

A METHOD TO ASSESS THE REDUCTION OF AMMONIA AND METHANE EMISSIONS BY APPLICATION OF BAT IN INTENSIVE LIVESTOCK FARMING

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ABSTRACT

Application of IPPC in Intensive Livestock Farming requires the estimation of the quantities of foreseeable emissions from the installations into each medium as well as the identification of significant effects of the measures taken to reduce these emissions. A mathematical model to attain these objectives has been set up and can be used via Internet. Calculation of methane and ammonia emissions are performed taking into account the amount of Phosphate, Nitrogen and Organic Matter excreted by the animals, feeding strategies, designs of floors and manure management in the different housing systems, on-farm treatments, type of storage, characteristic of the land concerned when applying manure. The different techniques that are BAT and that can be applied at the different stages in the manure management can be evaluated and selected according to their efficiency in reducing the emissions from the whole installation. The calculation programme has been calibrated on the reality of some Italian Regions, but can be implemented to work in different climatic conditions, land use and agricultural practices. The proposed calculation method is an useful tool for farmers to evaluate the convenience to select a technique instead of another and to apply for the IPPC permit requested by the competent Authorities.

Keywords: *IPPC, BAT, emissions, model.*

INTRODUCTION

The European Commission has approved a document (BREF, 2003) containing a list of the Best Available Techniques (BAT) agreed on by experts of a Technical Working Group. When available, the emission factors of ammonia and the percentage of emission abatement (environmental benefit) as regards a reference technique are given for each BAT. There is also a short description with informations on the limits to application, the cross-media effects, the operational data and an economic evaluation including investment and management costs for each technique in the list. A qualitative evaluation was also carried out to analyse the impact of the different techniques on the consumption of energy and primary materials.

The application of IPPC in Intensive Livestock Farming requires the estimation of the quantities of foreseeable emissions from the installations into each medium as well as identification of significant effects of the measures taken to reduce *these emissions* (Cortellini *et al.*, 2000).

A mathematical model to attain these objectives has been set up and can be used via Internet.

DESCRIPTION OF THE METHOD

The mathematical model considers the emissions from all the various pig and poultry effluent fractions (manure, slurries, separate and/or clarified fractions, bedding...) at all the different stages (housing, storage, treatment and soil application), and takes into account the effect that each emission has on the following stage.

Calculation of methane and ammonia emissions are performed taking into account:

- The amount of Organic Matter and Nitrogen excreted by the animals. The calculation of methane emissions from internal storage to housing facilities, from external storage and from

the subsequent land-spreading is strictly dependant on the quantity and dilution of organic matter present. The production of methane increases in proportion to the quantity of organic matter excreted and with increased volumes of stored manure. In the same way the quantity of nitrogen excreted, from different animal species at different growth stages, and the subsequent dilution, have a direct influence on the overall entity of emissions from the farms. As a consequence, a thorough assessment of these quantities is presumed indispensable for the correct calculation of emissions into the atmosphere. In addition to supplying standard quantities of excreted nitrogen for each animal species, the calculation program is structured to calculate the variations in nitrogen production at different growth stages in farms which have adopted feeding strategies aimed at reducing the amount of nitrogen in feeding;

- Designs of floors and manure management in the different housing systems: the program includes database on each animal species, subdivided into weight categories, which contain a series of effluent management techniques with the quantities of manure produced and the corresponding emission factors so that the user can calculate ammonia and methane emissions into the atmosphere. Figure 1 shows the program mask for selecting the management technique according to animal species.

Figure 1. Mask for entering the characteristics of manure management techniques in pig installations (suini: pigs; Scrofa in zona parto: farrowing sows; gabbie parto: farrowing crates; fossa sottostante: deep collection pit)

- On-farm treatments: the calculation program also considers the inclusion of chemical-physical treatment device in the management of manure production (techniques of solid/liquid separation, anaerobic digestion, purification, poultry manure drying systems.). Figure 2 illustrates the mask used for entering the treatment technique. The program includes a database, with the operating effectiveness of the different treatment techniques, which can be used to calculate the quantity of the fractions eventually produced together with ammonia and methane emissions.

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Inserisci i dati e premi "Invia" per salvare (l'asterisco indica i dati obbligatori)

ID Dichiarazione : S1300335

*Tecnica di separazione :

*Tecnica di depurazione :

*Scarico diretto in fognatura :

Nota : Se durante il Calcolo emissione totale di ammoniaca e metano si sono verificati dei problemi scrivi a Servizio.NetI PPC ricordandoti di specificare l'ID Dichiarazione e di riportare, se esiste, il messaggio di errore che ti è stato visualizzato.Grazie.

Figure 2. Mask for selecting treatment techniques for pig manure (depurazione: purification; scarico in fognatura: discharge in sewers).

- Type of storage: as far as emissions from outside stores are concerned the program is structured to distinguish basin typology (earth banked tanks or tanks) and filling/emptying dynamics (Figure 3). The latter is taken from the soil distribution program which in turn derives from the farm's breeding plan or the geographical area of the livestock farm. All solid manure is considered in heaps;

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Inserisci i dati e premi "Invia" per salvare (l'asterisco indica i dati obbligatori)

ID Dichiarazione : S1300335

*Stoccaggio in vasche a pareti verticali : m³

*Stoccaggio in lagoni : m³

*Stoccaggio in pozzi neri : m³

Nota : Se durante il Calcolo emissione totale di ammoniaca e metano si sono verificati dei problemi scrivi a Servizio.NetI PPC ricordandoti di specificare l'ID Dichiarazione e di riportare, se esiste, il messaggio di errore che ti è stato visualizzato.Grazie.

Figure 3. Mask for entering pig manure storage typology (vasche a pareti verticali: tanks with vertical walls; lagoni: earth banked tanks; pozzi neri: closed pits)

- Characteristic of the slurry concerned when applying manure. Calculation of ammonia emissions from the application of pig manure to the soil takes into account the characteristics of nitrogen and total manure solids concentrations determined on the base of the quantities excreted, the volumes produced and the emissions from preceding stages (housing, storing and treatments). The interface mask (Figure 4) is used to enter the percentiles of the different soil application techniques used. Algorithms from a mathematical model produced by Concerted Action ALFAM (1998) are used to calculate the emissions from this stage.

As far as poultry farms are concerned, the program is structured in order to also consider management modalities. In the very common case of transfer of bedding to the fertiliser industry, this part of manure management is removed from the calculation of emissions.

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Modifica i dati e premi "Invia" per salvare

ID Dichiarazione : 767894879

Tecnica	Percentuale utilizzo (%)
Distribuzione a largo raggio (gettone irrigatore o piatto deviatore)	<input type="text" value="0"/> %
Distribuzione superficiale a bande rasoterra	<input type="text" value="100"/> %
Iniezione superficiale con solco chiuso	<input type="text" value="0"/> %
Iniezione superficiale con solco aperto	<input type="text" value="0"/> %
Iniezione profonda	<input type="text" value="0"/> %

Figure 4. Mask for entering the soil application technique of pig manure (Suini: pigs; distribuzione a largo raggio: high-pressure broadcasting; distribuzione superficiale a bande rasoterra: bandspreading); iniezione superficiale con solco chiuso: closed slot injection; iniezione superficiale con solco aperto: open slot injection; iniezione profonda: deep injection).

CONCLUSION

The Best Available Techniques (BAT) which can be applied at the different stages of manure management can be evaluated and selected according to their efficiency in reducing the emissions from the whole installation. The calculation program has been calibrated on the reality of some Italian Regions, but can also be implemented to suit different climatic conditions, land use and agricultural practices. Farmers will find the proposed calculation method a useful tool for evaluating the various techniques and when applying for the IPPC permit requested by the competent Authorities.

REFERENCES

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