Environmental Control in Poultry (Broiler) units.

Raising broiler chickens is big business in Northern Ireland. Energy costs for heating broiler houses from around 32°C for the young birds lowering to 23°C by about the fifth week are considerable and can have major impact on gross margins. Houses have traditionally been heated using LPG air blown heater and canopy brooder systems.

Conversion to a biomass heating system can provide a cost effective, low carbon alternative to gas. Because biomass heating generates less moisture, the chicken litter is kept drier, reducing ammonia levels, boosting growth and improving bird welfare. With biomass fuel costing considerably less than fossil fuels, installing a biomass heating system can significantly reduce production costs.

Genetics and nutritional improvements in broiler production have been extremely important to the efficiency of poultry meat production. The full potential of broilers can not be reached unless the proper environment is maintained in the broiler house.

Maintaining proper temperature to promote growth is key to efficient broiler production. Thus, heating a broiler house is extremely important in terms of performance, economic standpoint and the welfare of the birds. Chicks are not able to completely maintain their body temperature until approximately 14 days of age. During this time, it is crucial that floor temperature be maintained around 30 degrees C with minimum variation.

Ventilation is necessary to deliver fresh air and remove excess heat, moisture and noxious gases from the broiler house. Ventilation systems are usually of two types, natural air flow and mechanical air movement (fans).

The Welfare of Farmed Animals Regulations (Northern Ireland) 2012 states that:

Schedule 1, paragraph 13 – Air circulation, dust levels, **temperature**, relative air humidity and gas concentrations shall be kept within limits which are not harmful to the animals.

Schedule 1, paragraph 20 – Were the health and well-being of the animals is dependent on an artificial ventilation system –

a. Provision shall be made for an appropriate back-up system to guarantee sufficient air renewal to preserve the health and well-being of the animals in the event of a failure of the system; and
b. An alarm system shall be provided to give warning of any failure of the system.

Schedule 5, paragraph 5 – Ventilation shall be sufficient to avoid overheating and, where necessary in combination with **heating systems**, to remove excess moisture.

This is of importance when considering the environmental conditions within the broiler house and the difference in that management between using a gas based heating system and a system utilising biomass.

Biomass will result in a drier atmosphere with relative humidity (RH) dropping below 40%. Day old chicks should be kept at 60 – 70% RH for the first 3 days. This provides the birds with a better start

being less prone to dehydration and consequently respiratory disorders. At a lower RH e.g. 40%, performance will be adversely affected and action need to be taken to increase RH.

As the chick grows the ideal RH drops, with a high RH (above 70%) causing wet litter and associated welfare problems. As the broilers increase in weight, RH levels are controlled using ventilation and **heating systems**.

According to Dr. Malcolm Mitchell from the Scottish Agricultural College, the temperature experienced by the birds is dependent on dry bulb temperature and RH. Birds lose heat to the environment by evaporation of moisture from the respiratory tract and through the skin. The higher the RH the less evaporation loss occurs, increasing the birds apparent temperature at a particular dry bulb temperature. Low RH will decrease apparent temperature so at low RH the dry bulb temperature will need to be increased.

What effect does Biomass heating have on the RH in a broiler house? Most farms have found a reduction in RH to 29 – 35% when using biomass heating systems. Thy dry-heat produced means less ventilation is needed to remove gases and water vapour, and is generally beneficial to bird health reducing . However For day-old chicks, the ideal dry bulb temperature at 60% RH is 30.8 deg. C. However, at 40% RH the dry bulb temperature would need to be 36 deg. C. Therefore, to achieve ideal RH additional heat will be required when using a biomass system.

Energy Requirement for heating

A standard 240 x 60ft, 27,000 bird broiler house (without renewable energy installed) in Great Britain, consumes on average 40,000 litres of LPG per year **(!!!This must be for two house unit!!!**). This is equivalent to 264,000kWh of heat. (40,000 x 6.6 =264,000). A typical broiler house in Northern Ireland will use 42,000 litres of LPG per year. This is equivalent to 277,200 kWh of heat. This can be explained by the difference in average temperatures between GB and Northern Ireland, NI being 2-3 degrees lower than GB (Met Office)

As explained above additional heat is required when using biomass for the heating of the houses.

A typical house in Northern Ireland will use xxx,xxx kWh of biomass heat per year.

A standard 280 x 66ft, 35,000 bird broiler house (without renewable energy installed) in Great Britain, consumes on average 33,600 litres of LPG per year. This is equivalent to 221,760kWh of heat. (33,600 x 6.6 =221,760). A typical broiler house in Northern Ireland will use 36,400 litres of LPG per year. This is equivalent to 240,240 kWh of heat. This can be explained by the difference in average temperatures between GB and Northern Ireland, NI being 2-3 degrees lower than GB (Met Office)

As explained above additional heat is required when using biomass for the heating of the houses.

A typical house in Northern Ireland will use 365,500 kWh of biomass heat per year.

(How we get this figure - 170t of pellets was used last year between 2houses, so 85t /house @ 4300kwh/t = 365,500kwh).

Without this level of input there is a number of potential issues:

Wet litter

Pododermatitis or foot burn

Breast blister

Resulting in poor performance, loss of sales to processor, increased penalties from the factory and potential loss of single farm payments.

Costs associated with conversion to biomass

Pellets	£179 per Tonne @ 4300kWh per Tonne	4.16p
Increase in electricity usage	@ 12p/kWh	0.3p
Boiler servicing cost		0.25p
Remedial repairs		0.1p
Total		**4.81p**

Not including cost of Capital repayment, Depreciation and additional time spent.

To: David Mark[David.Mark@moypark.com]
From: Keith Wilson
Sent: Fri 7/17/2015 11:46:31 AM
Importance: Normal
Subject: FW: Document
MAIL_RECEIVED: Fri 7/17/2015 11:46:31 AM
Environmental Control in Poultry (Broiler) units. C Ellis July 2015 2.docx

From: Ellis, Cathal [mailto:Cathal.Ellis@dardni.gov.uk]
Sent: 17 July 2015 11:06
To: Keith Wilson
Subject: Document

Keith,

Please find final version of the document as sent to DETI. Many thanks for your assistance.

Cathal

Cathal Ellis

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Environmental Control in Poultry (Broiler) units.

Raising broiler chickens is big business in Northern Ireland. Energy costs for heating broiler houses from around 32°C for young birds, lowering to 23°C by about the fifth week are considerable and can have major impact on gross margins. Houses have traditionally been heated using LPG air blown heaters and canopy brooder systems.

Conversion to a biomass heating system can provide a cost effective, low carbon alternative to gas. Because biomass heating contributes no moisture, the chicken litter is kept drier, reducing ammonia levels, boosting growth and improving bird welfare. With biomass fuel being slightly more expensive than fossil fuels, kW for kW, installing a biomass heating system can significantly improve the welfare of the birds, but it is not economically viable without being subsidised.

Costs associated with conversion to biomass vs. LPG

Example 1 Wood Pellets produced		Cost per kWh of heat
Pellets	£179 per Tonne @ 4300kWh per Tonne (Assuming 4800kW/T @ 90% efficiency)*	4.16p
Increased requirement in electricity usage for pumps and fans @ 12p/kWh		0.30p
Boiler servicing cost		0.25p
Remedial repairs		0.10p
Total		**4.81p/kWh**

This does not include cost of capital and interest repayment, depreciation and additional labour – (approximately an additional 2p to 3p/kWh).

For comparison, LPG currently costs around 25p/l @ 6.6kWh/l **3.79p/kWh**

***NOTE! Not all boilers will run at 90% efficiency. Potentially boilers may run between 80% and 92% efficiency based on age, service schedules and design of system. Assuming 4800kW/T @ 80% efficiency heat produced would cost 4.49p per kWh.**

Example 2 Wood Chip produced		Cost per kWh of heat
Wood Chip	£120 per Tonne @3150 kWh per Tonne@ 30% moisture content (Assuming 3500 kW/T @ 90% efficiency)*	3.81p
Increased requirement in electricity usage for pumps and fans @ 12p/kWh		0.30p
Boiler servicing cost		0.30p
Remedial repairs		0.10p

Total **4.51p/kWh**

This does not include cost of capital and interest repayment, depreciation and additional labour – (approximately an additional 2.5p to 3.5p/kWh).

For comparison, LPG currently costs around 25p/l @ 6.6kWh/l **3.79p/kWh**

***NOTE! Not all boilers will run at 90% efficiency. Potentially boilers can run between 80% and 92% efficiency based on age, service schedules, design of system and fuel quality/moisture content. Cost of heat produced assuming 3500kW/T @ 80% efficiency and 30% moisture content would cost 4.28p per kWh. Variation in moisture content can significantly change the heat produced and cost per kWh.**

Need for Heat!

Genetics and nutritional improvements in broiler production have been extremely important to the efficiency of poultry meat production. The full potential of broilers cannot be reached unless the proper environment is maintained in the broiler house.

Maintaining proper temperature to promote growth is key to efficient broiler production. Thus, heating a broiler house is extremely important in terms of performance, economic standpoint and the welfare of the birds. Chicks are not able to completely maintain their body temperature until approximately 14 days of age. During this time, it is crucial that floor temperature be maintained around 30 degrees C with minimum variation.

Ventilation is necessary to deliver fresh air and remove excess heat, moisture and noxious gases from the broiler house. Ventilation systems are usually of two types, natural airflow and mechanical air movement (fans).

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Schedule 5, paragraph 5 – Ventilation shall be sufficient to avoid overheating and, where necessary in combination with **heating systems**, to **remove excess moisture.**

This is of importance when considering the environmental conditions within the broiler house and the difference in management between using a gas based heating system and a system utilising biomass.

Biomass will result in a drier atmosphere with relative humidity (RH) dropping below 40%. This provides the birds with a better start making them less prone to respiratory disorders. It does

however require a higher degree of management to prevent dehydration in the first 24hrs. At a lower RH e.g. <35%, performance may be adversely affected and action may need to be taken to increase RH. As the chick grows the ideal RH should be <60%, with a high RH (above 70%) causing wet litter and associated welfare problems. As the broilers increase in weight, RH levels are controlled using ventilation and **heating systems**. With traditional LPG systems it has been almost impossible to achieve RH of <70% in the poultry sheds, which in turn can lead to CO_2 build up in the sheds of >3000ppm and ammonia levels of up to 20ppm. With the biomass systems installed CO_2 can be controlled at approximately 1000ppm and ammonia at 1 or 0ppm, making it a much-improved environment for the broiler and for the farmer.

According to Dr. Malcolm Mitchell from the Scottish Agricultural College, the temperature experienced by the birds is dependent on dry bulb temperature and RH. Birds lose heat to the environment by evaporation of moisture from the respiratory tract and through the skin. The higher the RH the less evaporation loss occurs, increasing the birds' apparent temperature at a particular dry bulb temperature. **Low RH** will decrease apparent temperature so at low RH the dry bulb **temperature will need to be increased.**

What effect does Biomass heating have on the RH in a broiler house?

Most farms have found a reduction in RH to 35% – 40% when using biomass-heating systems. The dry heat produced means less ventilation is needed to remove gases and water vapour, and is generally beneficial to bird health, reducing the incidence of hock burn, pododermatitis, breast blister, respiratory infections and possibly campylobacter. For day-old chicks, the ideal dry bulb temperature at 60% RH is 30.8 deg. C. However, at 40% RH the dry bulb temperature would need to be 36 deg. C. Therefore, to achieve the ideal temperature, additional energy will be required when using a biomass system.

Energy Requirement for heating

A standard 240 x 60ft, 27,000 bird broiler house (without renewable energy installed) in Great Britain, consumes on average 40,000 litres of LPG per year. (Article in Poultry World July 2015 by Paul Spackman - Simple steps to improve shed energy efficiency).This is equivalent to 264,000kWh of heat. (40,000 x 6.6kW =264,000). A typical broiler house in Northern Ireland will use up to 42,000 litres of LPG per year. This is equivalent to 277,200 kWh of heat. This can be explained by the difference in average temperatures between GB and Northern Ireland, NI being 2-3 degrees lower than GB (Met Office)

As explained above additional heat is required when using biomass for the heating of the houses.

A typical house in Northern Ireland will use 365,500kWh of biomass heat per year. (Around 30% more than LPG due to lower RH and an additional 5 deg. C. required). However, this can range between 360,000kWh and 388,000kWh of biomass heat per year depending on the size, insulation, age and type of house.

Without this level of input, there are a number of potential issues:

Wet litter

Respiratory Infections (potential could also affect farmer)

Pododermatitis or foot burn

Hock burn

Breast blister

Potentially this can result in poor performance, loss of sales to processor, increased penalties from the factory and potential loss of single farm payments.

Cathal Ellis

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16th July 2015