Animal Housing—Biofilters Overview

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Animal Housing—Biofilters Overview

Application: used for building ventilation air

Pros

• Effective on multiple substances.
• Uses common materials.
• Relatively easy construction.

Cons

• Careful design is necessary to not negatively impact the ventilation system.
• Requires maintenance and rodent control.
• Moisture maintenance is critical for effective treatment.
• Can require a relatively large footprint.
• Not practical to filter all the ventilation air during summer.

Description

Biofilters are used on mechanically ventilation livestock buildings to treat the ventilation air. A bed of biological material, normally wood chips, is created and the ventilation air flows through the material. Gases are absorbed by cultures of microbes that develop within the bed. Moisture content (>40%) of the biofilter media is critical for keeping cultures active to maintain effectiveness. Sprinklers or other wetting systems may be necessary, especially during warm months. Particulate matter (dust) is removed through physical impaction but may inhibit air flow in dusty environments as it accumulates within the biofilter, especially when used with poultry housing. To avoid plugging, some experts advocate some type of filtration upstream to the biofilter air intake to prevent the plugging of the media with dust.

One of the most critical design considerations is balancing air retention time with static pressure restriction. A longer retention time means more thorough treatment but requires more fan power due to increased pressure required to push air through the biofilter bed. Higher static pressure can reduce fan capacity and lead to air quality or heat stress issues within the livestock facility. Normally a retention time of 3-5 seconds is adequate for treatment.

Critical management issues include the maintenance of moisture in the biofilter bed (to promote better microbial action) and the maintenance of the bed air seal. In other words, if the biofilter develops air leaks around the perimeter, air will not be forced through the biofilter and air will be untreated. Rodent control is also critical because the plenum may be a good harbor for rodents and rodent activity can harm the integrity of the air seal.
In curtain-sided barns that use natural ventilation in summer it will not be possible to treat the natural ventilation portion of the air with a biofilter. It is generally not practical to filter all the ventilation during the summer in tunnel ventilated facilities due to the required size of the biofilter. If odor control is the main goal, a large impact may be made using the biofilter for the first several ventilation stages. These stages operate when odor transmission potential tends to be greatest. Using a biofilter only when air movement is toward odor receptors has also been developed and shown to have promise. (Hoff, et al. 2009).

Options
There are two main design configurations for biofilters. These include the flat-bed type and a vertical biofilter. The flat-beds are easier to construct and cost less, however they occupy more space than the vertical biofilters. Vertical biofilters are more difficult to construct and biological material can settle, causing leaks, which will cause the system to be rendered useless. Vertical biofilters can be designed in multiple layers to reduce the effects of settling.

Effectiveness

<table>
<thead>
<tr>
<th>Component</th>
<th>Effectiveness</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH3</td>
<td>45 to 75%</td>
<td></td>
</tr>
<tr>
<td>H2S</td>
<td>80 to 95%</td>
<td>Less effective in poultry</td>
</tr>
<tr>
<td>Odor</td>
<td>70 to 95%</td>
<td></td>
</tr>
<tr>
<td>Particulate Matter*</td>
<td>80% reduction</td>
<td>Estimated</td>
</tr>
<tr>
<td>Volatile Organic Compounds (VOC)</td>
<td>76 to 93%</td>
<td>Of 16 characteristic compounds</td>
</tr>
<tr>
<td>Cost</td>
<td>$$</td>
<td>Electricity and materials</td>
</tr>
</tbody>
</table>

*Particulate matter (dust) accumulation may eventually limit the air flow through a biofilter media bed.

Cost Considerations

Cost includes the initial construction of the biofilter, added fan operational cost, rodent control and moisture control. Estimates for initial construction range from $0.062 per cfm treated (1998) to $0.25 per cfm treated (2004). Operating costs were estimated from $0.005 to $0.015 per cfm treated.

More Information

University of Minnesota
- [http://www1.extension.umn.edu/agriculture/manure-management-and-air-quality/air-quality/biofilter-design-information/](http://www1.extension.umn.edu/agriculture/manure-management-and-air-quality/air-quality/biofilter-design-information/)
- [http://www.livestock.doa.sd.gov/environmental_docs/Biofilters.pdf](http://www.livestock.doa.sd.gov/environmental_docs/Biofilters.pdf)

eXtension
- [http://www.extension.org/pages/66419/clearing-the-air-on-biofilters](http://www.extension.org/pages/66419/clearing-the-air-on-biofilters)

References


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