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Best Available Techniques in French pig production
Nadine GUINGAND, IFIP Institut du Porc – France
nadine.guingand@ifip.asso.fr

Abstract :

Ammonia is one of the main gaseous compound emitted by pig units. Since 2002, European regulation impose to pig breeders to declare the whole quantity of ammonia produced by their farms. The NEC directive in 2001 combined to the IPPC directive adopted in 1996 fixed the level of emission and proposed technical tools with Best Available Techniques (BAT) to reduce ammonia emitted by pig farms. Intensive livestock concerned are installations for the intensive rearing of pigs with more than 2 000 places for production pigs (over 30 kg) or 750 places for sows. BAT are not only applied in order to reduce ammonia. Water and energy consumptions are concerned. The BAT's list is presented in a technical synthesis – the BREF document – dedicated to intensive rearing poultry and pigs. Because ammonia can be emitted by building, the storage units and during the slurry spreading, BAT concerned all those aspects.

In France, more than 3 000 installations for the intensive rearing of pigs and poultry are concerned by the IPPC directive and directly by the application of BAT. Most of the BAT proposed on the storage and the land spreading of manure are already commonly applied in intensive pig farms in relation with specific French regulation. At the opposite, the application of BAT dedicated to the reduction of ammonia emission from pig housing could be more difficult. Actually, in France, more than 75% of grower-finisher pigs are housed on fully-slatted floor with underlying deep collection pit. Most of the BAT identified in the BREF document is based on the reduction of the surface of the collection pit with partially-slatted floor and with frequent evacuation of manure.

The aim of this article is to illustrate the application of BAT under French pig conditions. Different techniques for housing, storage and manure application will be presented with their efficiency and applicability.

Key words : pigs – ammonia – reduction – technique - BAT

Ammonia and intensive rearing of pigs

In France, more than 90% of ammonia is emitted by the agricultural sector (CITEPA, 2009). Animal rearing is considered as the main source of ammonia emission with more than 80% of ammonia produced by the agricultural sector (CITEPA, 2009). The first source of ammonia is cattle production with 60 % (year 2007) following by poultry with 21 % (year 2007) and by pigs with 16 % (year 2007 - Table 1).

Year	Cattle	Pigs	Sheeps	Goats	Horses	Poultry	Total
2000	362 700	93 219	8 756	1 125	3 262	146 844	615 906
2001	365 194	94 981	8 461	1 120	3 279	148 629	621 665
2002	359 745	94 389	8 315	1 124	3 294	144 022	610 889
2003	350 689	93 218	8 262	1 128	3 291	135 938	592 526
2004	344 896	92 189	8 181	1 119	3 350	128 430	578 165
2005	343 545	91 741	8 122	1 125	3 345	124 564	572 442
2006	343 567	91 316	7 914	1 130	3 320	121 642	568 889
2007	345 208	91 055	7 679	1 118	3 320	121 642	570 022

Table 1: ammonia (in ktonnes) per animal categories in France (source : CITEPA)

Ammonia volatilisation is the result of urea degradation provided inside the building, during outside storage of manure and during land application. Connected to the French pig units management and in regard with national regulations, 60 % of ammonia is emitted by the buildings, 10 % during manure storage and 30% for the spreading (during and few days after) (Guinand, 2003).

European regulations for the reduction of ammonia

In September 1996, the Directive 96/61/CE was adopted by the European Union Council and commonly called the IPPC Directive (Integrated Pollution Prevention and Control). The purpose of the Directive was to limit the pollution transfer by applying a global approach including the protection of air, water and soil. Ammonia emissions, water and energy consumptions are mainly focused on this Directive. Among the list of industrial activities concerned, installation for the intensive rearing of pigs with more than 2 000 places for production pigs over 30 kg or 750 places for sows are considered under the scope of the Directive. Intensive poultry farming over 40 000 places for poultry are also concerned. Pig farmers have to take all appropriate preventive measures against pollution through the application of Best Available Technique (BAT) enabling them to improve their environmental performance.

The 2001/81/CE, called the NEC Directive (National Emission Ceilings) is adopted in October 2001 and fixed national emissions ceilings to reach in 2010 for nitrogen oxides, VOC, sulphur dioxide and ammonia. In the NEC Directive, BAT are given as a tool to achieve ceilings in particular for ammonia.

A definition of BAT

Best Available Technique is defined in article 2 of the directive as “the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for

emission limit values designed to prevent, where that is not practicable, generally to reduce emissions and the impacts on the environment as a whole". In the same article, a complete definition is given for Best, Available and Techniques as follows:

"Best" means most effective in achieving a high general level of protection of the environment as a whole

"Techniques" includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

"Available" for techniques already developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator.

The BREF document

For each activity concerned by the IPPC Directive, best available techniques are listed in a reference document called a BREF. This document is the result of an information exchange between Member States and the industries concerned on BAT. The first BREF document for intensive rearing of poultry and pigs (IRPP BREF) was written between 2001 and 2003 and published by the European Commission in 2003. The aim of this document is to provide reference information for the permitting authority to take into account when determining permit conditions. By providing relevant information concerning best available techniques, the BREF document for intensive rearing of poultry and pigs should act as valuable tools to drive environmental performance.

The whole document is available of the eippcb site (<http://eippcb.jrc.es/>) for intensive rearing of pigs and poultry but also for all activities concerned by the IPPC Directive.

The IRPP BREF document is divided in five chapters. Chapter 1 provides general information at a European level on poultry and pigs production sectors. Production systems and techniques are described in chapter 2. Current emission and consumption levels reflecting the situation of existing installations at the time of writing are given in chapter 3. For the determination of BAT, chapter 4 lists techniques that are considered to be most relevant for determining BAT and BAT-based permit conditions. Techniques that are considered to be compatible with BAT are presented in chapter 5.

The European Commission has expected technical evolution and the consequences on BAT. A five-years review process is integrated in the IPPC Directive for the updating of the BREF document. The review of the IRPP BREF started with the reactivation of the technical working group (TWG) in the beginning of May 2008.

Examples of BAT and their application in France

Feeding techniques

Reducing the excretion of nitrogen in manure can reduce ammonia emission. This reduction can be obtained by using different diets during successive phases of animal production matching the animal changing requirements. This technique, commonly called phase-feeding

is very frequently applied in France for sows and for fattening pigs. The CORPEN organisation gives recommendations for the average values of crude protein contents in feed by production phases since 1996. The following table gives values of standard levels, CORPEN recommendations (CORPEN, 2003) in comparison with BAT values given in the IRPP BREF. CORPEN recommendations are totally in accordance with values proposed by the IRPP BREF.

Species	Phases	Crude protein level (% in feed)		
		Standard levels	CORPEN	IRPP BREF
Sows	Gestation	16.5	14	13-15
	Lactation		16.5	16-17
Piglets	1 st age	21	20	19-21
	2 nd age	19	18	17.5-19.5
Fattening pigs	Growing phase	17.5	16.5	15-17
	Finishing phase		15	14-15

Table 2: Comparison of crude protein levels in standard feeds, in CORPEN and in BAT-feeds for pigs

Application of low crude-protein diet recommended by CORPEN permits a reduction of 28 % of ammonia emitted by the building. Because buildings are responsible to 60 % of ammonia emitted by pig production, reducing the crude-protein diet leads to a reduction of 17 % of ammonia of the whole production.

Multiphase-feeding is very commonly applied in French pig unit – more than 60 % of sows and 80 % of fattening pigs are concerned. The application of this BAT has no extra cost for pig breeders.

Housing techniques

The reduction of slatted floor, especially in fattening housing, is commonly presented in the BREF document as an efficient way to reduce ammonia emitted by building. Because of the reduction of manure surface area and frequent slurry removal, ammonia abatement between 15 and 35 % is expected.

In France, 60 % of sows and around 80% of fattening pigs are on fully-slatted floor. Previous studies have been achieved on the implementation of partly-slatted floor under French pig conditions and its consequences on ammonia and odour emissions. In those studies, reduction of slatted floor leads to an increase of the dirtiness of the solid floor and of animals. The main consequence was the increase of ammonia and odour emitted by the room with the reduction of the slatted floor. The comparison between literature and data obtained in French studies shows the great influence of ambient temperature in the process of ammonia volatilization probably connected to the lying and excreting behavior of pigs (Aarninck et al. 2006). Above a certain temperature, excretion on the solid floor increased (Aarninck et al., 2006). In literature, an abatement of 30% was obtained (Aarninck and al., 1997) with ambient temperature between 16 and 18°C. In the first study achieved by Guingand (2003), ambient temperature was close to 24°C, which is the classical level of ambient temperature applied in French pig production. In this study, ammonia and odours emitted from housing were considerably increased with the reduction of slatted floor and not appeared as a credible technique to be proposed to pig farmers. Reduction of temperature to 18°C was studied by Guingand (2009) in experimental farm. First results show that even if there is a reduction of

ammonia emitted from housing, the reduction of ambient temperature leads to an increase of feed conversion ratio.

Techniques for reducing emissions from storage

Ammonia emitted by manure during outside storage represents less than 10% of ammonia volatilized in the atmosphere by the whole farm. Covering outside storage units seems to be the only efficient way to reduce volatilization of ammonia in the atmosphere. Based on the reduction of manure surface, ammonia abatement between 70 and 90% are expected with this Best Available Technique (Hörning and al., 1999 – Sommer and al., 1993). Others advantages can be identified. Covering storage units lead to reduce the dilution of manure by rainfalls. Volumes of stored slurry are reduced and the fertilising value of stored manure, especially its nitrogen contents, is increased. Time spend for the application of manure to land is reduced what it represents too a save of energy.

In France, this Best Available Technique is only in progress. Less than 10% of outside storage units are covered. The cost of the technique is the main reason of this low implementation. Today, the cost of covering storage units is between 30 and 100 euros per square meter. The high price is calculated for outside storage units in area with high snowfalls. In those specific conditions, rigid covers are necessary.



Figure 1 : example of plastic cover

Techniques for reducing emission from slurry spreading

Using bandspreader or injectors are commonly accepted as techniques permitting a high reduction of gaseous emissions during the application of manure to land. The efficiency of those techniques is connected to the reduction of the contact surface between nitrogen and the atmosphere leading to a great decrease of ammonia volatilization. Actually, ammonia abatement between 70 and 90% is expected. Positive effects on odours are also clearly identified.



In France, a large development of manure application systems has been observed until last ten years. If the main reason is the positive effect of those systems on odours emissions permitting a higher acceptability of manure application to land by neighbourhood, specific conditions of use must be taken into account for the applicability of those techniques. The development of cooperative structures for the use of materials contributes too for a large part of the application of this BAT in France.

Conclusions

Under French conditions, the implementation of some BAT appears technically practicable, especially for storage and manure application to land. In every case, the economic part of their implementation must be analysed in a detailed way. In a global approach, the relation between the efficiency of the technique and the importance of ammonia's sources (housing, storage, spreading...) should be integrated into the assessment of the BAT. Application of BAT to reduce emissions from housing appears more difficult if the only way proposed is the reduction of slatted floor. Implementations of end-of-pipes treatments or the introduction of different types of floor materials could be an alternative to reduce emissions from housing.

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