Appendix 6.1

Thorntons recycling

Bioiaerosol Risk Assessment: Dispersion Modelling Methodology And Assumptions

Model description

The dispersion modelling study was carried out using the Atmospheric Dispersion Modelling System (ADMS) version 3.1. ADMS is widely accepted as a current industry standard model for dispersion from sources such as the proposed composting facility. This model is able to incorporate the influence of buildings close to a source on wind flows, and hence to assess the influence of any buildings on the dispersion of material released from the source.

ADMS is a PC based model of dispersion in the atmosphere of passive, buoyant, or slightly dense, continuous or finite duration releases from single or multiple sources. The development of ADMS was supported by the EA. A key improvement in ADMS over older models is its use of the most recent scientific understanding of the structure of the atmospheric boundary layer. In the ADMS approach, the boundary layer structure is defined in terms of measurable physical parameters obtained from meteorological readings, which allow for a more realistic representation of the changing characteristics of dispersion with height. The result is a more accurate and soundly based prediction of the concentrations of pollutants.

The presence of buildings close to the release point can significantly affect the dispersion of material from a source. This influence can be taken into account by the use of an appropriate module in ADMS. In the case of the proposed composting facility, the facility buildings may have a significant influence on the dispersion of emissions from the biofilter, and were taken into account using the buildings module of ADMS.

Models of atmospheric dispersion processes are generally more reliable for long period means than short period means. Models are usually more reliable over intermediate distances (100 m to 1000 m) than very close to the source, or more distant from the source. This reflects the range of data that have been used to compile the models.

To acknowledge the potential for variability in dispersion model results, a worst-case approach has been adopted in the study. This will ensure that modelled results are likely to be over-estimates of the levels that will arise in practice.

In summary, ADMS was considered to be the most suitable model for this application for the following main reasons:

- An industry standard model for atmospheric dispersion modelling;
- Advanced understanding of boundary layer meteorology;
- Ability to model the influence of buildings on dispersion.

Model inputs

Weather data

Meteorological parameters were taken from the data file "R91A-G.met" file supplied with the dispersion model. This provides a range of seven meteorological conditions typical of the range of conditions encountered in Ireland. These range from very unstable weather conditions, through neutral stability, to very stable conditions.

Unstable conditions are encountered on some hot sunny afternoons. Unstable conditions are caused by strong thermal mixing of the atmosphere resulting from warming of the lower layers of the atmosphere. Neutral conditions are when there is no significant heat transfer between the earth's surface and the atmosphere, either because the sky is cloudy or because wind speeds are relatively high. Stable conditions occur when the lower levels of the atmosphere are cooled because the earth's surface is colder than the air. This typically occurs during cold winter nights.

The model was run to estimate levels of released substances at each receptor under conditions when the wind is blowing directly towards each receptor in turn.

Design data

The location of the proposed facility, the building dimensions and heights was taken from information provided by Thorntons Recycling and Celtic Composting (Ref. 4 and Ref. 7) and the location of nearby sensitive receptors was taken from mapping of the area (Ref. 4).

Details of emissions from the plant were assumed from Millner Olenchock (1994) (Ref. 5). Emission locations and plant dimensions were taken from information provided by Thorntons (Ref. 4).

The dimensions of the biofilter were taken from information provided by Celtic Composting (Ref. 7), as 2430m². This corresponds to an effective source diameter of approximately 54m.

The volume flow through the filter was calculated from the proposed building air exchange rate of 6 air changes per hour multiplied by the volume of the building:

Six air exchanges per hour x volume of building; or

6 x (128.5 x 83 x 10.7) = 684,725 m³/hour = 190 m³/s

The emissions of bioaerosols were calculated by multiplying the estimated bioaerosols per cubic meter of air released by the total volume of air released per second to derive a colony forming unit per second release rate:

Bacteria: 190 x 9,600 = 1,824,000 cfu/s

Fungi: 190 x 361 = 68,590 cfu/s

The influence of buildings on atmospheric dispersion can be significant. The influence of the proposed development (Composting hall and maturation area) was taken into account by including a building in the dispersion model with dimensions 128.5 metres by 83 metres and a height of 10.7 metres at the ridgeline. The building centre was located 60m to the east and 30m to the south of the biofilter to reflect the relative location of the plant building.

Background levels

Background levels of bioaerosols are highly variable.

Data from Reference 8 indicated highly variable background levels at the three composting sites considered (Lynnbottom, Thorpe and Basingstoke). Background levels varied between 100 and 80,000 colony-forming units per cubic metre. The higher background levels may in fact be influenced by the presence of the facilities under consideration, and not be true background levels.

Background levels were identified at a site in an agricultural area near a town. Level of bacteria were 200 colony-forming units per cubic metre, and for moulds, 50 colony-forming units per cubic metre.

There are no known specific sources of bioaerosols in the vicinity of the proposed facility, other than normal rural and domestic activities including cattle farming, cooking food and disposing of food wastes, and gardening.

We have estimated background levels in the vicinity of the proposed facility to be approximately 200 colony-forming units of bacteria per cubic metre, and approximately 50 colony-forming units of moulds per cubic metre. It is acknowledged that these estimates are subject to considerable uncertainty. If anything, background levels are likely to be higher than these levels, due to the assessment site being located in a rural location, rather than urban fringe, that livestock and arable farming is more prevalent around the assessment site than at the site from which the background is derived. If background levels are in fact higher than these levels, then the impact of the proposed process relative to these levels will be less significant.

Worst case assumptions

A worst-case approach was adopted for this project. This means that the forecast effects of the proposed facility are if anything likely to be over-estimates. In practice, any effects will be less significant. In summary, the following worst-case assumptions were made:

- The highest measured level of bioaerosols cited by Millner, Olenchock (1994) at a composting facility will be used for the assessment.
- The wind was assumed to blow directly towards each receptor in turn. When the wind is not blowing directly towards any given receptor, then forecast levels of bioaerosols will be lower. Forecast levels of bioaerosols will be zero when the wind blows bioaerosols away from the receptor.
- Results obtained under the most adverse weather conditions were used in the risk assessment. Under all other weather conditions (which prevail for around 98% of the time), forecast levels would be lower - typically 50% of the values used in this risk assessment.
- No die-off of bacteria during atmospheric dispersion was assumed to occur;

Summary of Bioaerosol model inputs

Parameter			Units	Comments	
Biofilter	Height		m	Assumed to be the same as the roof height	10.7
	Emission temp		Celcius	Assumed	30
	Area source		m^2	Provided by Celtic composting	2430
	Flow (as actual)		m^3/s	Calculated from assumed air changes and volume of compost facility	190
	Emissions (including 90% reduction in biofilter)	Bacteria	cfu/s	See appendix 1 for derivation	1824000
		Fungi	cfu/s		68609
	Biofilter location	Easting	m	Assumed to be in centre of composting facility	0
		Northing	m		0
Building effects	Building	Height	m	Includes Composting Building and Maturation/Storage Building	10.7
		Length	m		128.5
		Width	m		83
	Building centre	Easting	m		0
		Northing	m		0
	Angle to north		degrees		80
Meteorological data	ADMS 7 category meteorological data is used				
Surface roughness	Applicable to agricultural land use, and is at the lower end of the likely range which represents a worst-case assumption.				0.2