EPR 6.09 Sector Guidance Note

How to comply with your environmental permit for intensive farming

Appendix 11

Assessing dust control measures on intensive poultry installations

Version 1

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Introduction

This appendix provides guidance on the sources of dust from poultry farms and the measures to minimise these dust emissions.

Dust is a general name for solid particles with diameters less than 500 microns. Particulates or particulate matter (PM) are tiny subdivisions of solid or liquid matter suspended in a gas or liquid. PM_{10} particles are 10 microns or less in size (smaller than the diameter of a human hair).

The UK National Atmospheric Emissions Inventory shows that poultry husbandry accounts for 9 ktonnes per year of PM_{10} (2008). This is around 6% of the total released from commercial and domestic human activities.

The IPPC Directive states that appropriate measures must be taken to minimise dust emissions by the adoption of 'Best Available Techniques' (BAT). The chapters of this document specify the measures that we expect you to consider to minimise dust emissions.

PM_{10} objectives

The Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland has set objectives for both PM_{10} and $PM_{2.5}$ to protect human health. For PM_{10}, there must be no more than 35 exceedances of the daily average of 50 µg/m^3 in a year. The objectives should apply at 'all locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, care homes together with hotels and some parts of the gardens of residential properties' (based on Box 1.4, Local Air Quality Management. Technical Guidance LAQM.TG(09) Defra). 'Some parts of the gardens' should represent areas 'where relevant public exposure is likely, for example where there are seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied'.

The PM_{10} objectives must be considered by local authorities under Local Air Quality Management (LAQM) and we are also required to 'have regard' to them in our regulatory activities. Our commitment is that no installation we regulate will cause or contribute significantly to a breach of a national objective. This is a duty placed on us by Local Air Quality Management – we believe that generally BAT will deliver this. It is more fully described in the Environmental Permitting Guidance, The IPPC Directive. Where these objectives are unlikely to be met, the local authority must declare an Air Quality Management Area (AQMA) under section 83(1) of the Environment Act 1995.

The likelihood of a poultry farm exceeding the PM_{10} AQS objective is influenced by a number of factors:

- The proximity of the closest sensitive receptor[1] to the poultry sheds, as the objective is only likely to apply in locations where members of the public are regularly present. Although particulate concentrations fall off rapidly with distance from the emitting source, if the sheds are located very close to a residential property, concentrations may be higher.
- The orientation of the sensitive receptor to the poultry sheds with respect to the prevailing wind direction. If the sensitive receptor is downwind of the poultry sheds then it is likely to experience a greater frequency of higher particulate concentrations than if the sensitive receptor was the same distance away but upwind of them.
- Background concentrations of PM_{10} in the local area. Poultry sheds located in rural areas where background levels are relatively low are less likely to exceed the AQS objective than poultry sheds located near urban areas and busy roads and motorways where levels of PM_{10} are already quite high.

These factors mean that poultry farms with similar set ups and bird capacities, may be required to undertake different levels of dust abatement.

Sources of dust

Dust from poultry houses mainly originates from feathers, skin particles and used litter, and to a lesser extent from feed, bedding, micro-organisms and fungi.

Dust abatement techniques

Defra financed a project (CTE0408 - Dust abatement techniques in the UK poultry industry June 2008 ADAS, by Walker O. and Emery. J) to look at such techniques in the UK poultry industry. Information from this project is summarised in the tables below.

The control of dust can be divided into two categories:
- control at source
- control at exhaust

Control of dust at source

Some of the dust control at source methods, i.e. those used inside a poultry building, are limited in the amount of dust they can remove. It is therefore debatable how practical or economical it is to use control at source abatement techniques as specific ‘stand-alone’ dust control methods in a poultry house.

Many techniques may well already make a contribution to dust control where they are part of normal flock management techniques. Most farmers already ensure that good quality feed pellets are fed to birds using modern feeders that do not break up the

[1] A sensitive receptor is a member of the public who is regularly present at locations which are situated outside of buildings or other natural or man-made structures, above or below ground. This applies to farm workers and their families who live on-site.

feed and are not over-filled. They also properly clean houses and equipment on a regular basis. Dust extracted bedding material is commonly used because it is better for the birds, more bio-secure and affordable. A summary of all the ‘at source’ control methods are given in Table 1.

Control of dust at exhaust

Dust particles that have not been trapped or eliminated at source may become airborne within the building and ultimately exhausted to atmosphere by the ventilation system. Since in many poultry houses air is exhausted via the fans, there is an opportunity to either vent exhaust air at high velocity or trap dust as this air leaves from these exhaust locations by using ‘end of pipe systems’. These typically consist of either passive air-cleaners or active systems, such as wet cleaning or air scrubbers. Exhaust cleaning systems have been proven to be an effective way of reducing not only dust, but also ammonia emissions from livestock housing, both in trials and in the commercial industry. However, they require a significant capital outlay on systems with high air change rates and may have high running costs. A summary of all control at exhaust methods are listed in Table 2.

How to use this guidance

Tables 1 and 2 below summarise the dust control methods at source and at exhaust. You may find that you are already using many of the techniques in Table 1 as part of your day to day management. If there are any breaches of air quality objectives or complaints about dust then we would expect you to consider further controls from Table 1 and Table 2.

After the tables, there are two checklists which can be used by the operator or the Environment Agency to assess and record which dust control methods are being used on the installation. Make sure you’ve read the comments in Tables 1 and 2 so you know what is feasible on your installation. If a method is not achievable record your reasons in the comments box of the checklist. From this assessment you can identify where improvements could be made.

Table 1. A summary of at source control methods for particulate reduction at poultry farms

Source of dust	Method	How is reduction achieved?	Comments
Poultry feed	Dust from silos	Covers put over feed silo pipes.	Bags or containers should be in place on silo exhausts to catch any excess feed and dust.
	Dust extraction in feed mill areas	Filters reduce dust emissions to the outside.	
	Storage of feed	Use of covers for feed containers.	Biosecurity issue as well.
	Feed spill control	Collection of any feed spill is undertaken to avoid dust being generated.	Good management practice and avoids possible pollution into a watercourse
	Form of feed	Mould feed into pellets so that dusty ingredients are bound together.	May affect flock performance in laying hens, additional cost of the feed, lack of pelleting equipment in UK mills, as well as increased feed consumption.
	Fat content	Increase fat content so that dusty ingredients are bound together.	Not economical or desirable for laying hens.
	Spraying oil or water mist onto feed	Mainly prevents particles on surfaces from becoming airborne again by making them too heavy.	Risk of deterioration in litter condition that could be detrimental to the welfare of the birds.
	Feed ingredients	Both wheat and barley have been found to be more dusty than maize.	Maize is not readily available compared to wheat in the UK for agronomic and economic reasons and is not commonly used in poultry diets.
	Feeding method	Hand feeding is preferable to screw auger systems and automatic feeders, which can produce increased dust levels.	Hand feeding is likely to be impractical on larger farms.
		Fit a material sock to the end of the auger pipe that delivers the feed directly into the bin.	Auger pipes tend to have downpipes that stop around 30–60cm short of the internal feed bin. Fitting a material sock to the end of the pipe that delivers the feed directly into the bin may reduce the feed dust that is created by 'free-falling' into the bin.
		Cover the internal feed bin, e.g. with a ply-wood constructed top, and fit the auger pipe through the cover.	The feed delivery into the bin is effectively sealed by the cover.
		Feed pans may be preferable to tracks.	Consider bird welfare issues.
	Over administration of feed to birds	Avoid spilled feed crushed on the floor into particles which become airborne.	

Source of dust	Method	How is reduction achieved?	Comments
Bedding material	Type of bedding	Sawdust and flax straw have been found to produce less dust than wheat, barley or rye straw.	Suitable litter materials for poultry must also consider availability and cost, ability to dispose of the used litter after the flock, and the risk of litter consumption by poultry. For example, turkey poults are more likely to consume wood shavings to the detriment of their health than straw.
	Treatment of bedding	Dust from straw can be reduced effectively if the straw is humidified prior to application.	Using dampened straw is not considered good practice in poultry production, as damp straw can cause pododermatitis and is contrary to welfare regulation.
	Amount of bedding	Deep bedding systems have been shown to contribute less dust to the environment than shallow bedding systems.	Suitable for ducks and turkeys but not broilers.
	Application of bedding	Bedding applied internally.	Bedding supplied in bales rather than in bulk. Bales opened in housing rather than blown in to reduce dust.
		Fit catching curtains when unloading and augering bulk bedding into housing.	Where bulked product is used, delivered by lorry and unloaded by a vehicle with a bucket that 'augers' (the auger is fitted in the bottom of the bucket) the bedding throughout the house to maintain an even depth, this is a source of dust. The amount of emitted dust could be reduced by fitting the catching curtains while spreading the bedding. Catching curtains are generally detachable and consist of thick black polythene strips which are used to keep light levels down when catching birds during the day.
	Age of bedding	As bedding materials break down to a dry friable litter dust production increases.	Even with "pre-packed, dust-extracted" bedding materials, dust levels will be low at first but will increase due to activity occurring in the litter.
Litter systems	Use of cage systems for layers	Dust emissions were much higher from houses using litter rather than cages with wire floors.	Producers in the UK and throughout Europe are moving towards littered systems for poultry on the grounds of animal welfare. Ban on the use of conventional egg production cages from 2012.
Relative humidity	Increasing humidity	Using misting systems to increase the humidity at low ventilation rates has been shown to reduce inhalable dust.	Increasing relative humidity in littered floor systems may result in pododermatitis resulting from damp litter and an increase in ammonia emissions.

Source of dust	Method	How is reduction achieved?	Comments
Ventilation	Increasing ventilation	An effective method is by significantly increased and controlled airflow velocities.	Increasing ventilation may reduce airborne dust within the house, but still exhausts dust to the outside. Consideration must also be made for the type of stock being ventilated For example, broilers require careful control of air flow over them as they are readily disturbed by draught and wind-chill. Fully feathered adult birds are much more tolerant of increased airflows at bird level than young birds. Increased ventilation is often used in summer months through the use of gable end fans.
House cleaning	Good management	Good house cleaning between flocks is essential to reduce the volume and potential for air contamination within the house and via exhaust systems.	Exhaust vent cleaning – take care to avoid dust accumulation around exhaust vents. Cleaning should take place in such a way that does not cause a release of dust to air or water, i.e. do not blow dust off site or wash it into surface water drains. Litter should be covered as soon as possible before leaving the site or moved to a store on site.
	Dust removal by vacuum cleaner	In-house dust removal by vacuum cleaner when the birds are in situ, reduces dust that could be disturbed by ventilation and emitted.	Only applicable for layers in cage systems.
Genotype	Animal activity	Birds that exhibit higher activity levels create elevated levels of dust in the air.	A genotype with lower activity levels may be difficult to initiate in a commercial setting and activity is recognised as having some positive benefits.
	Feather crunchiness	Greater feather crunchiness causes increased dust levels at moulting periods.	A genotype with less crunchy feathers may not be possible in a commercial setting.
Number of birds	Reduced flock numbers	Fewer birds, less feed, less litter means less activity to produce dust airborne.	Changing stocking density or moving from, for example, broilers to broiler breeders are options.
Crop cycle length	Lower final body weight	Birds grown to a shorter cycle length and lower weight produce less dust as most dust is emitted from day 20.	Depends on contract with the processing company.

Table 2. A summary of control at exhaust methods of particulate abatement at poultry farms

Dust control	Method	How is reduction achieved?	Comments
Screens and wind breaks	Natural and artificial	Both rely on exhaust air being directed towards them, typically from end-wall mounted systems, so that dust particles can be both intercepted and air lifted into the atmosphere for better dilution and dispersion. Vegetative screens have been seen to reduce dust levels by approximately 50%.	Natural screens also reduce odour, noise and visual impact on the local environment. However, you need the space to create them in a particular way and this makes them difficult to retro-fit.
Dry filters	Collecting dust onto filters on exhaust vents	Dry filters can be fitted to internal air recirculation units.	Can be used in poultry houses when air change rates are relatively low and where the system will not interfere with the air distribution within the house. However, to remove anything other than large particles would need both a large and impractical surface area of filter, or very frequent cleaning or changing, which may prove impractical.
Electrostatic precipitation devices (ESP)	Attraction and collection of dust particles	ESPs impart electric charges to dust particles. The electromagnetic force either pushes the particles out of the airstream into a collection tray, or attracts them to earthed surfaces.	However, although construction is simple, operating costs are relatively low and airborne dust removal is significant, electrostatic collectors still need development before they can be used to great effect within commercial poultry houses with large air change rates. An advantage is that no replacement filters are required.
Passive dry air cleaning units	Filter panels that collect dust across the width of the house	Fans are located in the end-wall of the house, in front of which is a plenum chamber fitted with linked filter panels making a filter wall. As air is drawn through to the fans the filter separates the dust into collection pockets that can be emptied. Commercial results suggest a 70% reduction in visible exhaust dust.	Can be retro-fitted to most existing houses. Several examples have recently been fitted to UK broiler farms at a cost of approximately £1 per $30m^3$ of air. Do not require water. Filters do present a resistance to air flow, so fans must be able to operate at higher pressure to prevent heat stress in broilers.

Dust control	Method	How is reduction achieved?	Comments
Active wet cleaning units	End-wall ventilated systems	Water air-cleaning units intercept dust as air passes through a water or chemical spray, often over a pad matrix.	Most easily incorporated into systems with end-wall ventilation fans or into systems with one dedicated ventilation exhaust outlet. Some systems can be retro-fitted to the outside of poultry houses as 'stand-alone' units, however, they usually require some alteration to the ventilation system control. They are expensive to install and operate, for example, simple stand-alone units can cost over £20,000 for about 100,000 m^3/hr of air change, or £1 per 5 m^3 of air.
	Roof ventilated systems	Water is sprayed over the exhaust air from exhaust chimneys, binding the dust. All units are connected together and used water falling on the roof goes to a central acidified treatment basin where odour and ammonia molecules are trapped. Requires the air pressure to be more than 30 Pa.	Currently not available at present but commercial trials show promising results.
Scrubbers	Bio-filters and acid-filters	Air passes through a water scrubber to remove the larger dust particles. Next, in the bio-filter system the air is passed over moistened beds of plant material, removing dust, odour, microbes and pathogens. In the sulphuric acid filter scrubber, 99% of ammonia molecules and other odorous compounds can be removed.	Due to the amount of filtration in the combination scrubbers, additional air pressure is needed to ensure the optimum flow rate of air. Some need a working pressure of 150 Pa to work correctly, increasing consumption of electricity and conflicts with CCLA requirements. This pressure can be five times greater than conventional poultry ventilation systems. Bio-filters are used in mainland Europe but are rare in the UK at present in commercial poultry production. They are typically fitted into new buildings where the ventilation system is specifically designed to guide air through the bio-filters. Acid-filter systems can cost approximately £1 per 3-4m^3 of air to install. There are concerns with regards to ensuring operators are sufficiently well trained to handle the very corrosive liquids and that all chemicals are safely stored and controlled.

Checklist 1 – Options for dust control at source

Source of dust	Method	How is reduction achieved?	Achieved Yes/No	Comments
Poultry feed	Dust from silos	Covers put over feed silo pipes.		
	Dust extraction in feed mill areas	Filters reduce dust emissions to the outside.		
	Storage of feed	Use of covers for feed containers.		
	Feed spill control	Collection of any feed spill is undertaken to avoid dust being generated.		
	Form of feed	Mould feed into pellets so that dusty ingredients are bound together.		
	Fat content	Increase fat content so that dusty ingredients are bound together.		
	Spraying oil or water mist onto feed	Mainly prevents particles on surfaces from becoming airborne again by making them too heavy.		
	Feed ingredients	Both wheat and barley have been found to be more dusty than maize.		
	Feeding method	Hand feeding is preferable to screw auger systems and automatic feeders, which can produce increased dust levels.		
		Fit a material sock to the end of the auger pipe that delivers the feed directly into the bin.		
		Cover the internal feed bin, e.g. with a ply-wood constructed top, and fit the auger pipe through the cover.		
		Feed pans may be preferable to tracks.		
	Over administration of feed to birds	Avoid spilled feed crushed on the floor into particles which become airborne.		
Bedding material	Type of bedding	Sawdust and flax straw have been found to produce less dust than wheat, barley or rye straw.		
	Treatment of bedding	Dust from straw can be reduced effectively if the straw is humidified prior to application.		

Source of dust	Method	How is reduction achieved?	Achieved Yes/No	Comments
	Amount of bedding	Deep bedding systems have been shown to contribute less dust to the environment than shallow bedding systems.		
	Application of bedding	Bedding applied internally.		
		Fit catching curtains when unloading and augering bulk bedding into housing.		
	Age of bedding	As bedding materials break down to a dry friable litter dust production increases.		
Litter systems	Use of cage systems for layers	Dust emissions were much higher from houses using litter rather than cages with wire floors.		
Relative humidity	Increasing humidity	Using misting systems to increase the humidity at low ventilation rates has been shown to reduce inhalable dust.		
Ventilation	Increasing ventilation	An effective method is by significantly increased and controlled airflow velocities.		
House cleaning	Good management	Good house cleaning between flocks is essential to reduce the volume and potential for air contamination within the house and via exhaust systems.		
	Dust removal by vacuum cleaner	In-house dust removal by vacuum cleaner when the birds are in situ, reduces dust that could be disturbed by ventilation and emitted.		
Genotype	Animal activity	Birds that exhibit higher activity levels create elevated levels of dust in the air.		
	Feather crunchiness	Greater feather crunchiness causes increased dust levels at moulting periods.		
Number of birds	Reduced flock numbers	Less birds, less feed, less litter means less activity to produce dust airborne.		
Crop cycle length	Lower final body weight	Birds grown to a shorter cycle length and lower weight produce less dust as most dust is emitted from day 20.		

Checklist 2 – Options for dust control at exhaust

Dust control	Method	How is reduction achieved?	Achieved Yes/No	Comment
Screens and wind breaks	Natural and artificial	Rely on exhaust air directed towards them, typically from end-wall mounted systems, so that dust particles intercepted and air lifted into the atmosphere for better dilution and dispersion. Vegetative screens seen to reduce dust levels by approximately 50%.		
Dry filters	Collecting dust onto filters on exhaust vents	Dry filters can be fitted to internal air recirculation units.		
Electrostatic precipitation devices (ESP)	Attraction and collection of dust particles	ESPs impart electric charges to dust particles. Dust particles collected in a tray, or attracted to earthed surfaces.		
Passive dry air cleaning units	Filter panels that collect dust across the width of the house	Fans are located in the end-wall of the house, in front is a plenum chamber fitted with linked filter panels making a filter wall. As air is drawn through to the fans the filter separates the dust into collection pockets that can be emptied. Commercial results suggest a 70% reduction in visible exhaust dust.		
Active wet cleaning units	End-wall ventilated systems	Water air-cleaning units intercept dust as air passes through a water or chemical spray, often over a pad matrix.		
	Roof ventilated systems	Water is sprayed over the exhaust air from exhaust chimneys, binding the dust. All units are connected together and used water falling on the roof goes to central acidified treatment basin where odour and ammonia molecules are trapped. Requires the air pressure to be more than 30 Pa.		
Scrubbers	Bio-filters and acid-filters	Air passes through a water scrubber to remove the larger dust particles. Next, in the bio-filter system the air is passed over moistened beds of plant material, removing dust, odour, microbes and pathogens. In the sulphuric acid filter scrubber, 99% of ammonia molecules and other odorous compounds can be removed.		