Reducing emissions by air scrubbers

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Why combined air scrubbers?

- In specific areas restrictions on the emission of both ammonia, odour and PM10

- Need for a technology with high removal performances for all mentioned compounds to enable large scale pig and poultry operations
Restrictions of biofilters and chemical scrubbers

- **Biobed/biofilters:** very effective in odour removal
- Long term performance of biofilters affected by high ammonia loads, dust and insufficient humidification
- Given risks in performance limited application of biofilters in livestock
- **Chemical scrubbers:** very effective for ammonia removal (>90%) but poor odour removal (<30%)
Principles applied in combined air scrubbers

- High removal capacities for different compounds can be achieved by combining biological and chemical removal principles.

- Sustainability of biofilters can be ensured by pre-positioning scrubbing units in the waste air that eliminate dust, ammonia.
General layout of combined systems

- Air flow is treated in steps
  - Dust removal
  - Ammonia removal
  - Odour removal
Dust Removal

- Characteristics inflowing air
- Removal of particles
- Protection next steps
Dust Removal

Air

[Diagram of dust removal process]

[Image of dust removal setup]
Ammonia Removal

- Dust
- Acid washing fluid
- Recirculation
- Odour
- NH₃
- Discharge on ion strength
Ammonia Removal
Odour Removal

- Bacterial digestion
  - Volatile fatty acids
  - Sulfuric compounds

- Design
  - Biofilter
  - Bioscrubber
Odour Removal
Combined System

- Operating parameters
  - Back pressure
  - Cross influences
- Operating costs
- In practice both two-stage and three-stage scrubbers are developed
## Removal PM10 and PM2.5: field test NL

<table>
<thead>
<tr>
<th>System</th>
<th>Loading % of maximum</th>
<th>Residence time Mean (s)</th>
<th>Removal PM10 % (± s.e.)</th>
<th>Removal PM2.5 % (± s.e.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-stage</td>
<td>29</td>
<td>3.6</td>
<td>83 (±3)</td>
<td>62 (±9)</td>
</tr>
<tr>
<td>Two-stage</td>
<td>21</td>
<td>1.2</td>
<td>62 (±3)</td>
<td>47 (±2)</td>
</tr>
<tr>
<td>Three-stage</td>
<td>15</td>
<td>7.4</td>
<td>93 (±1)</td>
<td>90 (±2)</td>
</tr>
</tbody>
</table>
Conclusions

- Scrubbers are effective in removing total dust
- First indicative results: high PM10 removal potential of combined air scrubbers
- Removal performances are lower for PM2.5
- Proper dimensioning important
- More in depth research required: package material, residence time, particle size etc.