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Odour regulation in Italy: the regional guidelines on odour emissions in Lombardia

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In the region of Lombardia, a specific guideline about odour emissions is on the point of being issued. The proposed regulatory approach is conform to the guidelines of other countries, such as UK, Netherlands and France. All of them provide to fix limits to odour immissions, rather than to emissions. More in detail, these guidelines provide to simulate the odour concentration on the territory by dispersion modelling, and give limits expressed in terms of 98th percentile, on an yearly basis, of the peak odour concentration values. The regional guidelines about odour emissions of Lombardia represent an important tool for evaluating odour impact and therefore objectively respond to the question "is there an odour nuisance?". Moreover, the philosophy of limiting the odour impact directly at receptors and not at the emission source is surely more effective for the safeguard of the quality of the environment and of the citizens' well-being, and it could therefore be exported also to other pollutants.

1. Introduction

In the last 30 years, odours have become a serious environmental concern. This increased attention towards air quality topics concerning odour emissions brought on one hand to the development of specific techniques for odour sampling and measurement, and on the other hand, as a consequence, to the definition of acceptability criteria and limits for the evaluation of odour emissions and immissions. Many countries have recently issued specific laws or guidelines for the regulation of odour emissions from industrial activities, with the aim of safeguarding citizens from odour exposure, which is proved not to represent a risk for human health, but nonetheless to potentially cause negative effects on human beings (Nicell, 2009).
In some cases, odour guidelines apply only to specific sectors. For instance, in Austria and in the Netherlands, there are guidelines fixing limits to the emissions from livestock productions (Schauberger et al., 1997; VROM 2006); in France, limits to the odour emissions from composting plants have been recently fixed by the Arrêté 22/04/2008

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(Journal Officiel de la République Française, 2008). In other cases, guidelines are horizontal, i.e. they apply to all the activities that may potentially represent a cause of odour nuisance. Examples therefore are the guidelines in Germany (GIRL, 2008) or in the UK (UK Environmental Agency, 2002).
One important aspect to be highlighted is that the trend of all the above mentioned guidelines is not to fix limits to emissions, but rather to fix limits to odour immissions.
This kind of approach is rather innovative because, despite of the easiness of evaluating pollutant concentrations at emissions, due to the existence of well established and reproducible measurement techniques, it provides to evaluate immissions, which is surely more complicated but more effective for the safeguard of the quality of the environment and of the citizens' well-being. Immissions shall not be determined by direct measurement at receptors, given the low pollutant concentrations and the difficulty of relating these concentrations to a specific emission source, but they shall be evaluated by simulation of the atmospheric dispersion of emissions. This entails the necessity of defining in detail the simulation methods, which, starting from the measured emission data, allow to estimate ground concentration levels (e.g., dispersion model, quality of input data), in order to produce reliable and reproducible results.
Even though the single limits fixed by the above mentioned guidelines may differ from each other, one common aspect is that those limits to odour immissions are expressed as odour concentration values that should not be exceeded for a given percentage of time in one year at receptors or at given distances from the emission source.
More in detail, the guidelines of the UK, Netherlands and France provide to simulate the odour concentration on the territory by dispersion modelling, and give limits expressed in terms of 98^{th} percentile, on an yearly basis, of the peak odour concentration values. According to the definition of 98^{th} percentile, these values represent the odour concentration that is exceeded for 2% of the hours in a year.
The same approach for odour regulation has been adopted in the regional guideline of Lombardia, which was written thanks to the collaboration of different subjects representing local authorities, environmental protection agencies, public and private laboratories and research institutes, and which is now on the point of being issued.
This paper has the aim of presenting the most important aspects of this new guideline and to discuss them with particular care to the consequences of its issuing.

2. Aims and field of application

The guideline has the aim of giving indications about the characterization of odour emissions, their confinement and the necessity of providing suitable gas treatment systems and abatement performances with the final purpose of harmonizing the coexistence of activities causing odour emissions and the surrounding territory.
The guideline applies to all activities that may originate odour emissions and that are subject to environmental authorization.

3. Methods for odour impact assessment

As already mentioned, it is very important to fix the methods adopted for odour emission simulation, in order to obtain reliable and reproducible results. Annex 1 to the

guideline describes in detail the requirements for the odour impact studies by dispersion simulation. IN this paragraph the main aspects of this annex are mentioned.

Odour impact shall be assessed by dispersion modelling. Based on the results of specific olfactometric surveys if the plant already exists, or on bibliographical data (e.g., Odour Emission Factors (Sironi et al., 2005)) if the plant is in project, on the meteorological data and on the orography of the territory, a suitable dispersion model shall be applied in order to evaluate the dispersion of the plant odour emissions within a radius of 3 km from the plant boundaries, with the purpose of evaluating the olfactory nuisance eventually caused on the receptors in this area.

More in detail, as far as the emission data are concerned, the guideline provides to consider all the potential odour sources of the studied plant having an odour emission rate (OER) of 500 ou_E/s or more. Point, area and volumetric sources have to be taken into account, exception made for the emissions whose odour concentration is below 80 ou_E/m^3. The evaluation of the OER depends on the source typology (Sironi et al., 2010), as described in detail in Annex 2 to the guideline about odour sampling. One important consideration is that, given that the OER from area sources is a function of the wind speed over the emitting surface, the OERs relevant to area sources shall be calculated for each hour of the simulation domain based on the current wind speed, according to the following equation (Sohn et al., 2003):

$$OER_{v2} = OER_{v1}\left(\frac{v_2}{v_1}\right)^{\frac{1}{2}}$$

For the simulation, other information about the odour sources is required, e.g. the geographical coordinates, height and geometry (e.g., horizontal or vertical). Moreover, it is important to account for the temporal variability of the emissions.

Another fundamental aspect discussed in Annex 1 is the retrieval of the meteorological data. The quality of the meteorological data adopted for the dispersion simulation is critical, and may affect the results more than the choice of the model. The guideline indicates some characteristics of the meteorological station, which are important in order to guarantee that the data are representative of the meteorological situation at the emission source. For instance, the meteorological station should be at least 5 m high, and located, in the case of flat ground, within 10 km from the emission source. In cases of complex orography the meteorological station should be located in the same valley as the emission source or in any case be chosen in order to be representative of the source anemological conditions.

The guideline also provides that detailed information about the meteorological processor used in order to obtain the micrometeorological (e.g., mixing height) and turbulence parameters (e.g., Monin-Obukhov length and Friction velocity) should be given in the study.

The simulation domain should be defined in order to include all the receptors at which the odour impact acceptability criteria has to be verified.

As far as the dispersion model is concerned, following code typologies are recommended: non stationary puff or segment models, 3D lagrangian (puff or particle) models or 3D eulerian models (Wang et al., 2006).

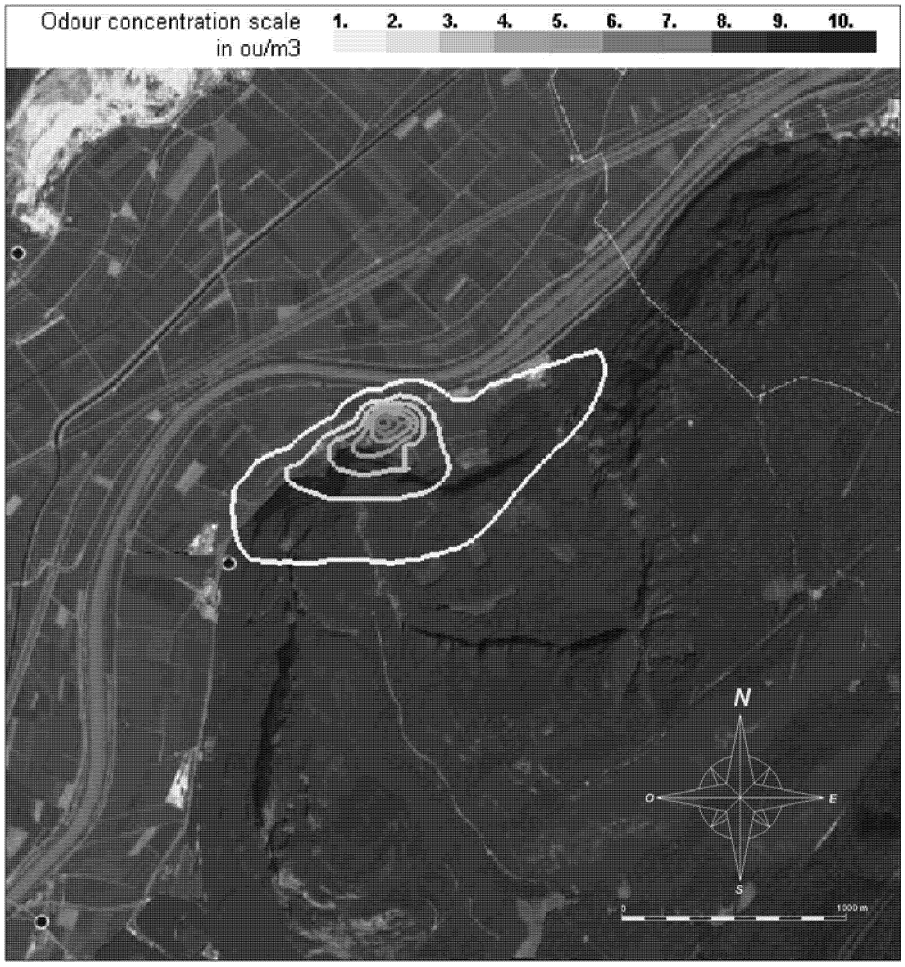

Figure 1 Example of the results of an odour impact study by dispersion simulation illustrated as map of the 98° percentile of the hourly peak odour concentration values

4. Acceptability criteria

The limits to be respected by the odour emitting activity are expressed as 98° percentiles of the peak odour concentration values on yearly basis. The limits are different for new or existing activities, and they are a function of the destination of the territory (residential, commercial, agricultural, or industrial).
More in detail, the acceptability criteria relevant to new activities are:

- 2 ou_E/m^3 at the first receptor in residential areas;
- 3 ou_E/m^3 at the first receptor or at 500 m from the plant boundary in commercial areas;
- 4 ou_E/m^3 at the first receptor or at 500 m from the plant boundary in agricultural or industrial areas.

In case of mixed areas, the lower value shall be considered.
For existing activities the limits are:

- 1 ou_E/m^3 at the first receptor in residential areas located farer than 500 m from the plant boundary; 2 ou_E/m^3 at the first receptor in residential areas located between 200 m and 500 m far from the plant boundary; 3 ou_E/m^3 at the first receptor located within 200 m far from the plant boundary;
- 2 ou_E/m^3 at the first receptor in commercial areas located farer than 500 m from the plant boundary; 3 ou_E/m^3 at the first receptor in commercial areas located between 200 m and 500 m far from the plant boundary; 4 ou_E/m^3 at the first receptor in commercial areas located within 200 m far from the plant boundary;
- 3 ou_E/m^3 at the first receptor in agricultural or industrial areas located farer than 500 m from the plant boundary; 4 ou_E/m^3 at the first receptor in agricultural or industrial areas located between 200 m and 500 m far from the plant boundary; 5 ou_E/m^3 at the first receptor in agricultural or industrial areas located within 200 m far from the plant boundary.

According to the hedonic tone (pleasantness / unpleasantness) of the odour emissions, the authorization may allow higher limits than those above reported.

5. Procedures for odour annoyance evaluation

The odour impact study by dispersion modelling is mandatory in case for the authorization of new plants or for the renewal of the authorization of existing plants.
For existing plants that aren't subject to the renewal of the environmental authorization but however cause odour nuisance problems, the guideline proposes a 4-phase procedure to be followed.
The first phase (phase A) is activated owing to repeated citizens' complaints about odour perceptions. This first phase provides to evaluate the entity of the odour nuisance by a questioning survey (Sironi et al., 2010), which shall involve the resident population. If the odour nuisance problem turns out to be occasional and caused by exceptional conditions no further action is required, otherwise, if the subsistence of the problem is proved, phase B is actuated, which provides the execution of an olfactometric survey followed by an odour impact study by dispersion modelling in order to evaluate the keeping of the acceptability criteria.
If the acceptability criteria are not respected (Phase C) the plant authorization shall be re-examined while the plant shall undertake correction works with the aim of reducing the odour impact below the limits. Finally, Phase D is the re-proposal of Phase A in order to evaluate the effectiveness of the adopted solutions for odour impact reduction.

6. Conclusions

The regional guidelines about odour emissions of Lombardia represent an important tool for evaluating odour impact and therefore objectively respond to the question "is there an odour nuisance?".
The fact of applying acceptability criteria to immissions overcomes the objections about dispersion modelling that up to now brought, in the field of environmental pollution, to

fix limits in terms of maximum concentrations or maximum emission rates at the emission source. This is a consequence both of a greater knowledge and competence about dispersion modelling techniques and of a more detailed definition of the methodologies to be applied, which entails the obtainment of reliable simulation results. The philosophy of limiting the odour impact directly at receptors and not at the emission source is surely more effective for the safeguard of the quality of the environment and of the citizens' well-being, and it could therefore be exported also to other pollutants.

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