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Situation Analysis in the Event of Complaints about Odour from Dairy Cattle Housing

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Abstract

When designing livestock-housing systems, it is important to bear in mind land-use planning interests and the protection of nearby residents from odour nuisance. Cattle housings are generally open, partially open or naturally ventilated buildings. This means that the situation in terms of both emissions and odour impact is different from that of housings with forced ventilation. As an example this paper describes and analyses an instance of a complaint relating to a dairy farm with an adjacent residential area. The initial aim here, after analysing location, housing system and management, was to suggest approaches for odour reduction. In addition, procedural steps contributing to clarity in the event of odour complaints are identified and discussed for the benefit of public authorities.

The farm comprises a single-building cubicle loose-housing system for 89 dairy cows, an outdoor exercise area with slatted flooring, including a manure pit that is stirred daily, and a horizontal silo installation. The distance from the housing with outdoor exercise area and silage store to the adjacent residential area is 85 m. The farm is characterised by large ground-level area sources. Bearing in mind the specific site location with differences in altitude and woodland, cold-air flow is to be expected. Information on the nuisance situation was available from a survey of the residents of the affected housing estate, but the requirements for carrying out a survey had not been met in the case of the conflict. It was therefore not possible to determine whether the nuisance was excessive.

Although the farm complied with the precautionary measures for emission reduction and with good professional practice, further advice on odour reduction was indicated. These concern organisational measures: no longer stirring the manure daily, but only before spreading it, if possible; more-frequent cleaning of heavily soiled floor surfaces, especially in the outdoor exercise area; and limiting and protection of the cut surface of the silage.

The emission situation is characterised by a combination of farming mode on the one hand and individual sources in the region of the buildings with feed store, farmyard-manure store and housing on the other. In individual cases, the settling of the emission and nuisance situation often involves technically complex combinations of meteorology, dispersion, animal husbandry and technology, as well as situations of several affected parties.

Odour complaints must be taken seriously by plant operators and public authorities from the outset. Various methodological aspects are discussed which highlight the scope of application and limits regarding the settling of odour complaints: resident surveys, odour diaries, smoke tests, plume and grid measurements.

Choice of location is decisive in the planning of livestock housing. To date, starting points for odour reduction for already existing locations, extended diffuse sources, natural ventilation, and especially for combinations with cold-air flow have been few in number. For dealing with the individual complaint, as holistic a methodological approach as possible is helpful, allowing the complex situation to be coped with adequately, ensuring that the odour complaints are taken seriously, and enabling situation-based solutions for odour reduction to be reached.

Keywords: odour impact, nuisance, dairy cattle housing, location, odour assessment methods

1 Introduction

When designing livestock-housing systems, it is important to bear in mind land-use planning interests and the protection of nearby residents from odour nuisance. Cattle housings are generally open, partially open or naturally ventilated buildings. This means that the situation in terms of both emissions and odour impact is different from that of housings with forced ventilation. The spread of housing estates into rural regions makes selecting a location for livestock-housing systems more difficult. The situation is exacerbated by the residential population's diminishing relationship to agriculture. Environmental agencies and courts are increasingly faced with complaints and lawsuits concerning the odour nuisance caused by livestock-housing systems. Whereas in the past lawsuits were primarily filed against pig and poultry farms, they are now also increasingly common in the case of farms keeping cattle. In the event of a complaint, the location, housing and residents' assessment must be analysed. As an example this paper describes and analyses an instance of a complaint relating to a dairy farm with an adjacent residential area. The initial aim here, after analysing location, housing system and management, was to suggest approaches for odour reduction. In addition, procedural steps contributing to clarity in the case of odour complaints are identified and discussed for the benefit of public authorities.

2 Odour Complaints concerning a Dairy Farm – Initial Situation

In 2007 a cubicle loose-housing system for 89 dairy cows was built after the due planning-permission process (Figure 1). Once the housing had been in use for about a year, inhabitants of the adjacent residential area filed a joint complaint regarding odour nuisance, whereupon the authorities conducted a survey of the residents of the housing estate in question. Various issues associated with the nuisance situation and its possible causes emerged from the survey. Below, the initial situation in terms of location, housing, management and odour nuisance is explained. In addition to an on-site inspection, planning principles were used to describe and analyse the initial situation. Furthermore, available documents such as meteorological data as well as information from the farm manager and the municipal and cantonal authorities were consulted.



Figure 1: Interior (left) and exterior view (right) of the housing with outdoor exercise area and horizontal silo.

2.1 Housing system and management

Details on the housing system, including feeding and management of the dairy farm, are summarised in Table 1 below.

Table 1: Overview of housing system and management.

Part of Procedure	Description	Dimensions, Frequency or Time of Activities
Housing concept, Type of housing, Spatial structure (Figure 2)	<ul style="list-style-type: none"> + Single-building cubicle loose-housing system + Cubicles with straw/dung mattress + Calving / Calf area on deep litter + Solid-concrete exercise areas: with rubber pads, no slope + Outdoor exercise area alongside, permanently accessible, with slatted flooring on slurry pit + Herringbone milking parlour, waiting area incorporated in outdoor exercise area 	89 dairy cows 319 m ² 42 m ² 466 m ² 313 m ²
Building envelope, Ventilation, Climate	<ul style="list-style-type: none"> + Non-thermally-insulated + Building orientation north-south + Longitudinal walls partly open, with curtains + Transverse walls closed, three gates, open depending upon weather + Ventilation ridge in roof + Water-sprinkler system over feeding aisle for cooling 	air temperatures > 25 °C
Bedding material, management	<ul style="list-style-type: none"> + Lying areas with long straw + Manual distribution of bedding material 	weekly
Dung removal, management	<ul style="list-style-type: none"> + Dung removal in housing with combiscraper + Manual cleaning of outside exercise area + Cross channel with flushing 	5:30, 9:00, 12:00, 16:00, 22:00 weekly as required
Manure storage, management	<ul style="list-style-type: none"> + Slurry pit below outdoor exercise area + Stirring with wing-blade agitator 	1100 m ³ , Ø = 7 m 03:00-03:15
Feed storage, Feeding	<ul style="list-style-type: none"> + Horizontal silo: in summer, generally one silo open, + TMR with 50% maize silage, 40% grass silage, 5% hay, protein concentrate, high-performance feed at feed station + Feed distribution with feed-mixer 	3 x 600 m ³ ; cut surface approx. 25 m ² , removal in the a.m. 08:00-09:00 09:00 and 16:00
Cleanliness (animals, housing, feed preparation etc.)	On the occasion of the site visit, the farm made an impression of cleanliness and order. The cleanliness of outdoor-exercise and lying areas, feeding alleys, horizontal silo installation and circulation areas corresponded to good professional practice.	

2.2 Location

The farm is located at the edge of a high plateau, 580 metres above sea level (Figure 2). From the last emitting points on the farm to the residential area there are distances of around 85 m in an easterly direction. In a westerly direction at a distance of 570 m from the farm there is uninterrupted woodland with an area of 1.5 km² rising to an altitude of 600 m. In a west-to-east direction, the terrain around the farm slopes by 8% over a distance of 2 km.

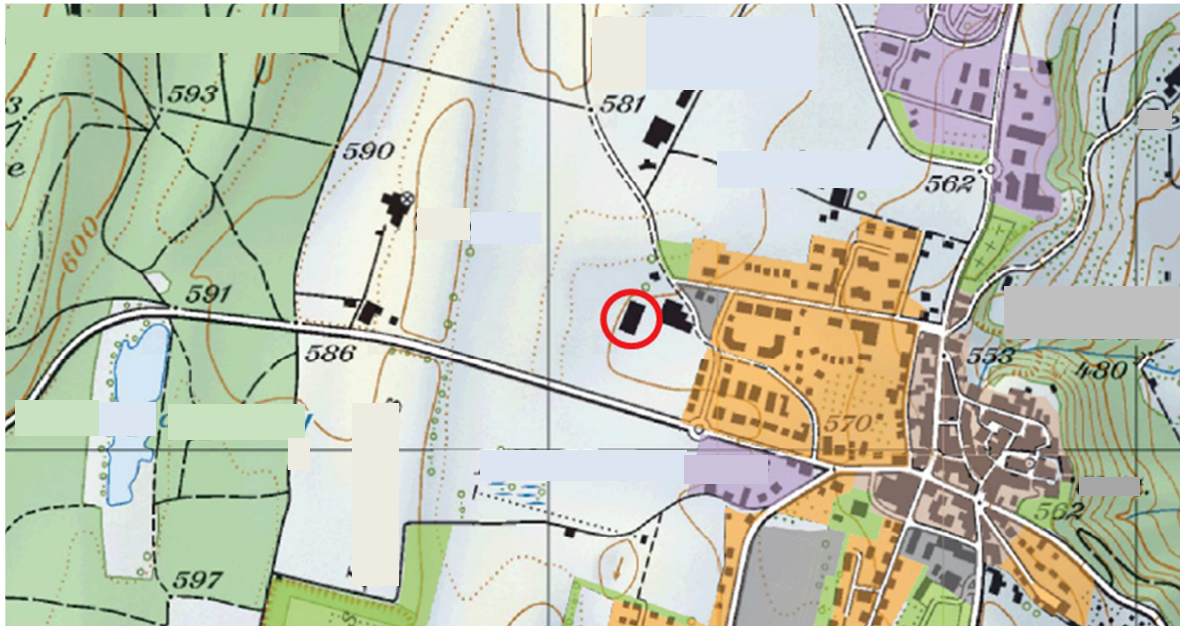


Figure 2: Detail from map showing the location of the farm (www.geo.admin.ch).

2.3 Odour-nuisance situation

Information on the nuisance situation was available from a survey of the residents of the affected housing area. The survey was sent out to 247 households in the residential area; 131 questionnaires were returned and evaluated. A majority of the respondents stated that they were annoyed by odour from the cattle keeping in the summer months (80% of responses), especially in the evening (70% of responses). At the time of the survey, a conflict situation between the parties in question already existed. No simultaneous survey was conducted in a reference area. Furthermore, agreements were assumed to exist among the residents. The survey was supplemented by inspections with independent persons; these confirmed the nuisance situation in qualitative terms. It was not possible to answer the question of whether odour nuisance was excessive.

3 Analysis of the Situation in Terms of Odour Emissions and Odour Impact

Figure 3 shows individual elements whose interaction might contribute to odour emission and the perception of annoyance by the residents. The emission situation is characterised by a combination of farming mode on the one hand and individual sources in the region of the buildings with feed store, farmyard-manure store and housing on the other. Meteorology, and location are also of importance in terms of the residents' perception of odour impact.

Cold-air flow

The terrain type (on a slope) and land use (with woods) predispose the farm location in question to cold-air generation and flow. Cold-air flow plays a key role in the spread of odour compounds from ground-level sources of odour (Koutny, 2002; VDI 3787, 2003).

Wind systems

Several years' data from measurements at meteorological stations at a distance of 20 and 40 km respectively have yielded observations on the prevailing wind directions. Moreover, public authorities and residents have confirmed that downdraughts occur in the summer months. In addition, situations with low wind levels are relevant at the location in question.

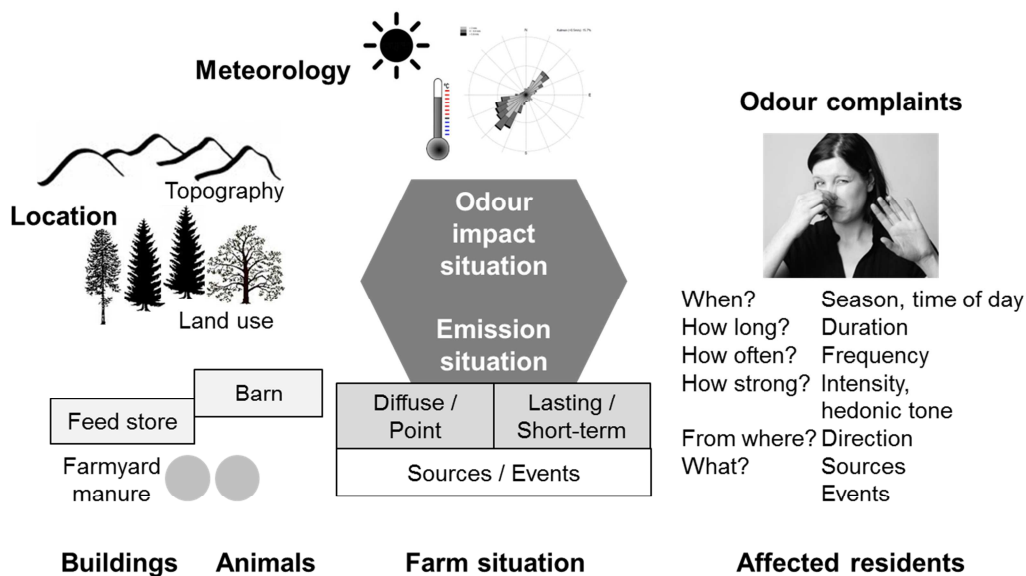


Figure 3: Elements contributing to the odour emission and odour impact situation.

Housing systems and feed stores

The release of odorants in cattle farming can be affected by feeding, dung removal and manure management in addition to housing concept. In the cubicle loose-housing system studied here, the 466 m² surfaces of the exercise areas and 361 m² lying areas in the housing as well as the outside exercise area with integrated waiting area (313 m²) dominate as diffuse area sources of odour. In addition to this, there is the cut surface area of the stored silage with around 25 m².

As far as source strength is concerned, there are considerable differences between the individual sources. In the comparison of odour concentrations, the values of solid-concrete floor surfaces were markedly higher than those of lying cubicles; the values for outdoor exercise areas fell somewhere in between (Keck, 2011).

The source strength of the stored silage varied within a wide range (Feistkorn, Al-Shorachi, Kost, 2013), amounting in the summer situation to several times the values of the floor surfaces. The feed-distribution area in the housing should also be added to this.

Farmyard manure: production, storage and management

The introduction of liquid manure with a remarkable proportion of straw in one corner of the storage pit makes mixing-in difficult. Because of this, the manure agitator was operated daily. The wing-blade agitator achieves a strong stirring effect whereby harmful gases and odours may be released above the agitator blade and at the baffles after only a few minutes (Nosal, 1997). These gases and odours are released through the slatted flooring. In order to prevent odour-nuisance complaints, the agitation process was shifted from the morning hours to the night-time. It is worth considering whether improvements in the layout of the building and in the stirring technique might ensure greater efficiency in the mixing in of the fresh slurry.

Further emitters

Towards the north at the same height above sea level there is another livestock farm with housing for 350 fattening pigs. The distance to the residential area is 320 m. Although this farm has been operating for several years now, there have been no odour-nuisance claims. During the planning stages, the public authority assumed that there was no spatial connection between the emitters, whereupon further clarifications were dispensed with. Given the actual location and the source strength to be expected from the pig housing, however, it must be assumed that this housing also affects the residential area.

4 Recommendations for Odour Reduction

At the time it was put into operation, the housing met current regulations in terms of precautionary measures for the prevention of excessive odour impact; nevertheless, further recommendations for odour reduction were deemed advisable.

Manure management

In view of the release of odour and harmful gases, it is important to avoid frequent stirring of the contents of the slurry pit. As a matter of principle, the manure should only be agitated just before it is to be spread. A gradual reduction in stirring frequency is advisable, from the previous daily stirring to the longest possible interval which still allows the fresh slurry to be mixed in.

Dung-removal technique and management

Heavily soiled areas with excrements should be avoided, the waiting area should be mucked out after every milking. During the animals' activity period, the manure scraper should be operated fairly frequently. However, this measure presupposes the use of especially animal-friendly scrapers in terms of dimensions, speed, and protected pinch-points.

Silage storage

The cut surfaces of the silage in the horizontal silo installation should be protected from strong sunlight, wind and rainwater. A separate silo film or fleece material can be used for this. The surface should be levelled as smoothly as possible in order to keep the emitting surface to a minimum.

5 Evaluation of Methods for Settling Odour Complaints

Table 2 highlights individual elements that could contribute to the settling of the emission and odour impact situation in individual cases. Accordingly, it is often a case here of technically complex combinations of a wide variety of subjects, ranging from meteorology, dispersion, animal husbandry and technology, as well as combinations of several affected parties that are challenging in terms of psychology and communication. Odour complaints must be taken seriously by plant operators and public authorities from the outset, and must wherever possible be tackled jointly, provided that positive conditions for doing so still exist (DEFRA, 2010). Below, methodological aspects are discussed which highlight the scope of application and limits regarding the settlement of odour complaints.

Table 2: Evaluation of methodological aspects for settling odour complaints.

Part	Methodological Elements	Evaluation	Literatur
Odour emission	Observing a minimum distance as a precautionary measure for reducing emissions	+ Rough estimate - Not farm- and situation-based	Richner & Schmidlin (1995)
	Observing good professional practice	+ Evaluation of qualitative aspects - Farm- and situation-based to a limited extent	DEFRA (2010)
	Individual sources: Documentation and quantification of odour concentration, volume flow, odour emission	+ Underlying data - Selective survey, not a long-term survey	VDI 3880 (2011) VDI 4285/1 (2005) EN 13725 (2003)
Dispersion	Smoke samples: Illustration of the flow	+ Clear depiction + Estimate especially for the immediate area - Qualitative statements	Porch et al. (1989)
	Meteorological data: <i>inter alia</i> wind direction and speed, turbulence	+ Location-based - Long survey period	VDI 3783/8 (2002)
	Dispersion modelling	+ Comparison of variants - Input variables often not available - Building in vicinity and cold-air flow cannot be depicted realistically on a small scale	VDI 3783/13 (2010)
Odour impact	Survey of residents: Proportion of strongly annoyed persons	+ Quantification of the nuisance situation + Differentiation of high-pollution areas and reference areas - Not applicable in conflict situation - Minimum number of evaluable questionnaires - Reference area essential	VDI 3883/1 (2013)
	Odour diary: Events and description when odour perceived	+ Farm- and situation-based + Assignment to meteorological conditions, activities and events	VDI 3883/2 (1993) DEFRA (2010)
	Plume measurement: Frequency, type, intensity at fixed points	+ Orientated, targeted survey + Independent, trained test persons + Combination with meteorological and farm data - No odour hours	VDI 3940/2 (2006)
	Grid measurement: Percentage time assigned to a certain facility	+ Random-sampling concept + Independent, trained test persons - Long assessment period of 1 year	VDI 3940/1 (2006)

6 Conclusions

The choice of location is of key importance when planning livestock-housing systems. At this early stage, room for manoeuvre is greatest and the risk of subsequent complaints owing to odour is at its lowest. To date, the starting points for odour reduction for already existing locations, extended area sources, natural ventilation, and in particular for combinations with cold-air flow have been few in number. The requirements for determining whether the nuisance is excessive are often not met, and the effort of conducting more comprehensive surveys seems to be high. For dealing with the individual complaint, a holistic methodological approach is of help, allowing the complex situation to be coped with adequately, ensuring that the odour complaints are taken seriously, and enabling situation-based solutions for odour reduction to be reached.

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