Nitrogen Foam Delivery System

Julian Sparrey

• Two projects funded by DEFRA and the Dutch Government
• Joint Research with University of Glasgow, Royal veterinary College and Wageningen UR, Lelystad
• Designed and built small laboratory scale prototype
• Test on individual birds (Broilers, Hens, turkeys and ducks)
• Tested Carbon Dioxide and Nitrogen
• Tests on groups of birds under controlled conditions
• Final full scale trials funded by DEFRA and the UK Poultry Industry (BPC, BEIC & BFREPA)
Key Research findings

<table>
<thead>
<tr>
<th>Time in relation to submersion (s)</th>
<th>Hens</th>
<th>Broilers</th>
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<tbody>
<tr>
<td>Transitional EEG</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Loss of posture</td>
<td>15</td>
<td>9</td>
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<tr>
<td>Wing flapping</td>
<td>18</td>
<td>15</td>
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<tr>
<td>Suppressed EEG</td>
<td>30</td>
<td>18</td>
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<tr>
<td>Isoelectric EEG</td>
<td>65</td>
<td>47</td>
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<tr>
<td>Motionless</td>
<td>65</td>
<td>51</td>
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</tbody>
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Key Research Findings

- Variable but minimal reaction to foam application, no difference in the initial behavioural response to air filled versus nitrogen filled foam
- All birds exposed to nitrogen foam showed vigorous wing flapping characteristic of anoxic death (oxygen concentrations in the foam were less than 1%)
- Trachea was never occluded by foam
- Suppressed and isolectric EEG patterns seen sooner in broilers than hens
Nitrogen Foam Delivery System

- Expansion ratio of between 250:1 to 350:1
- Nitrogen produced more consistent foam
- Potential for wing flapping to destroy foam
- Height of foam achieved above the bird before wing flapping begins is crucial

Concept

Liquid Nitrogen storage  
Vaporiser  
Water Storage  
Foam Generator Units  
Pump, mixing, distribution and control platform
Liquid Nitrogen Supply

Vaporisers
Foam System – On farm

Broiler trial video
Foam System – Broiler Shed trial

Foam loss from shed
**Foam Knockdown**

- Foam left to drain for 1 hour
- Broken down using air line from compressor
- Will decay naturally over 12 hours depending on environmental conditions
- Birds can be removed mechanically in floor reared systems
- By hand in Layer systems, but dust and potential exposure to virus is reduced

**Emergency Deployment**

- 4 structurally damaged sheds (1600 m² each)
- Unable to enter sheds
- Deployed foam through doors, walls and roof
- 30 000 litre water tanker capacity available to produce at least 9000 m³ of foam,
- Liquid Nitrogen tanker capacity for 18 000 m³ of foam.
**Summary Foam System Capability**

- Delivers 100m$^3$ Nitrogen filled foam per minute
- No requirement to enter sheds
- Oxygen levels in foam verified at below 1%
- Only birds submerged in foam are affected – short induction period
Questions

Thank you