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Full application of Odour Field Inspection according to VDI 3940 in Italy: odour impact evaluation of an anaerobic digestion plant

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In the second half of 2009 an Odour Field Inspection lasting six months according to German Guideline VDI 3940 was completed, with the aim of measuring the odour impact generated by a municipal waste treatment plant with anaerobic digestion system in Bassano del Grappa.
A group of 16 panellists was recruited and selected according to EN 13725, and was trained to recognise typical plant emission odours: biofilter, biogas, green waste. Following the German Guidelines, a grid of squares with sides of about 200 m was built on the territory around the plant, generating 48 intersection points; twelve different paths crossing four non-adjacent vertices were created where panellists performed odour assessments and subsequently filled in a form.
During the campaign every point was visited 26 times by different panellists at different hours and week days (except for night time, from 1 a.m. to 7 a.m.).
Collected data were processed and isofrequency curves for every kind of plant odour were generated; a different frequency distribution can be observed for each odour, due to the different source and odour flowrate and intensity.
Main difficulties found during organisation of the study, as well as odour recognition problems, will be described.

1. Introduction

Odour Field Inspection by trained panellists according to German Guideline VDI 3940 (2006) is an odour impact evaluation technique well established in Germany and in other Northern European countries.
Such technique may be useful to better understand results obtained by mathematical odour dispersion models, and eventually to correct them; it may also integrate data from other survey methodologies, like odour diaries of residents and questionnaires.
In Italy, Odour Field Inspection has been rarely used: the first and unique example consists in the study made by Valli et al. (2008); the long time required (at least six

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months) and high costs of training panellists have been a great obstacle to the diffusion of this technique.
E.T.R.A. SpA, owner of a waste treatment plant with anaerobic digestion system in Bassano del Grappa, requested to perform a complete study in order to measure odour impact of the plant on the surrounding territory, because of frequent complaints of residents about odour annoyance.

2. Materials and methods

Odour Field Inspection was performed according to German Guideline VDI 3940 (2006). With the aim of reducing the cost of trained panellists, it was decided to employ assessors recruited among the resident population, following the procedure described in the UK Technical Guidance Note IPPC H4 (2002), where use of local panellists is suggested.

2.1 Field Inspection organisation

A grid of squares with sides of about 200 m was built on the territory around the plant, based on the frequency of complaints by the residents; for this reason the grid is not symmetrical around the plant, but it is mainly developed at the South of the town, following the main wind direction.
The grid was made of 33 cells and 48 intersection points, that were properly chosen in the field, avoiding places difficult to reach or dangerous for the assessors (Figure 1); twelve different paths, each one crossing four non-adjacent vertices, were created.

Figure 1: Municipal waste treatment plant localization in the assessment area with 48 measurement points and 33 measurement squares.

Every day two panellists made different paths at different day times: they stopped in the four places and performed odour assessments, filling in a form; during the campaign every point was visited 26 times, by different panellists at different hours and week days (except for night time, from 1 a.m. to 7 a.m.).
Odour assessment is made on each point by sniffing the air every 10 seconds over a period of 10 minutes (i.e. 60 measurements), and evaluating any perceived odour; recognised odours are then reported in the form.
This six-months study started on 16 July 2009 and finished on 15 January 2010.

2.2 Panellists' selection

A group of candidates was recruited among the resident population, excluding people living near the plant and relatives of plant employees.
Assessors were selected according to EN 13725 (2003): their olfactory sensitivity to reference substance n-butanol was measured by dynamic dilution olfactometry, and candidates having a threshold odour concentration for n-butanol out of the range 20-80 ppb were discarded.
A group of 16 selected panellists was trained to recognise three typical plant odours: biogas, biofilter, and green waste; due to the assessors' lack of experience in odour recognition, it was decided to reduce the choice of different plant odours, and, consequently, to group together under the category "green waste" different subtypes of odours, i.e. "green matter" , "fresh refuse" and "mature compost".
Panellists filled in the form choosing one of the plant odours, or "other odour", or "no odour".

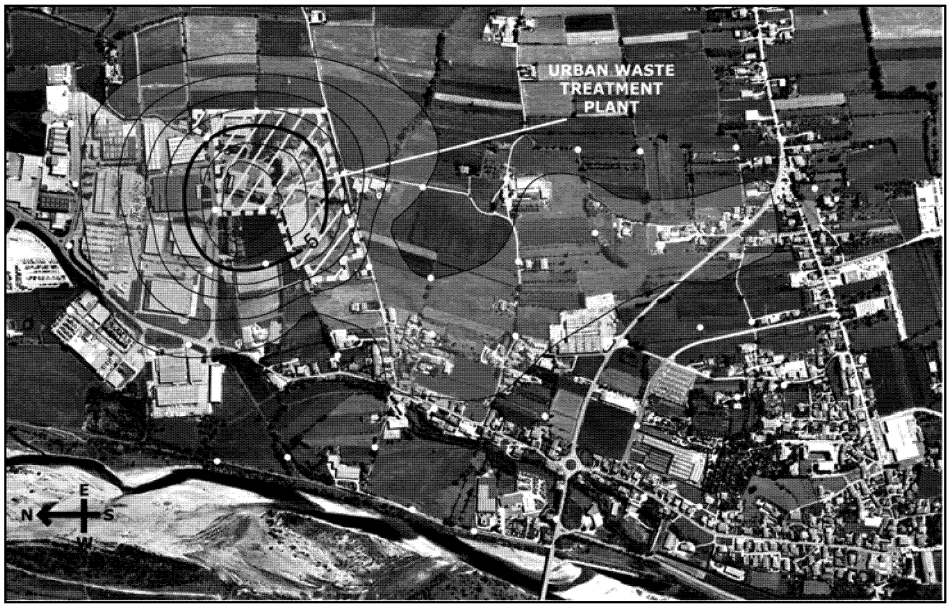

*Figure 2: Isofrequency curves of **biogas** odour*

3. Results

All panellists' forms were processed and, for each kind of odour, the odour frequency in every point of the grid was calculated; for each grid square the odour load was calculated combining the results obtained for the four vertices.
According to VDI 3940 (2006), plant odour recognition data were validated evaluating meteorological situation during odour assessment.
For each square the frequency of each odour was obtained.
A better presentation can be achieved building the isofrequency curves with an interpolating software like Surfer™; odour load values are centred in the middle of each square.
Isofrequency curves for the three plant odours are reported in Figure 2 (biogas), in Figure 3 (biofilter) and in Figure 4 (green waste); Figure 5 shows the sum of the odours from the plant.
Biogas odour gives a small contribute to the plant odour; probably it is due to fugitive sources from the plant, and for this reason it is difficult to obtain the plant's proper odour emission rate to put in a dispersion model.
Biofilter is the most typical odour of the plant: it is due to a channelled source, and often it is the only source used in a dispersion model.
Green waste odour has the largest distribution on the field, and its frequency is very high around the plant; it may be considered a sum of odours, and may be influenced by field sources different from the plant.
Total odour is very high (more than 10% of odour load) around the plant, mainly because of green waste odour; a careful evaluation of green waste odour recognition must be done in order to avoid overestimation of plant impact.

*Figure 3: Isofrequency curves of **biofilter** odour*

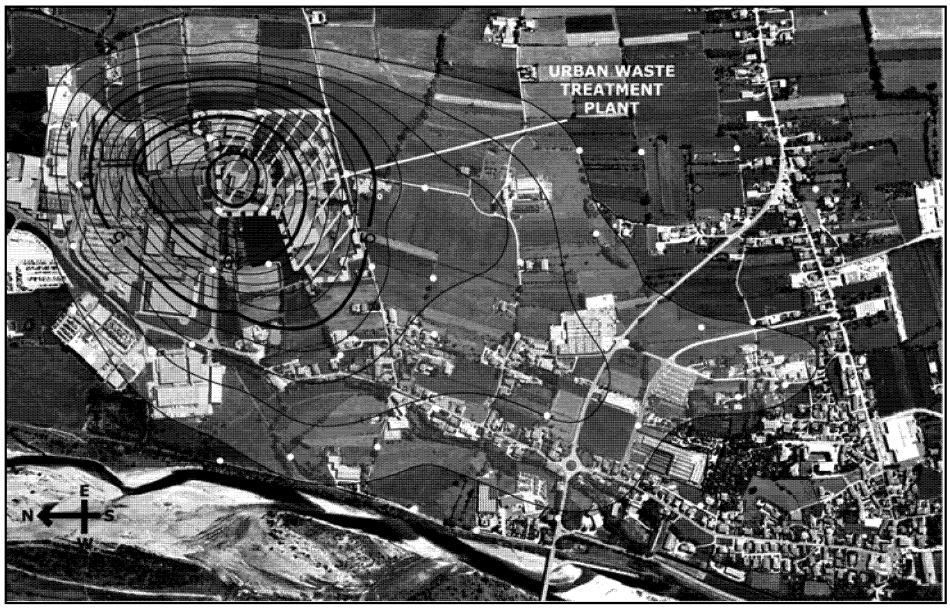

*Figure 4: Isofrequency curves of **green waste** odour*

*Figure 5: Isofrequency curves of **total plant** odour*

Furthermore, two critical points can be observed.
Initially, biofilter odour was not always correctly recognised by some assessors, probably because this kind of odour was totally new to them. Consequently, further training was required in order to achieve a better recognition.
It would be more useful to distinguish between the different odours grouped under the category “green waste”, since it may help to obtain a better understanding of their contributions to the whole plant odour.

4. Conclusions

Application of the Odour Field Inspection proved to be successful; after some initial difficulties in odour recognition due to lack of experience – panellists gave consistent results.
A critical point was the choice of classifying different odours under the “green waste” odour category: the presence of different sources in the field may contribute to an overestimation of this source from the plant.
In this case validation process is not able to correct such overestimation: a better definition of odour sources is necessary, as well a more careful training of the panellists.

5. References

EA UK Technical Guidance Note IPPC H4, 2002, Draft IPPC Horizontal Guidance for Odour, part 2 – Assessment and Control

European Committee for standardisation (CEN) 2003, EN 13725: Air quality-Determination of odour concentration by dynamic olfactometry

Valli L. and Immovilli A., 2008, Measurement of odour annoyance by integrated assessment methodologies, Chemical Engineering Transactions (vol. 15)

VDI 3940 (Part 1), 2006, Measurement of odour impact by field inspection – Measurement of the impact frequency of recognisable odours – Grid measurement