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# MODELLING ODOUR DISPERSION FROM LIVESTOCK: SEPARATION DISTANCE DEPENDING ON ODOUR IMPACT CRITERIA

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## 1. INTRODUCTION

Odour is one of the major nuisances in the environment mainly caused by livestock units and the industry (Schauberger et al., 2000c). To overcome the odour nuisance as far as possible, a separation distance between the odour source and residential areas is used to reduce the odour annoyance to an acceptable level. Apart from empirical guide lines (e.g. Piringer and Schauberger, 1999), the separation distance can also be calculated by dispersion models. Making use of the latter implies knowledge of the odour release (Martinec et al., 1998; Schauberger et al., 1999), a dispersion model, the calculation of the instantaneous concentration (Schauberger et al., 2000b), and the validation of the instantaneous odour concentration taking into account the FIDO factors (frequency, intensity, duration, and offensiveness) of odour sensation and the reasonableness.

This paper analyses the separation distance for a pig fattening unit of 1000 heads, where the ambient odour concentrations are calculated by the Austrian Odour Dispersion Model AODM (Schauberger et al., 2000b), with respect to odour impact criteria used in different guide lines.

## 2. MATERIAL AND METHODS

AODM consists of three modules to determine odour emission, dispersion, and instantaneous concentrations. . The emission module is based on a steady-state balance of the sensible heat flux, used to calculate the indoor temperature, and the volume flow of the ventilation system of the livestock unit (Schauberger et al., 2000a). The corresponding odour flow is assessed by a simple model of the odour release taking into account for its diurnal variation (Schauberger et al., 2000c). The Austrian regulatory Gaussian dispersion model (Piringer, 2000) calculates ambient odour concentrations as hourly or half-hourly values. Instantaneous odour concentrations are calculated via a flucturation module, depending on wind velocity and stability of the atmosphere (Schauberger et al., 2000b). The peak-to-mean ratio is modified by an exponential attenuation function (Mylne and Mason, 1991) to take into account for its reduction with distance from the source.

With the AODM, the separation distance is calculated by using a threshold of the odour concentration and its exceeding probability. In a series of countries, different odour impact criteria exist based on these two parameters (Schauberger et al., 2000c) mostly related to land-use categories. Modelled separation distances are compared to those of the empirical guide lines.

## 3. RESULTS AND DISCUSSION

The odour impact criteria (odour threshold in odour units per $m^3$/exceeding probability in %) and their labels used in some countries are summarized in Table 1 (for details, see Schauberger et al., 2000c). The threshold systems are different. In Germany and The Netherlands, primarily the exceeding probability varies, whereas it is fixed in Australia. In the UK, the odour thresholds are related to different levels of

**TABLE 1**

| **Germany** | Criteria | **Austria** | Criteria |
|---|---|---|---|
| G-PURE | 1/3 | AUT | 1/8 + 3/3 |
| G-MIX 1 | 1/5 | **UK** | |
| G-MIX 2 | 1/8 + 3/3 | UK 1 | 10/2 |
| G-AGR | 1/10 + 3/5 | UK 2 | 5/2 |
| **Australia** | | UK 3 | 1/2 |
| AUS 1 | 5/0,5 | UK 4 | 1/0,5 |
| AUS 2 | 2/0,5 | UK 5 | 10/0,01 |
| AUS 3 | 10/0,5 | **NL** | |
| **Denmark** | | NL 1 | 1/2 |
| DEN 1 | 5-10/0,1 | NL 2 | 1/0,5 |
| DEN 2 | 0,6-20/1 | NL 3 | 1/5 |

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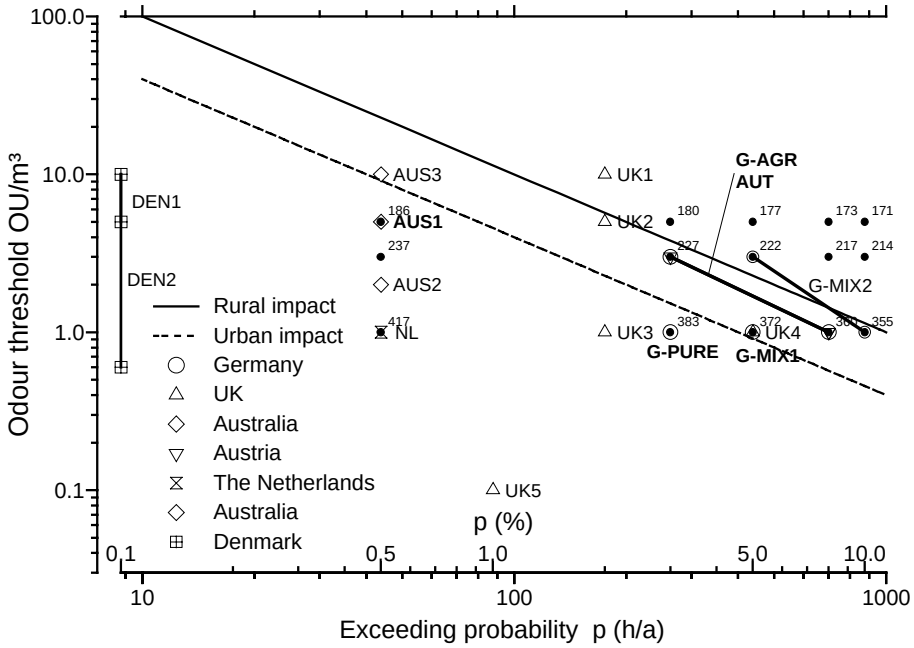


Fig. 1: Separation distance (m) depending on odour threshold and exceeding probability

annoyance, starting with serious annoyance expected (UK 1) and ending with safe target value for new sources (UK 5). Land use categories in Germany go from pure residential over mixed residential to agricultural.

The odour thresholds for urban and rural impact suggested by Watts and Sweeten (1995) as well as the sepration distances for the odour impact criteria from Table 1 are shown in Fig. 1. The separation distances calculated by the AODM for selected pairs of odour thresholds and exceeding probabilities are marked with filled circles. The limits of Watts and Sweeten show a similar slope as if a pair of limit values (G-AGR, G-MIX2, AUT) is used for the definition of the impact criteria.

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