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Odour emission factors for assessment and prediction of Italian MSW landfills odour impact

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Abstract

Among the human activities that may generate problems related to unpleasant odour emissions, landfills represent one of the major causes of odour complaints. In this study, the results of odour concentration measurements sampled from the principal odour sources of seven different and dimensionally representative Italian Municipal Solid Waste (MSW) landfills are presented. Experimental data are then used to estimate an Odour Emission Factor (OEF). The average OEF is calculated to be $5.5 \pm 3.4\,ou_E\,s^{-1}\,m^{-2}$. This value is consistent with the OEFs that can be calculated based on existing literature data, such as surface flux rates relevant to the Landfill Gas (LFG) emissions through the landfill surface.

Keywords: Landfill gas; Odour emission rate; Specific odour emission rate; Dynamic olfactometry; Emission factors

1. Introduction

Although odorous compounds are not necessarily toxic or hazardous for human health, it has been demonstrated that the psychophysical well-being and behaviour of people are negatively influenced by exposure to odours (Bertoni et al., 1993). Historically, odour emissions from industrial processes were accepted as part of the activity itself, but in the last 20 years odours have become a serious environmental concern, particularly when associated with waste disposal or treatment plants.

The odour impact of an industrial site can be evaluated by first identifying all the potential odour sources of the examined site, sampling identifiable sources and then quantifying the odour concentrations associated with each source (IPPC, 2002) by using dynamic olfactometry (EN 13725, 2003).

Among existing types of industrial installation that can cause odour nuisance, landfills represent one of the most common sources of odour emissions and complaint. Odours from landfill sites originate principally from the atmospheric release of compounds that are formed during the biological and chemical processes of waste decomposition (El Fadel et al., 1997).

According to the Italian Environmental and Territorial Protection Agency APAT (2003), there are 619

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landfills in the Italian territory. These waste disposal installations receive over 67% of the total Italian household waste production. Municipal Solid Waste (MSW) in Italy was generated at the rate of approximately 30 million tonnes in the year 2002.

The database of odour concentration values collected during last year's monitoring of seven different and dimensionally representative MSW Italian landfills was examined in the following study. Based on these data, it was possible to derive some general principles regarding the impact of odour from these landfills, and thereby to obtain the ''odour emission factors'' (OEFs) relevant to these sites.

According to the United States Environmental Protection Agency (1995), an emission factor is a representative value that relates the quantity of a pollutant released to the atmosphere to a given associated activity. With analogy to material emission factors (US EPA, 1995), this paper argues that it is possible to define ''OEFs'' in terms of odour units released, which in turn enables an estimate of the odorous emissions of an industrial site to be made that relates to a specific activity index.

These estimates can be useful for planning assessments and other predictive purposes. The calculated odour emission rate (OER) values have the potential to be used directly as odour impact indicators of an existing landfill, or as input data for specific ambient dispersion modelling (Sironi et al., 2003). Furthermore, these values can be helpful in the choice and development of odour control strategies and in determining the efficiency of odour control systems designed to reduce odour impacts (US EPA, 1995).

2. Experimental

2.1. Sampling

The collection of air samples conformed with the requirements of EN 13725 (2003), using Nalophan™ bags equipped with a Teflon™ inlet tube.

Sampling on area sources was carried out using a wind tunnel system (Gostelow et al., 2003; Jiang and Kaye, 1996), which consists of a PET hood that is positioned over the emitting surface. A neutral air stream, filtered through activated carbon, is introduced at a known velocity by a fan, simulating the wind action on the liquid or solid surface. Air samples are then collected in the outlet duct by means of a vacuum pump (Jiang et al., 1995).

The wind tunnel (Fig. 1) used during the experimentation has a circular section inlet and outlet duct, of 0.08 m diameter. The central body of the hood used was a 0.25 m wide, 0.08 m high and 0.5 m deep rectangular section chamber. Inside the inlet duct there is a perforated stainless steel grid and inside the divergent that connects this duct to the central body of the hood there are three flow deflection vanes. Both these devices have the function of making the airflow as homogeneous as possible (Céntola et al., 2004).

2.2. Analysis

Olfactometric analyses were conducted in conformity with EN 13725 (2003).

An olfactometer Mannebeck model TO7, based on the ''yes/no'' method, was used as a dilution device. This instrument with aluminium casing has four panellists' places in separate open boxes. Each box is equipped with a stainless steel sniffing port and a push-button for ''yes'' (odour threshold). The measuring range of the TO7 olfactometer starts from a maximum dilution factor of 1/64,000 with a dilution step factor of 2. All measurements were carried out within 30 h after sampling, relying on a panel composed of eight panellists (4 + 4), adequately selected in conformity with EN 13725 (2003) .

The odour concentration was calculated as the geometric mean of the odour threshold values of each panellist, multiplied by $\sqrt{2}$.

2.3. Methodology

2.3.1. Determination of single odour sources specific odour emission rate values

The evaluation of a landfill odour impact first requires the identification of its principal odour sources, and

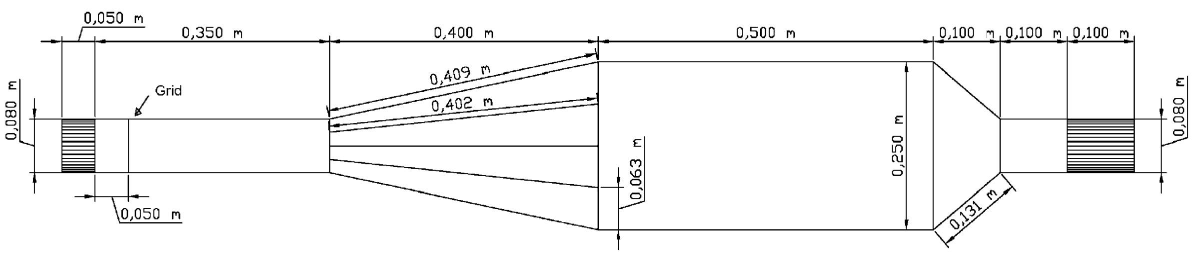

Fig. 1. Plant of the wind tunnel.