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Abstract
This work evaluated the use of additives (Mg/P and nitrification inhibitor dicyandiamide - DCD), on nitrous oxide emission during swine slurry composting. The experiment was run in duplicate; the gas was monitored for 30 days in different treatments (control, DCD, Mg/P and DCD + Mg/P). Nitrous oxide emissions rate (mg of N₂O·N·day⁻¹) and the accumulated emissions were calculated to compare the treatments. Results has shown that emissions of N-N₂O were reduced by approximately 70, 46 and 96% through the additions of DCD, MgCl₂·6H₂O + H₃PO₄ and both additives, respectively, compared to the control.

Keywords
Composting; swine slurry; additives; nitrous oxide.

INTRODUCTION
Swine slurry composting with sawdust is an emerging technology in Brazil and an important strategy for the sustainability of intensive swine production systems. Nevertheless, previous study showed relevant N losses (up to 54%) during the composting process as NH₃ (15%), N₂O (5%) and N₂ (79%). This N loss during swine slurry composting decrease nutrient content of the compost and also can cause environmental risks, such as global warming, and odours problems (Angnes et al., 2013; Zhong et al, 2013).

Therefore same studies employ different methods to reduce N losses, as use of additives. The nitrification inhibitor, dicyandiamide (DCD) is used to inhibit the first-stage of nitrification: the ammonia (NH₄⁺) oxidation to nitrite (NO₂⁻). According to O’Cornnor et al (2012) the DCD acts specifically on ammonium oxidase bacteria, maintaining the nitrogen as NH₄⁺ and reducing its loss as NO₃⁻.

The Mg and P can form the struvite (MgNH₄PO₄·6H₂O). The crystallization of struvite has been considered an effective method to decrease N loss by volatilization of NH₃ and struvite is a valuable fertilizer of slow release. Previous studies showed that the precipitation of struvite affects the microorganisms that participate in the nitrification process, the conversion of nitrite (NO₂⁻) to nitrate (NO₃⁻) by nitrobacter (Lee et al, 2009; Fukumoto, 2012).

The aim of this work was to evaluate two additives that promote the inhibition of nitrification (dicyandiamide - DCD) and the crystallization of struvite (MgNH₄PO₄·6H₂O) to control gaseous N losses from swine slurry composting piles. This may be a useful tool to improve compost quality and to mitigate pollutant and greenhouse gases emissions.
MATERIAL AND METHOD

Reactor Composting
Experiment was run during 30 days in 8 tubular PVC reactors V= 25 L (ф=200 mm; h= 800 mm). Reactors (Figure 1) were filled with a mixture of swine slurry and sawdust (50:50 v/v) and the following treatments were carried out in duplicate: (1) Control, (2) DCD - 1.07% in Dry Matter- DM, (3) MgCl₂.6H₂O + H₃PO₄ – 1.01% Mg: 5.32% P in DM and (4) Both additives in the same loads as (2) and (3). The biomass from each reactor was revolved twice a week and samples of composts were collected and analysed dry DM and N-NH₄ according to official methods (APHA, 2005).

Nitrogen Gases Emissions
Emission of N-N₂O from each reactor was daily measured using static chambers and the increase of gas concentration was measured by infrared photoacoustic gas monitor (INNOVA 1412, Denmark). The fluxes were calculated based on a standard protocol (Robin et al, 2006).

RESULTS AND DISCUSSION
The N-N₂O losses were reduced by 70; 46 and 96,56% through the additions of DCD, MgCl₂.6H₂O + H₃PO₄ and both additives, respectively, compared to the control treatment.
Figure 2 shows that in terms of efficiency on reducing N-N₂O emission, DCD+Mg/P reached the best result (18,73 mg of N-N₂O in 30 days), followed by DCD and Mg/P an .

Fukomoto (2012) showed that the addiction of Mg and PO₄ can reduce 25-43% NH₃ emission compared to control, according to these authors this happened by struvite formation, reducing the amount of nitrogen dissolved, which doesn’t have a direct influence on nitrification/denitrification process (N-N₂O emission). Otherwise Luo et al (2013) observed that the treatment with DCD shows significant reduction emission of N₂O because it inhibit the metabolic turnover of Nitrosomonas bacteria. O’Callaghan et al (2010) states that DCD did have effect on the ammonium-oxidizing bacteria by reducing the population and altering their activity.
Figure 2. Accumulate emission of N-N2O during the experiment.

Figure 3 shows the concentration of N-NH4 (%) in the resulting composts. It was observed that the treatment DCD+Mg/P has the higher N-NH4 concentration when compared with control. The amount of N-NH4 in this study were 0.7% (DCD), 0.5% (MgP) and 0.4% (DCD+Mg/P). These results confirms that Mg/P decreases N-NH3 loss and keep it in the resulting compost increasing its’ fertilizing a potential.

![Graph showing N-N2O emission over days](image)

![Bar graph showing N-NH4 concentration](image)

**CONCLUSIONS**
The additives DCD and MgCl₂.6H₂O + H₃PO₄ mitigated N₂O emission from swine slurry composting piles through different processes. Also, the resulting compost had higher N-NH4 contents which may have influence in the performance of the organic compost as a fertilizer for crop production. Further studies should address the mechanisms and interactions among additives controlling N losses from compost piles.

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