A NOVEL APPROACH FOR ODOUR REGULATION 
BASED ON “BUFFER ZONE” CRITERION

Extended abstract

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Background

Odours produced by anthropic sources represent a complex issue to face because they directly affect both the environmental and human quality. In fact, the proximity of industrial plants and farms, very often source of bad odours, to residential zones, really limits the acceptability of such activities and leads to citizen’s complaints (Nicell, 2009). Furthermore, odours strongly affect people’s daily life and health, as, although they do not represent a risk for human health, smells could cause both physiological symptoms (respiratory problems, nausea, headache) and psychological stress (Schiffman, 1998).

Odour emission monitoring and its regulation are characterized by a great complexity due principally to the strict association of odour pollution to human perception. For this reason, odour emission control can not be rigorously equalled to air quality monitoring and different legislative approaches have been applied for preserving air quality from industrial odour emissions.

Objectives

The aim of this work is to provide a description of a novel approach for the regulation, developed in Puglia Region, located in the South of Italy. The main purpose is to present the innovative aspect of this regulation, based on a “buffer zone” criterion, compared to the most widely applied at international level.

Outline of the work

This work is divided in two main parts:

• The first part discusses the state of the art of the legislative approaches used in international regulation and in national one. This part provides the necessary background for understanding the complexity in regulating odour emissions from industrial plants and for underlining the lack of a unique approach for this matter.

• The second part is dedicated to the development of the innovative methodology, applied in a region of the South of Italy, Puglia region. It describes the principal features of the regulation, providing examples of applications.

Methods

The odour emission regulation generally considers two main aspects:

• emissions, expressed as the odour concentration released by a particular source. In this case, two approaches have been adopted by the legislations of the different countries, establishing precise limits for the whole odour mixture and/or for single chemical compounds. In the first case, the odour concentration is expressed in odour units.
Recently published a regulatory act setting a limit for digester plants producing biogas equal to 400 ouE/m³ and 5

give limits expressed in terms of 98th percentile, on an yearly basis, of the peak odour concentration values. Netherlands and France provide to simulate the odour concentration on the territory by dispersion modelling, and transport and the diffusion of the pollutants, and topography of the site. More in detail, the guidelines of the UK, estimate the downwind concentration according to emission rates, meteorological parameters, that affect the aspect is generally attained by means of decision making support tools and, in particular, of dispersion models that estimate the downwind concentration according to emission rates, meteorological parameters, that affect the transport and the diffusion of the pollutants, and topography of the site. 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 98th percentile, on an yearly basis, of the peak odour concentration values.

In the last years, the trend in legislative approaches is to avoid to fix limits at emission sources and to consider acceptability criteria at receptors (immissions). This last aspect is more complicated to realize, compared with the emissions control, for which reproducible measurement techniques exist. This requires the definition of the simulation procedures, which allow to estimate ground concentration levels (e.g., dispersion model, quality of input data) based on the measured emission data, in a detailed manner, in order to produce reliable and reproducible results.

In Italy there is no national legislation disciplining odour emissions. This lack has led some Italian regions to adopt regulatory measures and guidelines, specifically for odours, useful to support their control activities. The first odour emission limits were fixed by the Region of Lombardia and applied to composting plants (“Guidance for the construction and operation of compost-producing plants” (D.G.R.n.7/12764, 2003)). This limit provided a maximum odour concentration at the outlet of treatment systems at 300 ouE/m³, as measured by dynamic olfactometry. Later, other Italian regions like Sicilia (Sicilia-Ordinananza-Commissariale, 2002), Abruzzo (D.G.R.n.400, 2004) prepared similar directives with the same emission limits for composting plants. This approach showed some drawbacks in its application; the most important being that the prescribed limit was applied not only to treatment systems in composting plants, but indiscriminately to any other industrial plant and source. For this reason, Regione Lombardia (D.G.R.n.IX/3018, 2012) has recently published a legislative act, fixing no more emission limits but evaluating the odour impact at receptors through the use of dispersion models. Emilia Romagna Region (D.G.Rn.1495, 2011) has recently published a regulatory act setting a limit for digesters plants producing biogas equal to 400 ouE/m³ and 5 mg/m³ for ammonia.

In Puglia Region, a specific regional law was adopted for the point emissions of olive residues treatment plants (L.R.7/99, 1999). In this case, two different emission limits are fixed (in parts per million) distinguishing the substances according to their odour thresholds. This approach is hardly applicable because of the lack of unambiguous values of odour thresholds reported in literature for several substances. So, consistent with the actual trend in regulation, an innovative methodological approach for an odour guideline has been developed in this region with the purpose of defining acceptability and monitoring criteria for odour emissions. The present methodology suggests a coupling between a predictive approach, based on dispersion models, and a systematic approach to carry out the monitoring and the control through reliable methodologies.

Results and discussion

The focus of the proposal consists in the implementation of two approaches for the authorization of odour emissions (Brattoli et al., 2011):

- assessment of acceptability criteria using predictive methods. Similarly to international approach, it employs the use of mathematical models to predict the downwind odour concentrations at receptors on the basis of odour emission rates, topography and meteorological data referred to a selected period of time. Such models aim to determine whether the estimated emissions at sensitive receptors are in compliance with ambient air quality criteria, considered acceptable for the exposure of the population. These criteria can be defined on the basis of several parameters, such as: presence of sensitive receptors; distance between the plant and sensitive receptors; land use (residential, commercial, agricultural, industrial); existing or new plants; distribution of concentration values expressed as percentiles; averaged time considered for simulations.

- the buffer zone approach. The buffer zone identifies an area around the plant boundaries, outside of which a prescriptive limit, expressed in odour units and detectable through dynamic olfactometry, must never be exceeded. The buffer zone can have a more or less regular shape, individuated according to the predominant wind directions,
A novel approach for odour regulation based on "buffer zone" criterion

the presence of receptors and the geographic location. The buffer zone extension can be defined using dispersion models based on the meteorological scenarios that have determined the worst odour dispersion conditions in a defined period of time. These scenarios have to be described so that a possible exceeding, determined by a meteorological situation worse than those previously considered, could be permitted. If the prescriptive limit is fulfilled inside the plant boundaries, the buffer zone overlaps with the plant perimeter.

For better understanding the meaning of the buffer zone criterion, Fig. 1 and Fig. 2 explain how the buffer zone is defined according to the worst scenarios. For example, if the prescriptive limit, called Z, is equal to 50 ou/m³, the buffer zone might comprehend the area where 50 ou/m³ are overcome in the worst meteorological conditions. In Fig. 1 (case 1) the buffer zone is outside the plant perimeter, while in Fig. 2 (case 2) overlaps with it. In this last case, the Z value must be applied and verified at the plant perimeter.

![Fig. 1](image1.png)

**Fig. 1.** Maps illustrating the individuation of the buffer zone considering the worst odour dispersion conditions for a landfill (case 1). The white rectangle delimits the plant perimeter while the red one individuates the buffer zone perimeter; the white points are the odour sources. In all maps, the buffer zone is defined on the bases of the isoline of 50 ou/m³.

![Fig. 2](image2.png)

**Fig. 2.** Maps illustrating the individuation of the buffer zone considering the worst odour dispersion conditions for a landfill (case 2). The white rectangle delimits the plant perimeter; the white points are the odour sources. In all maps, since the isoline of 50 ou/m³ falls within the plant perimeter, the buffer zone overlaps with the plant boundaries.

The definition of a buffer zone is a valid approach particularly for landfills that present areal emissions, usually located in ground-line; in fact, in this type of emissions the odour concentration decreases moving away from the sources. For this purpose, a monitoring plan should be proposed and verified. A greater extension for the buffer zone means more strict prescription for the plant in order to control its productive process; in fact the implementation of continuous monitoring systems can be planned in relation to the extension of the buffer zone and the presence of receptors inside, or near it. According to the different conditions, these systems can be located at the receptors and/or at the boundaries of the buffer zone and of the plant. It could be considered as adequate continuous monitoring systems, instruments that provide signals that have to be correlated with dynamic olfactometry data for the specific plant (e.g. electronic noses, sensors, conventional analyzers, sulfur compound analyzer).

In particularly complex cases, such as co-presence of other significant odour sources, this evaluation could be executed through chemical characterization of ambient air samples.

**Concluding remarks**

In this paper, a focus on the main legislative approaches for odour emission control is presented. In particular, it describes a methodological approach developed in an Italian region, in which the guideline integrates a predictive approach based on dispersion models and a systematic approach to carry out the monitoring and the
control. The novelty of the proposal is represented by the introduction of a buffer zone, that is a “respect area”, individuated by means of dispersion models, in which prescriptive limits have to be fulfilled and verified by standard measurement methodologies. In addition, the odour guideline endorses to perform a process control for particularly impactful plants, realized through continuous monitoring systems.

**Keywords:** buffer zone, dispersion models, dynamic olfactometry, odour regulation, process control.

**References**


