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Determination of the maximum odour emission scenario for respecting the impact criteria fixed by the guidelines in the district of Lombardia

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With regards to the new odour guidelines that are going to be issued by the district of Lombardia, in Italy, a general approach for the determination of the maximum odour emission scenario of new installations is presented. First, the main items to be considered in the definition of the odour emission rate from each odour source is illustrated. Then, the actions to be undertaken when the simulated odour impact exceeds the odour impact criteria fixed by guidelines or, on the contrary, when the simulated odour impact is much lower than the above mentioned criteria, are analyzed, from the point of view of the company proposing the new installation.

1. Introduction

According to the new guidelines that are going to be issued by the district of Lombardia, in Italy, for each new facility or plant planned to be installed in Lombardia (provided that it belongs to a given category), the proposer have to produce an odour impact assessment study: the study has to demonstrate that the odour emissions of the facility will generate an odour impact that comply with the established impact criteria.
As a consequence of the conceptual strategy underlying the guidelines, no source-specific odour concentration is fixed as a limit in the guidelines, but the proposer himself has to fix, for each odour source of the new facility or plant, the maximum odour emission rate and so, given the volumetric flow rate, the maximum odour concentration (Nicell J. A., 2009). When the facility will be built or installed, each gaseous emission shall comply with the odour emission rate that the proposer fixed in the odour assessment study. In other words, the proposer shall define an expected odour emission scenario for the facility as a whole, and this will become the maximum odour emission scenario the facility has to comply.
The present paper aims to show, with strict respect to new installations, the path the proposer has to follow in order to define the maximum odour emission scenario of a new facility or plant. Of course the path is quite simple when in the new plant just one odour source is planned, but in more complex cases many choices can be considered, and some method can be suggested.

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The main steps of this path are the following ones.

- Identification of all odour sources (both conveyed and diffuse) of the plant.
- Collection of emission data of the odour sources, in order to set the odour emission scenario for the "first-try" simulation.
- Collection of all other data needed for dispersion simulations (meteorological data, terrain, identification of sensitive receptors, etc.).
- Running of the simulation considering this odour emission scenario.
- Comparison between the results of the simulation (first-try odour impact) and the odour impact criteria established by the mentioned guidelines.
- Reviewing of the odour emission scenario (and, if necessary, of the plant design), in order to move the simulated odour impact to the impact criteria.

2. First-try impact assessment

2.1 Definition of the odour emission scenario

First, all odour sources of the planned plant have to be identified. Among common odour sources, the following ones may be listed.

- Stacks releasing effluents coming from equipments treating odorous materials (e.g. in waste, food or chemical industry) or treating materials at high temperature (e.g. in building industry).
- Open air tanks of wastewater treatment plants, or other open air tanks containing odorous liquids.
- Non-confined heaps of odorous materials (e.g. open air green waste heaps).
- Fugitive emissions from pumps, pipes, tanks or machineries.

For each odour source, the following information has to be collected or estimated.

- Exact location (geographical coordinates).
- Extent of the source. As far as stacks are concerned, the source extent is the stack height, the discharge section, or the diameter of the discharge section; for wastewater tanks or biofilters, that is the height and the area of the emitting surface; for open-air heaps, the extent can vary with time and some conjecture about this variation is needed.
- Volumetric flow rate and expected odour concentration (when considering conveyed sources, e.g., stacks or biofilters). In many cases, both parameters change with time (e.g., some plants are switched off during the nightly hours, odour concentration can vary depending on the material processed). In such cases, some assumptions have to be made. The expected odour concentration may be hypothesized based on the results of odour monitoring campaigns conducted on similar plants, or based on data from technical literature. In any case, both mean and maximum expected odour concentrations are useful in order to set the odour concentration vale relevant to a source in the emission scenario.
- Odour emission rate (when considering diffuse area or volume sources). As a rule, it depends on both intrinsic (e.g. qualities of the material forming the heap) and external parameters (namely, wind speed), both of which are possibly variable with time.

- Other data physically characterizing the source, especially temperature and exit velocity of the emitted gas.

When the first-try odour impact is to be simulated, the assumptions made should be as close as possible to real conditions, including variability with time. An exception to this statement is appropriate when the concerned odour source (including both the equipment/material generating the odorous gas and any possible odour abatement system) is well-known in technical literature, with specific reference to odour-related items: in such case the expected odour emission rate should not exceed what is recommended by literature or relevant regulations (e.g. European best available technology reference documents).

2.2 Simulation of the first-try odour impact

Once the odour emission scenario is defined (i.e. when the data, including variability with time, are ready to be put in the dispersion model), and the other input data files of the dispersion model have also been properly composed, the first-try simulation may be run. The mentioned guidelines issued by the district of Lombardia fix that, based on the results of the simulations, the 98° percentile on yearly basis of the hourly peak odour concentrations shall be calculated in each of the gridded receptors, and especially in the selected sensitive receptors.

The first-try odour impact therefore consists of the set of 98° percentile values of the hourly peak odour concentrations at all sensitive receptors (Capelli et al., 2010).

2.3 Odour impact criteria

The odour impact criteria established by the mentioned guidelines as far as new installations are concerned are summarized in Table 1.

Table 1. Odour impact criteria for new installations.

Land use at the sensitive receptor	Distance	Limit odour concentration (ou_E/m^3)
Residential areas	At the nearest sensitive receptor	2
Commercial areas	At the nearest sensitive receptor, but everywhere for distances over 500 m	3
Agricultural or industrial areas	At the nearest sensitive receptor, but everywhere for distances over 500 m	4

Note that also potential future receptors have to be investigated as sensitive receptors.

3. Reviewing the first-try odour emission scenario

3.1 First case: the simulated odour impact exceeds the odour impact criteria

When the simulated odour impact exceeds the odour impact criteria (i.e. when the simulated 98° percentile on yearly basis of the hourly peak odour concentrations exceeds the odour concentration limit shown in Table 1 at one or more receptors), the first-try odour emission scenario has to be reviewed in order to reduce the odour impact. Concerning simple emission scenarios (e.g. plant having just one odour source), the appropriate solution aimed to reduce the odour impact turns out to be rather easy, but when several sources are concerned, some more complex methods shall be taken into account.

First, the sources having the greatest contribution to the overall odour impact of the facility have to be determined. For this purpose, a set of more dispersion simulations may be run, considering one source at a time separately. In some cases, the contribution of each source to the overall odour impact may be derived by simply comparing the odour emission rate values, but when sources having variable odour emission rates or different shapes (e.g., tall stacks instead of ground-level heaps) are concerned, the simple comparison of the mean odour emission rate value relevant to each source might not give a clear solution, or even lead to incorrect conclusions (Capelli et al., 2009).
Of course, the sources having the major contribution to the overall odour impact shall be primarily regarded in order to reduce the odour impact beneath the impact criteria.
Some methods to reduce the impact from odour sources are listed below.

- Changing the position of the source: if the facility has a considerable size compared to the distance from the facility boundary to the sensitive receptor, that source may be placed on the other side of the facility area.
- Increasing the source height; for example: increasing the stack height or, even more advantageous, conveying the biofilter outlet, or confining and conveying diffuse area sources to a stack.
- Increasing the odour abatement efficiency of the designed abatement system, or replacing the designed system with a different one, having higher environmental performances, or designing an additional abatement system upstream or downstream (Mills, 1995; Mudliar et al., 2010).
- Reducing the volumetric flow rate, or reducing the duration of the period in which the volumetric flow rate of the source is at its maximum. Regarding air stream vented from sheds containing various machinery, a distributed exhaust gas collection system sucking the exhaust gases directly from the machine or just over may reduce considerably the odour emission rate of the whole shed. When sheds contain only heaps of odorous materials (e.g. municipal solid waste in bio-oxidation phase), the volumetric flow rate should be reduced as much as possible, provided that the shed is maintained under negative pressure; of course the industrial process shall be designed in order to avoid the presence of personnel in that area.
- Reducing the odour emission originated from the process.

3.2 Second case: the simulated odour impact is lower than the impact criteria

When the simulated odour impact is much lower than the odour impact criteria (i.e. when the simulated 98° percentile on yearly basis of the hourly peak odour concentrations is far below the odour concentration limit shown in Table 1 at every considered receptor), the first-try odour emission scenario may be suitably reviewed. Surely this does not mean that odour emissions should be increased: the matter is the overestimation of the odour emissions of some source types, in order to have a wider safety margin, e.g., when anomalous materials have to be exceptionally processed or when a failure occurs and unusual odorous exhaust gases are generated, or when an unusual increase of the material processed by the plant (especially in the case of waste treatment plants) causes an increase of the odour emissions.
In this context, some suggestions can be given.

- Variable odour emission rates can be simplified, fixing a constant emission rate equal to the maximum expected emission rate. This is an advantage, because the odour monitoring of sources with a complex time-dependant odour emission rate shall be likewise time-dependant (i.e. several odour sample shall be collected and tested), thus resulting in higher expenses for the monitoring.

- Odour emission rates from diffuse area sources (open air heaps) may be usefully overestimated, for many reasons: first, the extent of these sources cannot be exactly predicted, and may be affected by accidental increases; second, the surface odour emission rate (SOER) of some kinds of heaps (e.g. green waste or municipal solid waste) is not easily predictable before the plant is started and the actual material to be treated is collected; third, the specific odour emission rate may vary significantly from one point to another of the heap; fourth, the odour emission rate of some kinds of materials may suddenly increase when the material is moved or mixed.

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