the ovens can technically speaking be deemed to have general applicability. The maximum height which can be demanded depends on the situation, and is determined by the technical options offered by the construction. In general the extensions are limited to a length of 8 m upwards of the oven roofs and approximately 6 m above roof level.

Combining several emission points and venting them via a central elevated stack is technically feasible, but this has an impact on the baking properties of the oven. Other options available in order to limit the emissions further have not emerged from the research.

In situations where the nuisance occurs within 100 m of an operation use of the nomograms is inappropriate. Inside the range of 100 m the validity of the model on which the nomograms are based is limited. By raising the emission point it can be guaranteed that the concentration of 5 $ou_E/m^3$ as 98th percentile is not exceeded at distances of less than 100 m from the emission point. To this end it will be necessary, depending on the scale of the production, to demand an effective height of between 10 and 25 m.

Any restrictions on the height to which the emission points can be raised within the context of physical planning requirements must be resolved giving due attention to the situation at the operator involved.

The costs of the measures mentioned in these regulations measures are considered reasonable by the industry as a whole. However, the costs of raising the (central) emission point(s) of the oven waste gases can vary considerably depending on the number of emission points and the local situation at the operator's.

In individual situations it must be investigated whether, and to what extent, raising the (central) emission point(s) and/or implementing forced exhaustion of air from the production halls is considered necessary and justifiable. For both measures the costs can be considerable both in terms of the level of investment required and the financial resources of the average operator in this sector. The nature of the odours and the fact whether other environment protection measures are also taken can be taken into consideration in taking the final decision.

**Table 2 The (actual) annual operating periods and the assumed operating period (for using the nomograms)**

| Annual operating period (hours/year) | Assumed operating period (nomogram, hours/year) |
|---|---|
| 0 to 1400 | 1000 |
| 1400 to 2600 | 2000 |
| 2600 to 4700 | 4000 |
| 4700-continuous | 8500 |

**Table 3 Level of discharge and effective level of discharge**

| Level of discharge (average, in metres) | Effective level of discharge (model/nomogram) |
|---|---|
| 0–7 | 0 |
| 8–12 | 5 |
| 13–20 | 10 |
| 21–33 | 25 |
| 34–40 | 40 |

**Figure 1 Distances to the contour of 5 $ou_E/m^3$ as 98th percentile in the case of various stack heights and 1000 operating hours**

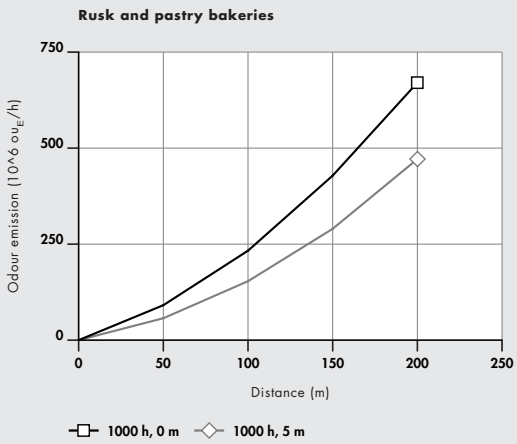



**Figure 2 Distances to the contour of 5 $ou_E/m^3$ as 98th percentile in the case of various stack heights and 2000 operating hours**

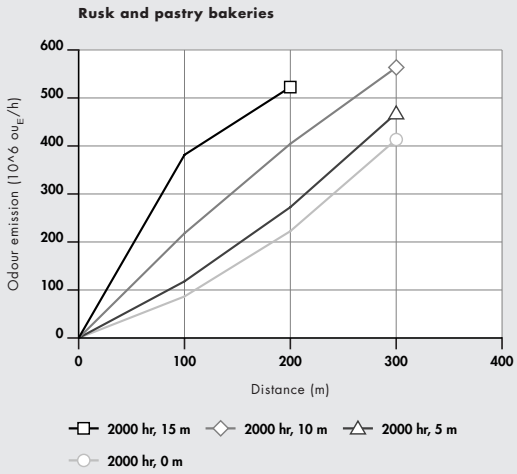



**Figure 3 Distances to the contour of 5 $ou_E/m^3$ as 98th percentile in the case of various stack heights and 4000 operating hours**

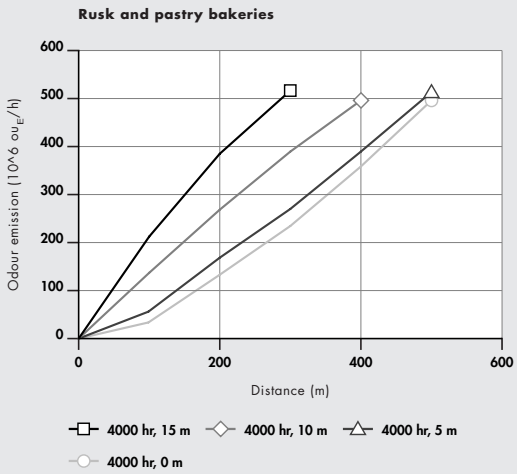
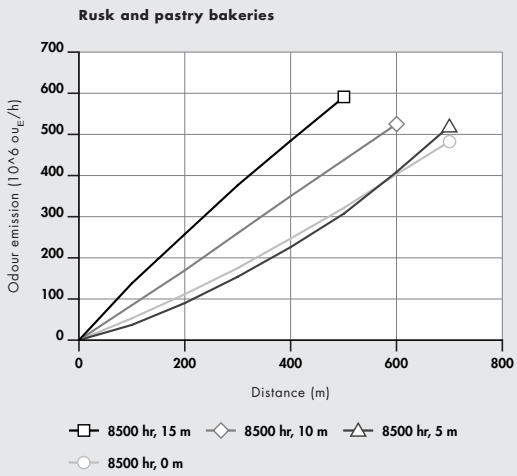



**Figure 4 Distances to the contour of 5 $ou_E/m^3$ as 98th percentile in the case of various stack heights and 8500 operating hours**




**Calculation example to demonstrate how the operating period must be taken into account**

*Production statistics*

Product A is produced during in total 2500 hours per year, product B during 3000 hours and product C during 4500 hours per year.

*Taking the operating period into account*

The annual operating period of an operator is equal to the longest annual production period of a certain product group, in this case 4500 hours. For the operating period the nomograms offer four possible values.

The emission factor for a given product is calculated by multiplying the key figure for that product group given in table 1 with the production per hour. The emission factor for product A is therefore an emission expressed in $ou_E$ per hour. The same applies to B and C. On the basis of these values the total emission is calculated.

| | |
|---|---|
| Total emission for product A: | emission factor product A (efA) x 2500 hours |
| Total emission for product B: | emission factor product B (efB) x 3000 hours |
| Total emission for product C: | emission factor product C (efC) x 4500 hours |
| Total annual emission: | 2500 x efA + 3000 x efB + 4500 x efC ($ou_E$/year) |

The average emission per hour is calculated by dividing the total annual emission by the operating period:
(2500 x efA + 3000 x efB + 4500 x efC)/4500

On the basis of the calculated odour emission it is possible, for a given effective level of discharge and the assumed annual operating period, to determine the distance at which the concentration of 5 $ou_E/m^3$ occurs from the nomogram. The operating period in the example is 4500 hours per year. The distance can be read from the nomogram for a 4000 hours operating period.

## B5 Meat 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.*

Within the meat industry various activities are distinguished. The industry-wide investigation into odours in the meat industry has resulted in a list of odour emissions from the activities distinguished in the meat industry and also established the correlation between the odour nuisance and the subjectively perceived nuisance. The aspect of odour nuisance is relevant for slaughterhouses, fat rendering plants and producers of meat products. For these activities separate odour concentration levels are included in §1, 2 and 3 of these regulations.
For the meat processing sector in 2000 the publication '*Werkboek milieumaatregelen vleesindustrie* (Workbook on environment protection measures in the meat industry)' with measures which can be included in the permit through reference to company environmental plans (CEPS).

**Emission factors**
The emission factors in the tables in these regulations are derived from the industry-wide investigation (Report: '*Bedrijfstakstudie geur vleesindustrie* (Industry-wide investigation into odours in the meat industry)', PRA report number pvf493a3, 1994, under the authority of the Produktschap voor Vee, Vlees en Eieren (Commodity Board for Livestock, Meat and Eggs)). For more background information and calculation examples please refer to this publication.

### 1 Slaughterhouses

*Scope*
These regulations are applicable to slaughterhouses requiring a permit for pigs, cattle, calves, sheep, chickens, turkeys and ducks, as well as casualty slaughtering locations.

*Sources of emission*
The odour emission for each facility is determined by adding up the odour emissions per unit using the pertinent odour emission factors. These are listed in table 5 through 8.
The odour emissions from slaughterhouses must initially be considered without taking the contribution of the waste water treatment plant into account. If it is found on the basis of the indicative emission factors that the emission from the sewage treatment plant (STP) makes a relevant contribution to the overall emission it may become necessary to carry out further research into this emission.

As a rule a well-dimensioned and well-operated STP will not give rise to odour related problems.
With the aid of the calculated odour emissions and the nomograms in the regulations (tables 5 through 8 and figures 1 through 4) it can be established at which distance the odour concentrations indicated in these regulations occur.

*Nuisance level*
An odour concentration level of 1.5 $ou_E/m^3$ as 98$^{th}$ percentile in the built-up areas or other objects sensitive to odours involved may not be exceeded. Where odour abatement measures are taken this value must be met or improved on.
Where the odour concentration is between 0.55 and 1.5 $ou_E/m^3$ as 98$^{th}$ percentile the competent administrative body must decide whether measures aimed at further reduction are necessary. For assessing the situation odour nuisance classification system must be used (refer to §3.6).
Below a calculated odour concentration of 0.55 $ou_E/m^3$ as 98$^{th}$ percentile measures are not necessary.

**Nuisance level**
On the basis of (among other things) the industry-wide investigation into the correlation between odour nuisance and subjectively perceived nuisance, the options offered by Best Available Control Technology and the cost benefit analysis at industry level it has been concluded that in most cases no measures are required if the odour concentration at the nearest object that has to be protected is lower than 0.55 $ou_E/m^3$ as 98$^{th}$ percentile. It is very unlikely that nuisance will be experienced at levels below this value. In the case of odour nuisance levels higher than 1.5 $ou_E/m^3$ measures will be required in almost all situations. The level of 1.5 $ou_E/m^3$ must be applied as a limit value to which exceptions are only possible in exceptional cases, which exceptions are only possible on duly stated grounds. In the case of concentrations between 0.55 and 1.5 $ou_E/m^3$ the measures contemplated must be assessed within the context of the local situation to determine whether they are necessary and economically feasible. The competent authorities will determine which objects sensitive to odour nuisance must be protected in accordance with the given maximum nuisance levels. In this context it will be taken into account that there must be a fair balance between the effort demanded from the permit holder and the effect on the environment one seeks to achieve. This careful consideration may result under the actual conditions in the case of scattered dwellings or dwellings on an industrial estate in a higher odour nuisance level being declared acceptable.
If an operator implements measures which reduce the concentration from levels in excess of 1.5 $ou_E/m^3$ to a value between 0.55 and 1.5 $ou_E/m^3$ it must be pointed out to the applicant that more stringent measures can be demanded if the residual nuisance is deemed unacceptable. It will be advisable to lay down arrangements regarding the phased implementation of such measures.

The value of 1.5 $ou_E/m^3$ as 98th percentile is considered to constitute the borderline between that which is desirable from an environment protection point of view and that which is feasible from a business economics point of view. At the time when the regulations were adopted approximately 20 per cent of operators fell into the intermediate category with emissions of between 0.55 and 1.5 $ou_E/m^3$.

*Measures*

For slaughterhouses the possible measures can be subcategorised according to their nature, namely as organisational/good housekeeping measures, process integrated measures and end-of-pipe technologies. The following measures fall under 'good housekeeping'.

**Table 1 Good housekeeping measures**

- Keeping the washing facilities clean
- Shower installations in the lairages in order to limit stress
- Keeping floors and walls clean
- Daily removal from the premises of materials destined for rendering
- Reduction of drip water

In addition to these good housekeeping measures, it is indicated in the following tables per type of slaughterhouse and per source distinguished which measures, from which a selection can be made in order to comply with the desired reduction of odour levels, are possible.

**Measures**

As regards the actual measures to be taken, this is left to the consultations between operators and the competent administrative body. There is no preference for certain types of measures. The order of the options listed in the tables does not constitute a ranking according to preference. Where the columns 'process integrated' and 'organisational' do not specify any measures the rule applies that no process related measures of general applicability have been determined. If in individual cases possibilities for such measures present themselves, they should in principle be preferred.

Generally speaking, measures must be devised which have a maximum effect (and are as cost effective as possible). It usually makes sense to try to control the sources with the greatest impact first.

**Table 2 Measures for pig slaughter halls**

| Source | Organisational | Process-integrated | End-of-pipe |
|---|---|---|---|
| Loading/ unloading | adequate lairage facilities, co-ordination of lairage capacity and number of animals being supplied | unloading animals indoors | biologically active filter (90%) biological waste gas treatment facility (80%) |
| Cleaning of lorries | adequate covering over of washing facilities, dry removal of manure from lorries | | |
| Lairage | | enclosed lairage | biologically active filter (90%) biological waste gas treatment facility (80%), elevated emission point |
| Killing area | | | biologically active filter (90%) biological waste gas treatment facility, elevated emission point |
| Singeing | | | biologically active filter (90%) biological waste gas treatment facility (80%), elevated emission point |
| Butchering area | | | |
| Processing of gastro-visceral complex | | | biologically active filter (90%) biological waste gas treatment facility (80%), elevated emission point |
| Materials destined for rendering | regular removal | enclosed, chilling/ refrigerated storage (indoors) | biologically active filter (90%) biological waste gas treatment facility (80%), sorption filter, elevated emission point |
| Blood intended for rendering | regular removal | cold storage | sorption filter, vapour recovery |
| Waste water treatment plant physical/ chemical | appropriate dimensioning and operation | limited ventilating | |
| Waste water treatment plant, | appropriate dimensioning and operation | covered over | biologically active filter (90%) |

**Table 3 Measures for cattle, calves and sheep slaughterhouses**

| Source | Organisational | Process-integrated | End-of-pipe |
|---|---|---|---|
| Loading/ unloading and cleaning of lorries | co-ordinating number of animals supplied and slaughtering capacity, keeping washing facilities clean | eliminating seams, flushing of drains | |
| Stables | co-ordination of number of animals supplied and slaughtering capacity | | biologically active filter (90%) biological waste gas treatment facility (80%) |
| Exsanguination and butchering area | | | biologically active filter (80%) biological waste gas treatment facility (80%), elevated emission point |
| Processing of gastro-visceral complex | | | biologically active filter (90%) biological waste gas treatment facility (80%), elevated emission point |
| Storage of skins or hides | | | |
| Materials destined for rendering | regular removal | covering over, indoors storage, chilling/cold storage in silos with separate compartments | biologically active filter (90%) biological waste gas treatment facility (80%), sorption filter, elevated emission point |
| Blood intended for rendering | regular removal | chilling/refrigerated storage, loading and unloading operations indoors | sorption filter, vapour recovery |
| Waste water treatment plant biological | appropriate dimensioning and operation | covered over | Biologically active filter (90%) |

**Slaughterhouses**

Determining the odour emission is done by multiplying the emission factors per part of the slaughterhouse by the determinant unit (number of animals, lorries etc). By adding up the emission flows obtained in this way for each part of the process the total emission can be calculated.

In the case of odour emissions of less than 5 x $10^6$ $ou_E$/hour it is usually possible for all types of slaughterhouses to decide against measures aimed at limiting odour emissions in addition to the basic measures.

The necessity of determining the actual odour emissions is not relevant in most cases if the production capacity per hour does not exceed 8 pigs, 5 cattle, 14 calves, 54 sheep, 400 chickens, 56 turkeys or 28 toms, or 300 ducks. For the purpose of this assessment it is valid in the case of horses to use the same criteria that apply in the case of cattle, in the case of goats to use those for sheep.

In the case of casualty slaughtering or slaughterhouses where more than one species of animal is processed the odour emissions are determined in proportion to the contributions made by the various categories of animals distinguished here (a calculation that can serve as an example is quoted in the report on the industry-wide investigation).

**Table 4 Measures for poultry slaughterhouses**

| Source | Organisational | Process-integrated | End-of-pipe |
|---|---|---|---|
| Supply and unloading | co-ordination of number of animals supplied and capacity of waiting area | indoors waiting area, unloading animals indoors | biologically active filter (90%) biological waste gas treatment facility (80%), elevated emission point |
| Hanging animals on slaughtering line and washing of crates | | | Particulates removal unit, biologically active filter, biological waste gas treatment facility |
| Drowsing through plucking | | | biologically active filter (90%) biological waste gas treatment facility (80%), elevated emission point |
| Ready-to-prepare department | | | biologically active filter, biological waste facility, elevated emission point |
| Processing of offal: | | indoors storage | biologically active filter (90%) biological waste gas treatment facility (80%), elevated emission point |
| • blood intended for rendering | regular removal | chilling/refrigerated storage, loading and unloading operations indoors | carbon filter/ vapour recovery fitted to vents |
| • feathers | | keeping containers covered, indoors storage | |
| • materials destined for rendering | regular removal | chilling/cold storage or heat treatment, indoors storage, covered storage | |
| Breading department | | | biologically active filter, biological waste gas treatment facility, elevated emission point |
| Waste water treatment plant, biological | appropriate dimensioning and operation | covered over | biologically active filter (90%) |

**Table 5 Emission factors for pig slaughter halls**

| Source | Calculation odour emission $10^6$ $ou_E/h$ |
|---|---|
| Supply and unloading | $3.85 \times W_1 + 0.065 \times V$ |
| Cleaning of empty vehicles | $3.85 \times W_2$ |
| Stables | 0.00455 |
| Killing area | 0.155 x H |
| Singeing | based on scorching oven: 0.047 x H |
| Butchering area | 0.021 x H |
| Processing of gastro-visceral complex | 0.0255 x H |
| Outdoors storage of offal (silo/container) | enclosed storage: 1<br>open storage: 2 |
| Indoors storage of offal | per silo/container: 2 |
| Transhipment of offal | per 10 minutes of unloading time: 5 (do not include in determining output of the source!) |

H = number of animals butchered per hour

$W_1$ = number of vehicles (average, present in one hour for supply and unloading)

$W_2$ = number of vehicles (average, present in one hour at the cleaning site)

V = number of animals delivered per hour

Vh = average number of animals present per hour in the stables

**Table 6 Emission factors for cattle, calves and sheep slaughterhouses**

| Source | Calculation odour emission $10^6$ $ou_E/h$ |
|---|---|
| Supply and unloading | 0.0365 x R; 0.015 x K; 0.0028 x S |
| Cleaning of empty vehicles | included in supply |
| Stables | 0.0155 x R; 0.0105 x K; 0.001 x S |
| Exsanguination area including butchering hall | 0.280 x H (R); 0.032 x H (K); 0.0305 x H (S) |
| Processing of gastro-visceral complex | 0.30 x H (R); 0.15 x H (K); 0.02 x H (S) |
| Storage of skins or hides | 0.004 x H (R); 0.002 x H (K); 0.001 x H (S) |
| Outdoors storage of offal (silo/container) | enclosed storage: 1<br>open storage: 2 |
| Indoors storage of offal | per silo/container: 2 |
| Transhipment of offal | per 10 minutes of unloading time: 5 (do not include in determining output of the source!) |

H = number of animals butchered per hour

R = number of cattle delivered per hour

K = number of calves delivered per hour

S = number of sheep delivered per hour

**Table 7 Emission factors for poultry slaughterhouses**

| Source | Calculation odour emission $10^6$ $ou_E/h$ |
|---|---|
| Supply and unloading | indoors: 0.00055 x Dh (k)<br>0.00115 x Dh (he); 0.0022 x Dh (ha)<br>0.00055 x Dh (e)<br>outdoors: 0.00275 x Dh (k)<br>0.0060 x Dh (he); 0.0110 x Dh (ha)<br>0.0028 x Dh (e) |
| Hanging animals from butchering line including crate washing facility | 0.00075 x H (k)<br>0.00375 x H (he); 0.0075 x H (ha)<br>0.00115 x H (e) |
| Drowsing through plucking | 0.00155 x H (k)<br>0.034 x H (he); 0.07 x H (ha)<br>0.00235 x H (e) |
| Ready-to-prepare departmen | 0.00065 x H (k)<br>0.0035 x H (he); 0.007 x H (ha)<br>0.00095 x H (e) |
| Breading department | 0.003 x H (kg meat/hour) |
| Processing of offal, including storage of blood, feathers etc. | 0.0013 x H (k)<br>0.0065 x H (he); 0.0125 x H (ha)<br>0.00195 x H (e) |

H = number of animals butchered per hour

Dh = average number of animals present per hour

k = number of broilers

he,ha = number of turkeys or toms

e = number of ducks

In determining the odour immission a distinction is made between operating periods of 8 and 10 hours per day in the case of a five-day week. The operating period is defined as the period during which slaughtering operations are carried out (including breaks), plus one hour for cleaning up. If the facility has non-standard operating periods, the distance within which nuisance is generally felt to occur must be estimated through extrapolation of the values quoted here.

The distance at which the concentration indicated in the regulations occurs due to the odour emissions can be determined using the nomograms (Figures 1 and 2).
To this end the subjectively weighted imaginary origin of the odours is situated at the scorching/singeing oven in the case of pig slaughter halls and at the most significant source in the case of other slaughterhouses. This assumption can give rise to inaccuracies where the distances between the various sources are large as compared to the distance at which the odour concentration must be determined. In such cases it may be necessary to do a calculation using the applicable National model on the basis of emissions from more than one source in order to obtain a more accurate estimate.

**Waste water treatment plant**

The contribution of a waste water treatment plant (STP) cannot be incorporated in the calculations used for quantifying the total odour emissions from a meat processing operator because this factor - in contrast to the odour emissions from the other individual processes - is continuous by nature. The key emission figures listed below serve to provide an insight into the ratios of the emissions by the various sources of the STP in comparison to the production process and, based on these findings, to decide on the relevance of further research (if any) into the emissions contributed by the STP. Because of a substantial variability in the implementation, dimensioning and manner of operating of STPs the information quoted can only serve as an indication.

**Table 8 Emission factors for waste water treatment plant**

| Source | Calculation odour emission $10^6$ $ou_E/h$ |
|---|---|
| Physical/chemical (pre)treatment: | 1 |
| Biological treatment: | aeration: 0.125 x surface area (in $m^2$)<br>post-treatment sedimentation: 0.03 x surface area (in $m^2$) |

**Figure 1 Distance to the contours of 0.55 and 1.5 $ou_E/m^3$ as 98th percentile in a north-easterly direction from the source, operating period 2080 hours**

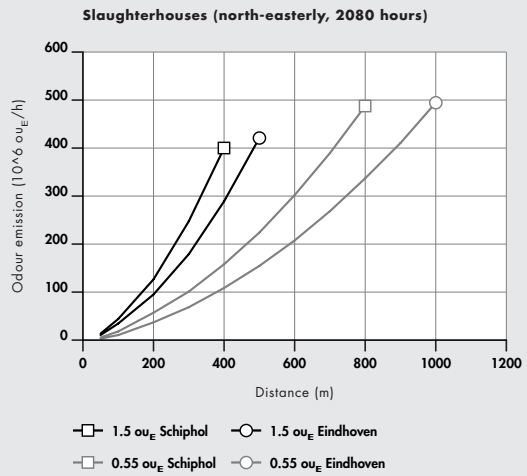



**Figure 2 Distance to the contours of 0.55 and 1.5 $ou_E/m^3$ as 98th percentile in a south-westerly direction from the source, operating period 2080 hours. In the figures a distinction is made between locations within The Netherlands to the east and to the west, respectively, of an imaginary line running from Bergen op Zoom to Delfzijl – the examples given here being Eindhoven and Schiphol, respectively**

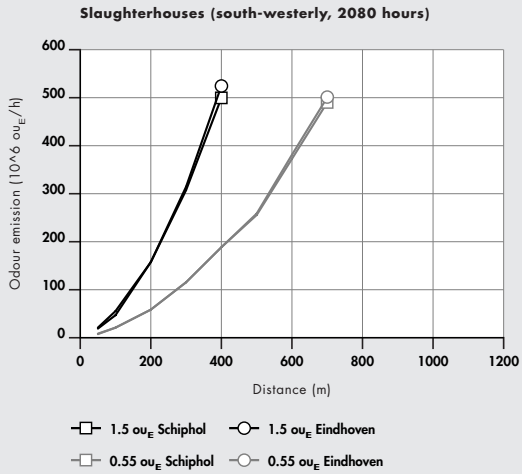



**Figure 3 Distance to the contours of 0.55 and 1.5 $ou_E/m^3$ as 98th percentile in a north-easterly direction from the source, operating period 2500 hours**

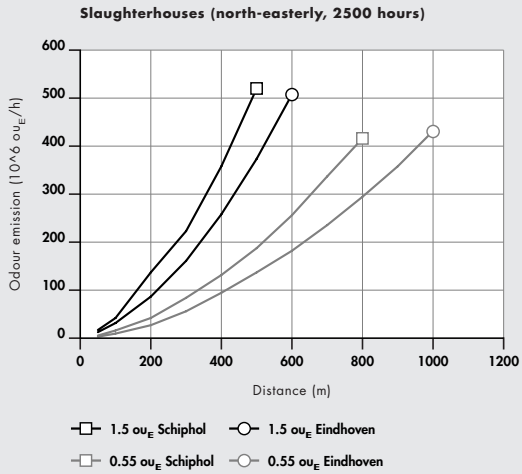
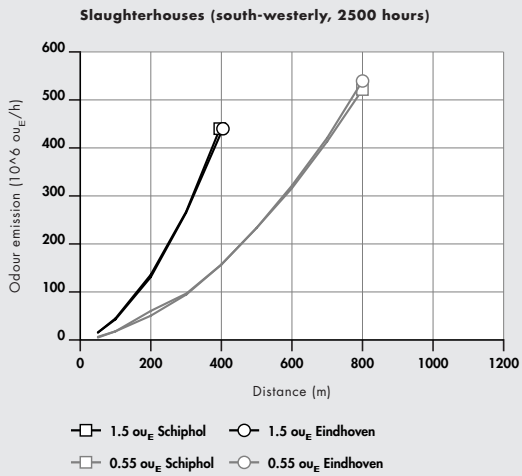



**Figure 4 Distance to the contours of 0.55 and 1.5 $ou_E/m^3$ as 98th percentile in a south-westerly direction from the source, operating period 2500 hours**



## 2 Fat rendering plants

For slaughterhouses where in addition to the sources mentioned a fat rendering plant is present the rule applies that the odour emissions resulting from this facility must be added to the emissions from the remaining sources.
The emission factors for fat rendering plants are indicated in Table 10.
For dry rendering plants no practicable emission factor could be derived from the report on the industry-wide investigation into odours produced by fat rendering plants (Report: *'Bedrijfstakstudie geur vetsmelterijen* (Report on the industry-wide investigation into odours produced by fat rendering plants'), PRA, 1994, report number bofe94a2; can be ordered from the Bofed).
Fat rendering plants which are isolated from slaughterhouses and operate as a separate facility can be assessed using the same odour immission concentrations applicable to slaughterhouses.
In the case of levels in excess of the quoted immission concentration levels the following measures are applicable to fat rendering plants:

**Table 9 Measures for fat rendering plants**

| Source | Organisational | Process-integrated | End-of-pipe |
|---|---|---|---|
| Melting installation | | | biologically active filter (90%) biological waste gas treatment facility (80%), elevated emission point |
| Cooling facility | | | biologically active filter, biological waste gas treatment |
| Area ventilation | good housekeeping | adequate separation of processing fumes and ventilation air | |
| Waste water treatment plant, biological | | proper dimensioning, covering over | biologically active filter |

**Fat rendering plants**
In cases where a fat rendering plant is part of a slaughterhouse the emission of this facility must be added to the emissions resulting from the slaughtering operations. The entire complex will be assessed on the basis of the points of departure used in the case of standalone slaughterhouses. The emission factors for fat rendering plants using a wet process are given in table 10.

**Table 10 Emission factors for fat rendering plants**

| Source | Calculation odour emission $10^6$ $ou_E/h$ |
|---|---|
| Melting installation | 0.00275 x production (in kg raw material/hour) |
| Cooling facility | 0.00275 x production (in kg raw material/hour) |
| Ventilation air of production areas | 0.00015 x production (in kg raw material/hour) |

## 3 Meat processing plants (including industrial cooking of meats)

*Scope*
These regulations are applicable to meat processing operations requiring a permit, including facilities for the production of fast food items such as hamburgers, mince and sausages. Exempt from the present regulations are operators producing other kinds of fast food, TV dinners, ready-made soup and ragout.

*Sources of emission*
The odour emissions from a facility can be determined on the basis of production quantities and emission factors (please refer to table 12) on a per sub-process basis. By adding up the values found the total odour emission is obtained.
If the production of meat products is combined with slaughtering operations the calculated odour emission must be added (in proportion to the relative operating periods) to the emissions resulting from the slaughtering operations. Than the entire complex involved in the production of meat products and slaughtering operations must be assessed using the criteria for slaughterhouses.
With the aid of the calculated odour emissions and the nomograms in Figures 5 and 6 it can be established at which distance the odour concentrations indicated in these regulations occur.

*Nuisance level*
An odour concentration level of 2.5 $ou_E/m^3$ as $98^{th}$ percentile in the built-up areas or other objects sensitive to odours involved may not be exceeded. Where odour abatement measures are taken this value must be met or improved on.
In the case of an odour concentration level of between 0.95 and 2.5 $ou_E/m^3$ as $98^{th}$ percentile the competent administrative body must deliberate whether measures aimed at further reduction are necessary. For assessing the situation the system used for classifying nuisance caused by odours must be used (please refer to §3.6).
Below a calculated odour concentration of 0.95 $ou_E/m^3$ as $98^{th}$ percentile measures are not necessary.

**Nuisance level**

On the basis of (among other things) the industry-wide investigation into the correlation between odour nuisance and subjectively perceived nuisance, the options offered by Best Available Control Technology and the cost benefit analysis at industry level we take the position that in most cases no measures are required if the odour concentration at the nearest odour sensitive object, expressed as a value in $ou_E/m^3$ as 98th percentile, does not exceed 0.95 $ou_E/m^3$. It is very unlikely that nuisance will be experienced at levels below this value.

In the case of odour nuisance levels higher than 2.5 $ou_E/m^3$ measures will be required in almost all situations. The level of 2.5 $ou_E/m^3$ must be applied as an upper limit to which exceptions are only possible on duly stated grounds. In the case of concentrations between 0.95 and 2.5 $ou_E/m^3$ the contemplated measures must be assessed within the context of the local situation to determine whether they are necessary and economically feasible. The competent authorities will determine which objects sensitive to odour nuisance must be protected in accordance with the given maximum nuisance levels.

In this context it will be taken into account that there must be a fair balance between the effort demanded from the permit holder and the positive effect on the environment one seeks to achieve. This careful consideration may result under the actual conditions in the case of scattered dwellings or dwellings on an industrial estate in a higher odour nuisance level being declared acceptable.

If an operator implements measures which reduce the concentration from levels in excess of 2.5 $ou_E/m^3$ to a value between 0.95 and 2.5 $ou_E/m^3$ it must be pointed out to the applicant that more stringent measures can be demanded if the residual nuisance is deemed unacceptable. It will be advisable to lay down arrangements regarding the phased implementation of such measures.

The value of 2.5 $ou_E/m^3$ as 98th percentile is considered to constitute the borderline between that which is desirable from an environment protection point of view and that which is feasible from a business economics point of view. At the time when the regulations were adopted approximately 20 per cent of operators fell into the intermediate category with emissions of between 0.95 and 2.5 $ou_E/m^3$.

*Measures*

For the producers of meat products the potential measures are indicated in Table 11. A selection may be made from these in order to comply with the desired reduction of odour levels.

**Measures**

Based on a list of the sources present and potential measures it must be determined which measures should be preferred. On the basis of the expected emission reductions it can be determined which measures are necessary as a minimum in order to comply with the desired odour concentration. The selection of measures that must be taken will result from consultations between the competent administrative body and the operator; these parties will negotiate the measures which are most appropriate to the situation at hand.

**Table 11 Measures for meat processing plants**

| Source | Process related mesure | End-of-pipe technology |
|---|---|---|
| Hot smoking of sausages and ham | | incinerator (> 99%); condenser (in the case of wet smoking); waste gas treatment facility (50–80%); elevated emission point |
| Cold smoking of sausages | | measures in most cases not necessary |
| Cooking bacon and mince based products | | condenser; biologically active filter (90%) (biological) waste gas treatment facility (80%); elevated emission point |
| Roasting hamburgers | | scrubber (80%), electrostatic fat interceptor, elevated emission point |
| Biological waste water treatment | proper dimensioning, covered over | biologically active filter (90%) |

**Meat processing plants (including industrial cooking of meats)**

Calculation of the odour emissions from the production of meat products is based on the table with emission factors listed below; only the items actually present will be taken into account, of course. Determining the odour emission is done by multiplying the emission factors per part of the meat processing plant by the determinant unit (air flow through the smokehouse, production). By adding up the emission flows obtained in this way for each part of the process the total emission can be calculated.

**Table 12 Emission factors for the production of meat products**

| Source | Calculation odour emission $10^6$ $ou_E/h$ |
|---|---|
| Smoking bacon and articles containing bacon | t x 0.5 x Q (for untreated smoke from smokehouse) |
| Hot smoking of ham | 0.215 x Q |
| Hot smoking of pork sausages and frankfurters | 0.255 x Q |
| Cold smoking of cured sausages | t x 0.01 x Q |
| Roasting hamburgers | 0.8 x P |
| Cooking mince based products | 0.1 x P/100 |

t = time fraction within production time (without dimension)

Q = air flow through smokehouse $m^3/h$*

P = products processed in kg per hour

The distance at which the concentration indicated in the regulations occurs due to the odour emissions can be determined using the nomograms (Figures 5 and 6).

**Waste water treatment plant**
For the contribution from a waste water treatment plant the same applies as in the case of slaughterhouses.

* Air flow through smokehouse in $m^3$, standardised to 293.15 K and 101.325 kilopascal, wet. Conversion of measurements standardised to 273 K: Q x 273/293, emission factor x 293/273

**Figure 5 Distance to the contour of 0.95 $ou_E/m^3$ as 98th percentile in the case of various operating hours**

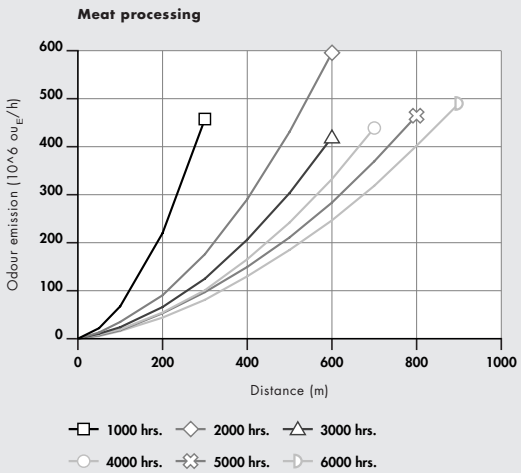
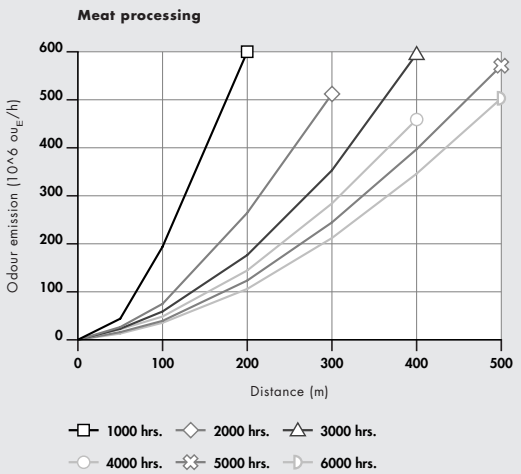



**Figure 6 Distance to the contour of 2.5 $ou_E/m^3$ as 98th percentile in the case of various operating hours**




## B6 Cocoa bean processing 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 Special Regulations are applicable to all existing operators in The Netherlands that process cocoa beans and to any extensions to their facilities.

*Sources of odours*
During the processing of cocoa beans odours are released during pre-processing, preparation, roasting, grinding and due to ventilation of working areas.
Of the total odour emissions 97% originate from the stages of preparing, roasting and grinding.

**Sources of odours**
In table 1 a list is given of sources that are relevant in the case of processing cocoa beans and of the average emission factors. The total emissions differ per operator and amount to between 0.5 and 1.5 million European odour units per kilogram of cocoa beans. The emission depends on the type of product and the equipment used.

**Table 1 Emission factors for the cocoa industry**

| Source (part of process) | Emission factor (average in the case of untreated waste gases) [$10^3$ $ou_E$/kg beans] | Average contribution to the total emission (%) |
|---|---|---|
| Pre-processing | 1.5 | <1 |
| Preparing | 495 | 53 |
| Roasting | 265 | 28 |
| Grinding | 150 | 16 |
| Ventilation air of production area: | 27.5 | 3 |
| Total | 940 | 100 |

The emission factors are quoted from the report: '*Stand van zaken bij het onderzoek naar de geuremissie- en geurimmissie-situatie en de mogelijkheden van bestrijding hiervan bij de cacaobonen-verwerkende industrie* (State of affairs in the research into the odour emission and odour immission situation and the options for eliminating these in the cocoa beans processing industry)', February 1995, TNO Report R95-045.

The relative contribution of the various sources varies somewhat. The variability of the total emissions is however less pronounced than the variability per stage of the process, due to the fact that for example a relatively small emission due to preparing results in a relatively elevated emission during the remaining processing stages.
The contribution of the various sources to the odour immission cannot be summarised unambiguously because this depends (among other things) on the level of emission, the heat-content of the waste gases, the situation of the sources and the distance to the source.

*Limiting odour nuisance*
For the cocoa bean processing industry no concentration has been established above which the odour nuisance is considered unacceptable.
On the basis of the ALARA principle a standard set of measures has been compiled. These measures represent 'Best Available Control Technology' for limiting odour nuisance.

**Limiting odour nuisance**
The cocoa bean processing industry has been making efforts for many years now to eliminate odour nuisance. Among other things, this has resulted in a number of operators investigating and adopting – although the latter with mixed results – a certain odour emissions reducing technology. Examples of technologies that have been implemented are cleaning using biologically active filters and regenerating incineration.
Completely preventing odour nuisance in the vicinity of cocoa bean processing industries seems unrealistic, though, due to the relatively large number of smaller sources of odours and fugitive sources of odours.
Opting for a practical approach to the odour related problems, it was decided to devise a standard set of measures. In this approach all companies concerned must make an effort with – as much as possible – the same level of commitment to limit the odour nuisance.

*Measures*
1 The waste gases from the preparing, roasting and grinding stages must be vented via a stack of sufficient height.
2 The remaining waste gases containing odours (such as ventilation air from working areas and fugitive sources) must, as much as possible, be redirected to this stack as well.
3 The implementation of process integrated measures for controlling the odour emissions will be the point of departure in the case of new investments.

Other measures can be allowed as an alternative to the above-mentioned measures, provided that at least a comparable effect is achieved.
On the basis of an evaluation at industry level it will be assessed whether additional measures are necessary, such as incineration of (part of) the waste gases.

**Measures**
*1 Height of the stack*
For untreated waste gas flows a height of the stack of 60 metres above ground level is generally sufficient.
In cases involving limited odour emissions, for example due to a limited production output or due to pre-treatment of the relevant waste gas flows (for example by incineration), a lower height of the stack may suffice.
*2 Inclusion of remaining waste gas flows*
On a per operation basis it will have to be established by drawing up lists of (fugitive) waste gas flows which of these, with the exception of the three main flows referred to above, are eligible for being vented to the stack.
In determining whether a given waste gas flow must be vented though the stack the technical and financial feasibility will be used as a criterion.
*3 Process integrated measures*
The implementation of process integrated measures in the case of new investments will be assumed to be 'company policy'.
The operator may propose alternative measures. A precondition in this context is that the effect on immission levels must be comparable to the effect of erecting a stack.

*Phased implementation*
At the latest on 1 June 1996 the operators concerned must submit a strategy document to the competent authorities for approval. This strategy document will discuss the phased implementation and the financial consequences of constructing a stack, give arguments for or against venting the various sources via the stack, and discuss scheduled new investments and any alternative measures being considered.

Limiting conditions in this context are:
- venting the three main flows via the stack has the highest priority;
- the latest date by which measures 1 and 2 must have been implemented is 31 December 1999.

**Phased implementation**
In the strategy document the emission of waste gases from the grinding, preparing and roasting stages must be the primary concern, also time-wise. Connecting the remaining (fugitive) waste gas flows may be done step by step over a longer period of time. However, in dimensioning the stack these flows must already be taken into account.
The above-mentioned latest date by which the measures must be implemented of 31 December 1999, must be taken to constitute the latest date by which 'the last' (fugitive) waste gas flow eligible for being connected to the stack is connected.
Prompted by (technical) developments the strategy may be changed, subject to approval by the competent authorities.

**Evaluation**
Evaluation of the measures taken will take place at the local level on an ongoing basis. In the year 2000 the effect of the measures will be evaluated at industry level. On the basis of the actual nuisance situation, any technical developments and the business economics situation it will be assessed whether additional measures and amendment of these Special Regulations are necessary.

## B7 Coffee-roasting houses

*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 installations which are used by coffee-roasting houses excluding decafeination processes.

**Industry-wide investigation**
These regulations are based on the final report '*Onderzoek naar de geuremissie en de mogelijkheden van vermindering hiervan bij koffiebranderijen* (Research into the odour emissions and options for reducing these at coffee-roasting houses)' published by the Vereniging van Nederlandse Koffiebranderijen en Theepakkers (Association of Dutch Coffee-roasting Houses and Tea Packers).

*Odour emissions*
In Table 1 the processes responsible for odours are indicated including the factors that cause odours. It is also indicated whether it concerns a point source or a fugitive source. The nature of the odours is exclusively one recognisable as coffee.

An estimate of the odour emissions can be made with the aid of the formula given below.

$$E(ou_E/\text{hour}) = \frac{H(\text{tonnes of uncleaned coffee/year})}{t(\text{hours during which production takes place/year})} * EF\ (ou_E/\text{tonne of coffee})$$

E = emission in European odour units per hour
H = quantity of unroasted coffee beans in tonnes
t = hours during which production takes place per year
EF = emission factor as determined using Table 1

On a per source and per situation basis it must subsequently be determined what the mass flow, the temperature and the location of the emissions are. The dispersion of odours is subsequently calculated using the applicable National Model.

**Table 1 List of sources of odours**

| Process | Factors responsible for odours | Type of source | Emission factor ($ou_E$/tonne of unroasted beans) |
|---|---|---|---|
| Roasting of coffee beans | Roasting conditions (time and temperature) | Point source, it concerns a stack on the roaster | $0.5 \times 10^9$ without measures |
| | Degree of recirculation | | $0.07 \times 10^9$ with recirculation |
| | Method of heat transfer (fluidised bed or drum) | | $0.0175 \times 10^9$ in the case of recirculation with catalytic incineration |
| Cooling down of coffee beans | Roasting conditions | Depending on the type of installation, this may be a point source or a fugitive source | $0.015 \times 10^9$ in the case of cooling by an air stream |
| | Cooling method | | $0.00375 \times 10^9$ in the case of prior control cooling |
| Grinding unroasted beans and de-gassing | Type of equipment | | $0.06 \times 10^9$ in the case of forced de-gassing |
| | Coarseness of grinding | | $0.0125 \times 10^9$ in the case of de-gassing by natural ventilation |

**Catalytic incinerator**
On the basis of the industry-wide investigation no emission factor could be established for burners equipped with a catalytic incinerator. The calculated effect on odours of a catalytic incinerator (without recirculation) is 75%.

*Immission levels*
An immission concentration of 3.5 $ou_E/m^3$, 98$^{th}$ percentile, calculated using the formula given in these regulations and the applicable National Model, may not be exceeded.

**Maximum immission level**
There is not sufficient information available to establish for the industry generally a correlation between odour concentrations and odour nuisance. However, on the basis of the available information yielded by research, including complaints analysis, and on the basis of the technical and financial options available to the industry, it has been concluded that a maximum immission level of 3.5 $ou_E/m^3$, 98$^{th}$ percentile, should not be exceeded.

**New situations**
The immission levels quoted in these regulations apply exclusively to existing situations.
In new situations such as newly established roasting facilities and/or newly built dwellings the acceptable level will be lower. It is recommended that in new situations sufficient distance be maintained between the coffee-roasting house and the dwellings. Please note that the odour of coffee in the case of immission concentrations below 3.5 $ou_E/m^3$, 98$^{th}$ percentile, will still be very much in evidence.

*Measures*
In the case of levels in excess of a calculated odour immission concentration of 3.5 $ou_E/m^3$ as $98^{th}$ percentile, measures to limit odours are required. The measures presented in Table 2 are relevant to this end.

**Table 2 List of possible measures (ordered by priority)**

| Measure | Criteria |
|---|---|
| Increasing the height of the stack | Can be used in the case of all waste gases |
| Catalytic incineration of waste gases from the roaster | |
| Recirculation of waste gases from the roaster | In the case of a major overhaul or replacement of an installation |
| Pre-treatment of waste gases from grinding and de-gassing operations by means of incineration combined with increasing the level of discharge or cleaning using biologically active filters | Cleaning using biologically active filters in the case of large coffee-roasting houses with sufficient expansion capacity and a continuous process |

## B8 Potato processing 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 of the regulations*
These regulations are applicable to installations used by producers of potato products intended for human consumption, with the exception of producers of potato starch and derivatives.
In these regulations the following product groups are distinguished:
- French fries;
- Long-life products;
- Specialties;
- Dried products.

The waste water treatment plant has not been included in these regulations because it does not give rise to odour nuisance provided that it is well-designed, properly installed and correctly operated.

*Odour emissions*
The nature of the odour emissions from operators in the potato processing industry is determined by the type of product.
The sources within the distinguished product groups are listed in Table 1 in order of significance.
In the regulations for the potato processing industry no key emission figures are quoted.

**Industry-wide investigation**
In the course of the research in order to determine key emission figures it was found that considerable variability exists in the emissions data on the sources which had been investigated earlier by the operators. It therefore proved impossible using the existing information to lay down key emission figures for the potato processing industry. Nor was an acceptable odour nuisance level established during the industry-wide investigation.

*Dispersion of odours*
For the potato processing industry no correlation was established between the number of odour units and the degree of nuisance. Nor have key emission figures been established for the potato processing industry. Calculation of the odour concentration in the surrounding area is not possible on the basis of the key emission figures found by the industry.

*Nuisance*
For the purpose of determining the nuisance level caused by an operator the methods described in the system used for classifying nuisance caused by odours can be used. On the basis of the description of the type of odour it is often possible to identify the source which causes the nuisance. The type of odour is indicated in Table 1, the list of sources.

**Enforcement under the actual conditions**
Where no limit values for odours have been established enforcement of the obligation to implement emission abatement measures must especially aim at the way the operation is run, with a view to the nature of these measures.
Under the actual conditions often measures have already be taken at the steam peeler and installations for the production of dry products because of other environment-related aspects such as noise and particulates. These measures often at the same time reduce odour emissions.

*Measures*
In Table 2 the basic set of measures is indicated. In addition to this, criteria are quoted next to each measure which must be given due consideration. The measures address the major sources.
In the event that the basic measures are not effective enough at eliminating the nuisance, additional measures will be necessary. Measures that can be considered are, among other things, increasing the height of the stack, installing biologically active filters, installing scrubbers, and installing incineration.

**Table 1 List of sources in the potato processing industry**

| Product group | Sources are listed in order of significance within product group | Type of odour |
|---|---|---|
| French fries | Cooling | Frying odour |
| | Frying | Frying odour |
| | Drying | Cooking odour |
| | Degreasing | Frying odour |
| | Ventilation air of production areas | Frying and cooking odour |
| | Steam peeling | Cooking odour |
| Long-life products | Steam peeling | Cooking odour |
| | Ventilation air of production areas | Cooking odour |
| | Blanching | Cooking odour |
| Specialties | Frying | Frying odour |
| | Cooling | Frying odour |
| | Cooking | Cooking odour |
| | Steam peeling | Cooking odour |
| | Ventilation air of production areas | Frying and cooking odour |
| Dried products: Flakes | Rolling | Cooking odour |
| | Cooking | Cooking odour |
| | Steam peeling | Cooking odour |
| Dried products: Granulate | Drying | Cooking odour |
| | Cooling | Cooking odour |
| | Afterdrying | Cooking odour |
| | Cooking | Cooking odour |
| | Steam peeling | Cooking odour |
| | Mixing | Cooking odour |

**Table 2 Standard measures**

| Product group | Sources | Measures | Criteria |
|---|---|---|---|
| French fries and specialties | Cooling | Recirculation using coolant | In the case of a major overhaul or replacement of a cooling tunnel |
| | Frying | Condenser | $T_{out}$ 85 °C maximum |

**Standard measures**
Cooling down fried products in many cases already takes place under contained conditions. A number of locations exist where cooling using air supplied from outdoors is still practised. Demanding a measure under these conditions is only reasonable in the event that a cooling tunnel is receiving a major overhaul or is replaced altogether.
In addition to condensers, other technologies exist which also result in an odour emission reduction, such as for example scrubbers. Depending on the local situation, a careful consideration of the options is indicated. The efficiency achieved by these technologies is generally lower. A condenser has the added advantage that part of the energy can be re-used. The manner in which the condenser is integrated into the production process may differ per location. It depends (among other things) on the use that is made of the heat which is recovered and the temperature of the cooling water that is used. In addition to these factors, in the end the product being fried also determines the efficiency of the condenser. Under the actual conditions the exit temperature can be lower than 85°C in the event that the volume of steam is below the designed maximum. The mass flow is determined by the fan speed.

**Extra measures**
For this branch of industry the rule applies that the standard set of measures should be used as a default which, under the actual conditions, may be adjusted by demanding more stringent measures depending on the actual conditions at the operator's.
Depending on whether nuisance is still being caused and the local conditions there may be occasion to demand extra measures. In addition to the measures mentioned other extra measures are also possible. In the case of extra measures the efficiency at achieving environment protection aims must be weighed against other aspects such as energy consumption, safety and noise, to mention a few points.
In new situations such as newly established operations and/or dwellings it is recommended to maintain sufficient distance between the potato processing operation and the dwellings.

## B9 Aromatics and flavourings manufacturers

*These regulations were included in the NeR in January 1998. 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 all operators who produce aromatics and/or flavourings.

**Industry-wide investigation**
The figures mentioned in these regulations are based for a large part on the research document: '*Categorie 1 onderzoek bij de Geur- en Smaakstoffenindustrie in het kader van de Nota Stankbeleid* (Category 1 research into the aromatics and flavourings industry within the framework of the Policy Document on Odours)', TNO, January 1996, R95-381.

**Scope**
Aromatics and flavourings are produced via basic processing such as extraction and distillation of natural products and by organic chemical reactions. The regulations apply both in the case of a number of large operators with a complex range of products and installations, and in the case of smaller operators with a limited product range that includes for example only aromatics or only flavourings.

*Sources*
During the production of, and in handling aromatics and flavourings, odour emissions occur at various stages of the process. For a number of sub-processes emission factors have been determined, based on emission measurements at three of the major operators.

It concerns the following sub-processes:

- production of flavourings
  - reaction/crystallisation
  - extraction/distillation
- production of aromatics or fragrances
- mixing and weighing of liquid flavouring agents (compounding)
- mixing and weighing of liquid fragrances (compounding)
- spray drying processes
- compounding of powders
- treatment with water
  - physical/chemical
  - biological
- rinsing (cleaning drums/containers and bottles)
- various (storage and transhipment, processing of waste).

**Odour emissions**

Due to the nature of the products being produced (aromatics and flavourings) and the manner of processing (typically in batches) odours are released at various processing stages. The major sources that have been identified and quantified are the following:

**Table 1 Emission factors in the production of aromatics and flavourings**

| Item | Emission factor ($10^6 ou_E$/tonne throughput) | Range |
|---|---|---|
| Production of flavourings[1)] | | |
| Reaction/crystallisation | 25000 | 21000–29000 |
| Extraction/distillation | 250 | 170–350 |
| Production of aromatics and fragrances | 1500 | 600–4000 |
| Compounding and weighing flavourings | | |
| Liquid flavourings | 750 | 550–800 |
| Pastes | 150 | 150 |
| Compounding and weighing liquid aromas or fragrances | 250 | 180–270 |
| Spray drying production | 2500 | 1000–7000 |
| Compounding powders | 50 | 50–70 |
| Treatment with water[2)] | | |
| Physical/chemical | 5 ($10^6$ $ou_E/m^3$ waste water) | 1.5–20 |
| Rinsing | 50 ($10^6$ $ou_E$/tonne)[3)] | 30–110 |
| Miscellaneous | 25 ($10^6$ $ou_E$/tonne)[3)] | 17.5–25 |

1) If no details are available regarding sub-processes then it is recommended that an average odour emission factor of 750 ($10^6$ $ou_E$/tonne) be assumed (range: 170–29000).

2) One operator in the industry has installed a biological waste water treatment facility, on the basis of a single measurement an emission factor of 100 ($10^6$ $ou_E/m^3$ waste water) has been determined.

3) Total throughput of all production units.

**Calculation of the emission**

The total odour emission can be calculated by multiplying the emission factor associated with each part of the process with the throughput and subsequently adding up the results. The total odour emission from large operators (more than 2000 tonnes production per year, approximately 6000 operating hours per year) amounts to (without emission abatement measures) approximately $1.5 \times 10^9$ $ou_E$/hour. For small operators producing 2000 tonnes/year during 2000 operational hours per year this is approximately $1.5 \times 10^7$ $ou_E$/hour.

*Nuisance*

An odour concentration level of 3.5 $ou_E/m^3$ as 98$^{th}$ percentile in the built-up areas or other objects sensitive to odours involved may not be exceeded in existing situations.

Where the odour concentration is between 2 and 3.5 $ou_E/m^3$ as 98$^{th}$ percentile and nuisance is being reported the competent administrative body must decide whether measures aimed at further reduction are necessary. For assessing the situation, the system used for classifying nuisance caused by odours (please refer to §3.6) can be used.

Below a calculated odour concentration of 2 $ou_E/m^3$ as 98$^{th}$ percentile measures are not necessary. For extensions to existing situations Best Available Control Technology must be utilised.

For new situations 2 $ou_E/m^3$ as 98$^{th}$ percentile must be considered the maximum permissible immission concentration.

**Nuisance level**

In the case of three operators measurements by 'smelling squads' were performed. In the case of two out of three operators the results of these measurements were correlated to measured emission values. In the case of one operator the results were correlated to calculated emission values.

From the research carried out by the 'smelling squads' it transpired that the odours released during the manufacture of flavourings are often described as 'unpleasant', even in the case of low concentrations. The odours released during the manufacture of aromatics is readily detected at low concentrations but generally not characterised as unpleasant. The measurements covered the entire range of products produced by the industry. For this reason it has been considered acceptable to base the acceptable nuisance levels quoted in the main body of these Regulations, and which apply to the entire branch of industry concerned, on the arithmetic average of these measurement results.

In the report '*Relatie geurbelasting en geurhinder bij de geur- en smaakstoffenindustrie* (Correlation between odour levels and odour nuisance in the case of aromatics and flavourings manufacturers)', PRA, NEA96B1, May 1997, the current state of affairs with respect to the correlation between odour levels and odour nuisance is discussed. Chapter 3 of the report mentioned in the text frame 'Industry-wide investigation' has since lost its relevance.

*Implementation in phases*
If it is concluded on the basis of the nuisance reported that an unacceptable nuisance situation exists it must be investigated which sources are eligible for odour emission reducing measures. To this end the total odour output from the operation must be calculated on the basis of relevant sources, production statistics and key odour output figures. The sources of odours must be identified and characterised for this purpose, both in terms of the nature of the odours released and of the emission pattern.
On the basis of details discovered about the emissions, the local correlation with nuisance reports, potential reductions and the required costs it will be decided on the basis of ALARA which measures must be implemented.

*Measures*
Measures to limit odour emissions and odour nuisance can be classified as organisational/preventive measures, device specific odour reduction technologies and end-of-pipe technologies.

*Organisational/preventive measures*
The discharge of odours can be limited by:
- use of enclosed process equipment;
- performing minor activities in which strong odours are released in special areas (for example in fume cupboard) in which an underpressure is maintained;
- keeping doors closed during operations;
- limiting or avoiding the production of certain products under adverse weather conditions;
- the use of vapour return systems during draining and filling of drums;
- the use of pumps with high quality seals or fully closed systems;
- covering over of parts of the waste water treatment plant;
- the use of fully closed systems for rinsing empty feedstock containers.

*Device specific technologies (process integrated measures)*
It should be possible to employ simple device specific technologies to limit emissions which reduce the release of aromatics in the production areas. These technologies are effectively part of the piece of process equipment involved and they are also appropriate for eliminating solvents or particulates from air flows. Examples of such technologies are (cascaded) condensers, scrubbers, carbon filters (exhaustion directly at the source), and cyclones/bag filters (at the exit of spray dryers, during compounding powders).

*End-of-pipe technologies for airflows extracted directly (at the source) and indirectly (from production halls)*
For these processes various technologies are available. The decision to opt for any particular technology depends on the quantity and nature of the odour components in the air flows. The approach through end-of-pipe technology is based on extracting air flows containing odours at the source as much as possible. These small and relatively concentrated flows can be treated in incinerators, biologically active filters or using technologies with a similar efficiency.

Any emissions not extracted at the source will be emitted via the ventilation air of the production areas. The ventilation air of the production areas is characterised by large mass flows and low concentrations of odour components and can be purified using biologically active filters or by means of a disposable adsorbing agent. Another possibility is to emit this stream of air via an elevated discharge point.

**Action plan and measures**
Due to the complex process operation, characterised by rapid fluctuations in the odour level and odour concentration, it is difficult to indicate a universally applicable (set of) measure(s) that is relevant to all odour related problems this type of operator may encounter. It will be necessary to identify for each operator the most significant sources of odours or nuisance (on the basis of complaints records). By evaluating the potential technologies it will be possible to take a well-balanced decision regarding the measures that must be demanded. Organisational and preventive measures should be among those considered first.
Before end-of-pipe technology is applied to airflows originating from area ventilation it must first be assessed- as for any source of emissions - whether the emission can be controlled through modification of the process at the source, or at least can be concentrated to a small flow and then be subjected to treatment.

The various waste gas flows released have been assessed by TNO to determine which technologies are most appropriate (Report on the industry wide investigation and interim report entitled '*Effectiviteit en kosten van mogelijke geurimmissiereducerende maatregelen* (Effectiveness and cost of potential odour immission reducing measures)', TNO, 95-08841, November 1995). On the basis of the characteristics most relevant for their cleaning the major waste gas flows containing odours can be classified into four types:
- Type 1: process exhaustion and exhaustion at the source in the case of the production of flavourings and the compounding and weighing of liquid flavourings and liquid aromas or fragrances;
- Type 2: process integrated exhaustion and exhaustion at the source in the case of the production of aromatics and fragrances;
- Type 3: process integrated exhaustion in the case of spray drying equipment;
- Type 4: exhaustion of ventilation air in production and compounding/weighing areas.

Type 1 waste gas flows are characterised by a relatively high odour concentration and a VOC content that may be as high as 100 mg/m$^3$. Cleaning using biologically active filters is an effective technique, increasing the level of discharge is cheaper but also less effective.

Type 2 waste gas flows are characterised by a relatively low odour concentration and a relatively high VOC content. Cleaning using biologically active filters is an effective technique, increasing the level of discharge is cheaper but also less effective.
Type 3 waste gas flows are characterised by a relatively high odour concentration and a relatively low VOC content. In addition to these, a number of high-temperature, humid waste gas flows with a high particulate content fall into this category. This means that a combination of particulate removing techniques and odour limiting technologies is indicated (scrubbing/cooling + cleaning using biologically active filters or bag filters, followed by incinerating).
Type 4 waste gas flows are characterised by a relatively low odour concentration and VOC content. For these emissions cleaning using biologically active filters, adsorption (using disposable agents) and increasing the level of discharge can be considered.

Introducing cleaning using biologically active filters in the case of flows exhausted directly at the source or as an integral part of the process is an effective solution, and the costs are reasonable.

## B10 Breweries

*These regulations were included in the NeR in February 2000. Unless specific requirements for emissions are explicitly mentioned in the following, the general provisions of the NeR will apply.*

*Introduction*
The regulations aim to limit or prevent nuisance caused by odours.

*Scope*
The regulations are applicable to breweries with an average production of at least one brew daily.
The regulations make a distinction between large breweries, where more than 200,000 hectolitres of beer is brewed annually, and small breweries where less than 200,000 hectolitres of beer is brewed.
The regulations are not applicable to maltings.
The regulations are not pertinent to waste water treatment plants operated by breweries.

**Distinction between large and small breweries**
Very small breweries which produce less than one brew daily are often combined with some other activity, like a bar or catering establishment. The situation in that case is strongly dependent on local factors and very specific. That is why for this type of operation no rules of general applicability are given here.
The distinction between small and large breweries on the basis of their annual production, and the criterion of 200,000 hectolitres referred to, is based in excise tax legislation.

The regulations do not specify requirements for waste water treatment plants because a waste water treatment plant which is well-dimensioned and operated in an expert manner will normally not cause any odour nuisance. If nuisance is being reported, though, the competent authorities, following consultations with the operator, must demand that measures be taken.

*Emissions*
There are four sources of odour emissions associated with brewing operations that are relevant here. These are: mashing, cooking the portion of the mash that contains the adjuncts, cooking the wort and various fugitive emissions. Fugitive emissions may result from fermenting, maturing, filtering and bottling operations.

To allow calculation of the odour emissions the following *key figures* have been established.

| | |
|---|---|
| • mashing | 10 $Mou_E$/tonne of ingredients loaded |
| • cooking the portion of the mash that contains the adjuncts | 19 |
| • fugitive sources | 6.5 |
| • cooking the wort | 265 |

**Key figures**
The key figures quoted were obtained during the research into odours carried out under the authority of the brewers' trade organisation (*Bedrijfstakonderzoek geurproblematiek brouwindustrie* (Industry-wide investigation into odour related problems associated with breweries), Witteveen and Bos, 1995).
These figures were verified by recent measurements. The key figures and emission values quoted are relevant for brewing Pilsener-type beer (lager). They may also be used in cases where specialty beers/ales are brewed, provided that such brews constitute only a limited portion of the total production. If specialty beers/ales make up more than several tenths of per cent of the total production, the competent authorities must assess whether it is necessary to use non-standard key figures in determining the emission of odours. Especially in the case of mashing other values may need to be used where specialty beers/ales are involved.
The key figure for the level of the fugitive emissions has been determined on the basis of a transition point percentage of 2.5% of the emission resulting from cooking the wort.

### Nuisance
*Large breweries*
For breweries with a capacity of more than 200,000 hectolitres per annum the following requirements to prevent odour nuisance must be met:

*New situations*
In new situations the odour concentration near objects sensitive to odour nuisance may not exceed 1.5 $ou_E/m^3$ as 98$^{th}$ percentile (hourly values averaged over one year).

**Odour concentration in new situations**
In the course of several polls on nuisance levels around breweries it was found that odour nuisance caused by breweries occurs in the case of odour concentrations above 1 to 1.5 European odour units per $m^3$ as 98$^{th}$ percentile. In lab tests researching the nuisance associated with odours produced by breweries, an odour concentration value of 1.35 to 3 European odour units was established as the threshold where nuisance may occur.
The limit value in the case of new situations has therefore been set at 1.5 European odour units.

*Existing situations*
If due to an existing large brewery the *odour concentration* in densely populated residential areas amounts to more than 1.5 European odour units per $m^3$ as 98$^{th}$ percentile (*hourly values* averaged over one year) then measures must be taken in the form of condensation or vapour re-compression of the cooking vapours from the wort kettle, or of a similar measure with an efficiency of reducing odours of at least 85%.

**Odour concentrations in existing situations**
In existing situations dwellings often lie at very small distances from breweries. In these cases an immission concentration of 1.5 $ou_E/m^3$ as 98$^{th}$ percentile is generally not achievable in the case of the dwellings lying immediately next to the brewery. For this reason this concentration has not been used as a limit value for existing situations. For existing situations the immission level of 1.5 $ou_E/m^3$ is set as a warning threshold level. If the odour concentration exceeds this value the measures mentioned must be taken.
This warning threshold level is not checked in the dwelling lying immediately next to the brewery, but in the nearest densely populated residential area. The competent authorities must determine the relevant immission point. This provision is included in order to take into account the technical options available to breweries for limiting emissions and the historic developments of existing situations.

*Small breweries*
Both in the case of new and of existing breweries the odour emissions must be limited by implementing measures in accordance with Best Available Control Technology for small breweries.

**Hourly average values**
The hourly average values of the odour concentration must be calculated using the applicable dispersion model. In this context it must be taken into account that there may be complicating effects due to a potential influence exerted by landscape features (in hilly country).
In calculating immission contour lines any increase in the actual discharge level due to the heat contents of the discharged vapours must be taken into account.
In assessing the situation it is important to also take into account short-lasting peaks in the odour emissions, in particular during cooking operations, as these may easily cause a nuisance situation to be subjectively perceived.

## Measures

*Large breweries*
The discharge originating from the major source, the boiling process, can be reduced by means of condensation of the vapours or vapour re-compression. Emission reductions of at least 85% can be achieved for odours.
The emissions from fugitive sources can be controlled by measures targeted at good housekeeping.
In addition, it is possible to limit the odour concentration in residential areas by demanding similar measures that have the same effect.

**Measures for large breweries**
The key emission abatement measure is collecting the vapours which are released in cooking the wort. For this, condensation of the vapours or vapour re-compression can be utilised, or a combination of both technologies. Condensation of the vapours and vapour re-compression may be considered as Best Available Control Technology in the case of large breweries. Both can reduce the discharge of odours due to cooking the wort by at least 85%.
Both measures extract heat from the cooking vapours. This heat in many situations can be made available for the brewing process. By cooling down the cooking vapours a large part of the aromatics in the waste gases will condense. This reduces the emission of odours considerably. In the case of a condenser a small residual continuous waste gas flow may remain, which still contains part of the aromatic constituents. In the case of vapour re-compression the brewing kettle remains closed during the greater part of the cooking process. Under these conditions no emissions occur at all. However, for a short time at the beginning of the process the kettle is open. At that time there will be a short-lasting, but untreated emission.
Both measures have a favourable effect on the energy balance of the wort cooking process. For many large breweries the rule applies that the measures will pay for themselves through the energy savings gained. The investments recovery time depends on the specific situation.

More drastic measures aimed at reduction of odour emissions are the following end-of-pipe technologies:
- biological waste gas treatment facilities/scrubbers;
- biologically active filters;
- oxidation of certain odour components using active oxygen;
- adsorption systems employing active carbon or zeolite;
- incineration.

Incineration will have disadvantages in the area of energy consumption if the heat generated cannot be used effectively elsewhere. This means that this particular measure under those specific circumstances will be at odds with the general policy promoting energy efficiency.
The feasibility of using these measures in the case of brewing kettles has not been established yet so that these measures cannot be considered Best Available Control Technology for breweries at this moment in time. When evaluation of the regulations is done this will be assessed.

*Small breweries*
In the case of small breweries the odour concentration at immission level must be limited by implementing measures according to Best Available Control Technology (listed below), by practising good housekeeping, by keeping closed the doors and other openings of installations and production halls must be kept closed. The odour concentration at immission level can also be limited by increasing the level at which vapours from the wort kettle are vented.

Measures according to Best Available Control Technology for small breweries include the following:
- Keeping doors and windows of the brewery closed;
- Keeping the brewer's grains basins covered;
- Regularly cleaning of the brewer's grains silo;
- Limiting the emissions discharged during the fermenting and lagering stages by installing a scrubber to absorb the odour producing components from the carbon dioxide before it is vented to the atmosphere;
- Storing yeast cultures (whether for re-use or disposal) in fully closed tanks;
- Implementing the combination filter (diatomaceous earth and sterilising plates) as a fully closed system (contained conditions);
- Keeping the covers of the rotapool, the brewing kettle and the clarification tank closed;
- Keeping the storage area for spent diatomaceous earth covered over;
- Implementing the sewer system as a fully closed system;
- Filling any cracks or seams in the buildings containing installations.

**Measures for small breweries**
If dwellings are located within a short distance from a small brewery and odour nuisance is being reported, measures can be demanded in the area of good housekeeping in order to reduce the discharge of odours from fugitive sources, or a stack can be required in order to reduce the immission concentration in the residential areas.
The distinction between measures for large breweries and measures for small breweries has been made because in the case of large breweries the investments in emission abatement measures, due to their favourable effect on the energy consumption, can usually be recovered in due time. For small breweries the investments recovery time is considerably longer than in the case of large breweries, especially due to the relatively great costs.

*Compliance deadlines and evaluation*
For existing situations a compliance deadline of five years after the inclusion of the present Special Regulations in the NeR applies. For new situations the requirements are applicable as of the commissioning of the facility.
Five years after the inclusion of these Special Regulations in the NeR an evaluation will take place. This will focus on fixing the immission levels which can be demanded in existing situations and on the performance of the emission limiting technologies mentioned above, both as regards their odour limiting effect and their efficacy at promoting energy savings.

**Evaluation**
The measures mentioned have already been implemented at various installations with a view to recouping energy. Applications specifically targeted at reducing odour emissions are relatively new. As the effectiveness under the actual conditions is not really known yet the provision is included here that in five years' time an evaluation of these Special Regulations will take place. This evaluation will focus on fixing the immission levels which can be demanded in existing situations and on establishing the performance levels that can be expected of the emission limiting technologies mentioned above, both as regards their odour limiting effect and their efficacy at promoting energy savings, and on the efficacy and possibilities for demanding implementation of the end-of-pipe technologies referred to above.