Reduction of Odor and Odorant Emissions from Slurry Stores by Means of Straw Covers

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Introduction

- Odor emission has become a major problem faced by livestock producers.
- The main compounds responsible for unpleasant odors:
  - Sulfur compounds (e.g. H₂S)
  - Phenols and indoles (e.g. p-cresol, skatole)
  - VFA’s (volatile fatty acids)
- Other compounds: e.g. NH₃
Introduction

• Covering of open slurry storage facilities is one of the most widely used ammonia and odor control method in Denmark.

1. More knowledge is needed on how moisture content, caused by rainfall, in the straw cover affects the odor reduction efficacy of straw covers.
Introduction

2. It has not been completely determined whether the gas emission reduction caused by the straw covers is mainly the result physical, chemical, or biological processes:

- Physical: The straw cover physically obstructs the transport of gases from the slurry to the atmosphere.
- Chemical: The degradation of the straw cover changes the chemical properties of the slurry (e.g. pH).
- Biological: The microbial population growing in the straw cover may convert the gases emitted from the slurry into biomass, nonodorous compounds, CO$_2$ and H$_2$O (biofilter).

The physical mechanism works from the moment the straw is placed on the slurry surface.

The biological mechanism is associated with the age of the straw cover, because the development of a microbial population that can “biofilter” the emitted gases takes time…
Objectives

- To evaluate the effect of the moisture content of straw covers (rainfall) on the reduction of emissions of odor and odorants from stored swine slurry
- To evaluate the contribution of the biological mechanism on the odor reduction effect of straw covers.

Materials and methods

- Slurry stored in chambers during 9 weeks
- Measurements
  - Odor concentration (OC)
  - Concentrations of 19 gases in the headspace air: 17 VOC’s, H₂S and NH₃
  - Slurry composition, temperature and pH
Materials and methods

U: Uncovered slurry
SD: Slurry covered by dry straw (no rainfall)
SM: Slurry covered by straw with moderate moisture (moderate rainfall)
SH: Slurry covered by straw with high moisture (high rainfall)
SDnew: Same slurry as in other chambers, but covered by new dry straw.

Materials and methods

U: Uncovered slurry
SD: Straw dry
SM: Straw moderate rainfall
SH: Straw high rainfall
SDnew: New dry straw
**Results**

**Reduction of gas emissions by 9 wk old straw covers:**

<table>
<thead>
<tr>
<th>Gas</th>
<th>Relative concentration, %</th>
<th>SD&lt;sub&gt;week 9&lt;/sub&gt;</th>
<th>SM&lt;sub&gt;week 9&lt;/sub&gt;</th>
<th>SH&lt;sub&gt;week 9&lt;/sub&gt;</th>
<th>SD&lt;sub&gt;new&lt;/sub&gt;</th>
<th>Uncovered slurry</th>
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</thead>
<tbody>
<tr>
<td>OC</td>
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<td>Hydrogen sulfide</td>
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<td>Ammonia</td>
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<td>Dimethyl sulfide</td>
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<tr>
<td>Phenol</td>
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<td>p-cresol</td>
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<td>Skatole</td>
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<td>Benzyl alcohol</td>
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</tbody>
</table>

n.s. = not significant (p>0.05)

Sig = significant (p<0.05)
Results

Difference on gas emission depending on moisture content:

Uncovered slurry

n.s. = not significant (p>0.05)
Sig = significant (p<0.05)
Results

Difference on gas emission depending on age of the straw cover (effect of the microbiological mechanism):

SD<sub>week 9</sub>  SM<sub>week 9</sub>  SH<sub>week 9</sub>  SD<sub>raw</sub>  Uncovered slurry

SD<sub>new</sub>

Uncovered slurry

Relative concentration, %

OC  Hydrogen sulfide  Ammonia  Dimethyl sulfide  Phenol  p-cresol  Skatole  Benzyl alcohol

n.s.  Sig.

Sig.  n.s.

n.s. = not significant (p>0.05)
Sig = significant (p<0.05)
Conclusions

• Aged straw covers, regardless of their moisture content, significantly reduced emissions of ammonia (by 99%), dimethylsulfide (by 81%), phenol (by 82%), p-cresol (by 95%), skatole (by 98%), and benzylalcohol (by 97%).
• The presence of straw covers did not have an effect on emission of odor, H₂S, and VOC’s such as VFA’s, dimethyldisulfide, and indole.

Conclusions

• The different moisture contents in the straw covers caused by the moderate and high rainfall patterns did not affect the odor and odorants reduction efficiency of straw covers.
Conclusions

• The main mechanism for odor and odorants emission reduction in straw covered slurry is associated with the cover acting as a physical barrier.
• However, the reduction in emission of specific gases (such as ammonia and p-cresol) appears to be also caused by the straw cover acting as a biofilter.

More information…


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Thank you for your attention