Litter Reconditioning as an Alternative Litter Management Strategy within the Commercial Poultry Industry

July 25, 2008

Gary A. Flory[1], Robert W. Peer[2], Becky Barlow[3], Doug Hughes[4], George W. Malone[5], Audrey P. McElroy[6]

INTRODUCTION

Litter reconditioning has had limited use within the poultry industry as an alternative bedding practice since the 1980's. Litter reconditioning—also known as composting, windrowing, pasteurization and recycling—is a process of composting litter between flocks to extend the life of the bedding material. Interest in litter reconditioning has grown in the last few years as the cost of quality bedding material has risen and the availability decreased. However, this single consideration was not sufficient to cause widespread application of this alternative bedding method. Today, a number of additional factors are causing the commercial poultry industry to take another look at litter reconditioning. These factors include disease challenges with reused litter, decreased use of antibiotics in poultry flocks, excess litter production in areas of high poultry production, increased concerns about pathogens in litter used as fertilizer, and environmental concerns related to the storage of poultry litter.

[1] Agricultural & Water Compliance Manager, Virginia Department of Environmental Quality, Valley Regional Office, P.O. Box 3000, Harrisonburg, Virginia 22801 Phone: (540) 574-7840 Email: gaflory@deq.virginia.gov

[2] Agricultural Program Coordinator, Virginia Department of Environmental Quality, Valley Regional Office, P.O. Box 3000, Harrisonburg, Virginia 22801 Phone: (540) 574-7866 Email: rwpeer@deq.virginia.gov

[3] Organic Resources Marketer, Shenandoah RC&D, P.O. Box 60, Verona, VA 24482 Phone: (540) 248-6080 Email: rebecca.barlow@rcdnet.net

[4] Agricultural Program Specialist, Virginia Department of Environmental Quality, Valley Regional Office, P.O. Box 3000, Harrisonburg, Virginia 22801 Phone: (540) 574-7829 Email: dehughes@deq.virginia.gov

[5] Extension Poultry Specialist, University of Delaware, 16684 County Seat Hwy, Georgetown, Delaware 19947 Phone: (302) 856-7303 Email: malone@udel.edu

[6] Associate Professor, Virginia Tech, Blacksburg, Virginia 24061 Phone: (540) 231-8750 Email: amcelroy@vt.edu

MATERIALS AND METHODS

A broiler chicken farm raising approximately 75,000 birds a year for Tyson Foods, Inc. was identified for this study. The farm contained 2 identical 42-foot wide by 600-foot long poultry houses. Each poultry house contained approximately 4 inches of poultry litter evenly distributed throughout the house. In one poultry house the litter was managed utilizing a litter reconditioning strategy. The second house served as the control and was managed consistent with the farm's existing litter management strategy of removing caked litter between flocks.

Equipment, Windrow Construction and Management

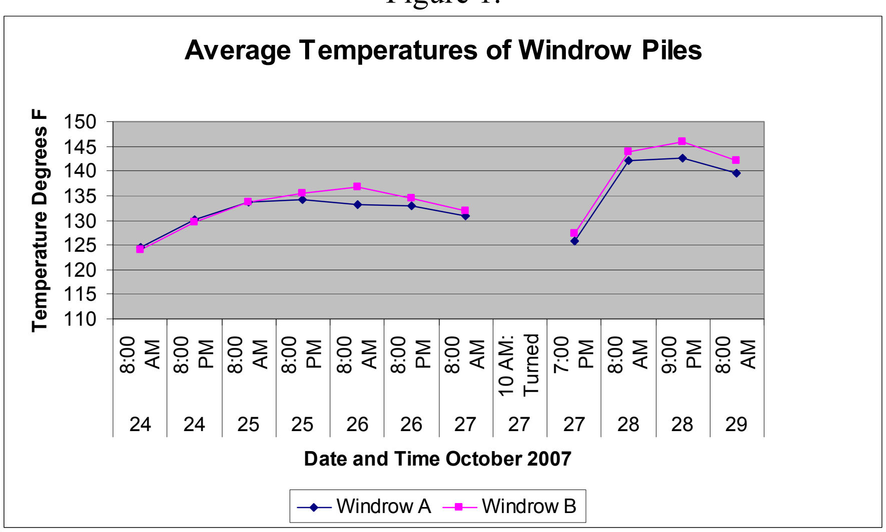
On October 23, 2007, one day after the chickens were removed from the houses for processing, a Brown Bear R24C aerator attachment on the front of a New Holland high flow skid loader was used to aerate and mix the poultry litter in the experimental house and construct 2 windrows. The windrows ran the length of the poultry house. Initially, 3 windrows were constructed by the aerator, but 2 of the windrows were combined to evaluate if sufficient mass existed in a single windrow to generate adequate composting temperatures and control pathogens. The single windrow was approximately 24 inches tall and 5 feet wide. The combined windrow was approximately 30 inches tall and 7 feet wide.

The windrows were turned with the aerator 4 days after construction. Six days after construction, the windrows were spread out using a tractor mounted scraper blade to prepare the house for the next flock of chickens. Fourteen days after the previous flock was sent to processing, new flocks of chickens were placed in both the control and the experimental houses.

Sampling Protocols

Both windrows in the experimental house were flagged at 10 locations approximately 60 feet apart. Temperatures within the windrows were sampled twice a day, beginning 12 hours after windrow formation as summarized in Figure 1. Temperatures were collected using 36-inch analog compost thermometers.

Figure 1.



Bacteriological samples were collected at the flagged locations in the windrows. Samples were also collected in the control house at the same 60-foot intervals. Samples were collected at each of these sampling locations 3 times throughout the composting process. Each sample was a mixed collection of surface material and material from approximately 6 inches deep below the litter surface on the windrows. Approximately 2 pounds of litter was collected at each sampling location and sent to a Virginia Tech laboratory for analysis. All samples were analyzed for *Salmonella*, *E. coli*, and Total Aerobic Plate Count.

Litter nutrient samples were collected as a composite of samples grabbed from flagged locations in both the control and experimental houses, and collected at the beginning and end of the composting process. Samples were analyzed for moisture, ammonium nitrogen, total nitrogen, phosphorus as P2O5, potassium as K2O, and 8 micronutrients by the Agricultural Service Laboratory at Clemson University.

Ambient ammonia levels in the poultry houses were analyzed throughout the composting process in the experimental house as well as in the control house. Additionally, ammonia levels were analyzed during the production of the first post-treatment flock. Ammonia levels were measured with a portable ammonia meter.

A major goal of the project was to evaluate and compare the productivity of the birds grown in the control house versus the birds produced in the experimental house immediately following litter reconditioning. To ensure a valid comparison, Tyson Foods, Inc. agreed to place birds from the same hatch in both the control and experimental houses and process each house separately. Data on feed deliveries, fuel usage, ambient temperature, processing and flock settlement were collected from each house.

PROJECT RESULTS

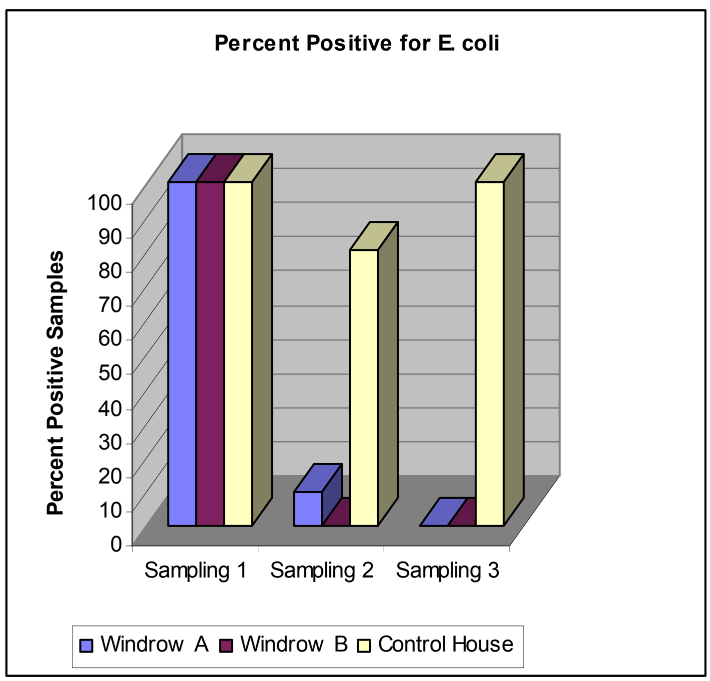
Windrow Temperatures

Analysis of the temperature data showed that the smaller windrow (Windrow A) reached and maintained optimum composting temperatures almost as well as the larger combined windrow (Windrow B). The temperature goal of 135 ° F was met and exceeded in both cases. Additionally, Figure 1 illustrates the temperature surge immediately following windrow aeration at 4 days.

Bacteria Reductions

Large reductions in the bacteria levels within the litter bedding were observed in the experimental house when compared to

Figure 2.



the control house. This was true of the total aerobic count, *E. coli* and *Salmonella*. Figure 2 illustrates the reductions in *E. coli* during the composting process compared to the stable *E. coli* levels in the control house. Figure 3 illustrates similar results for the *Salmonella* data.

Figure 3.

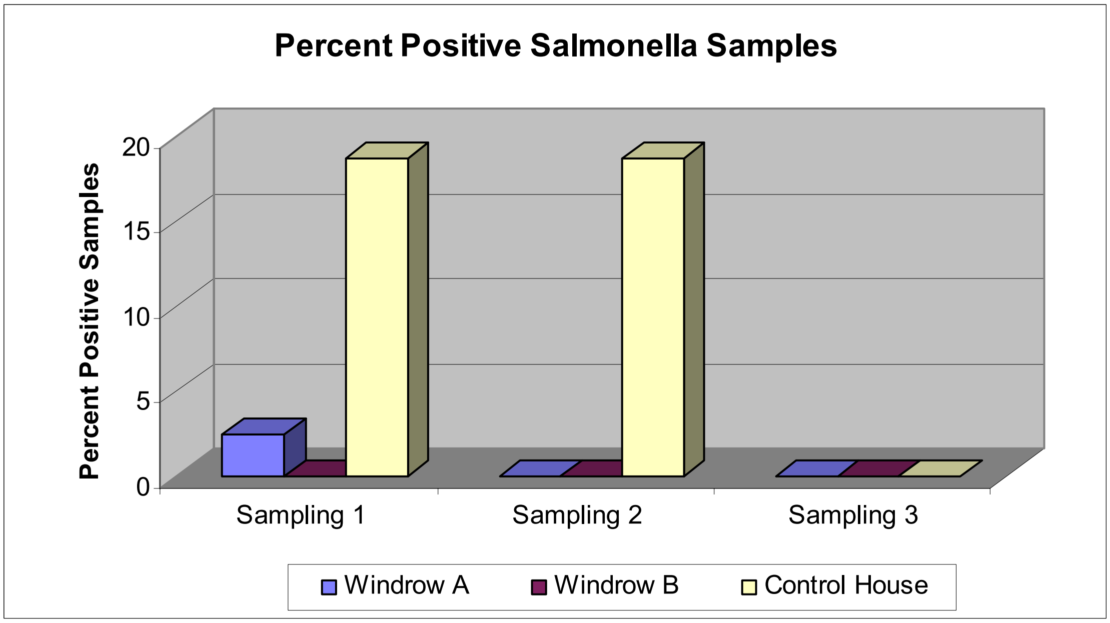
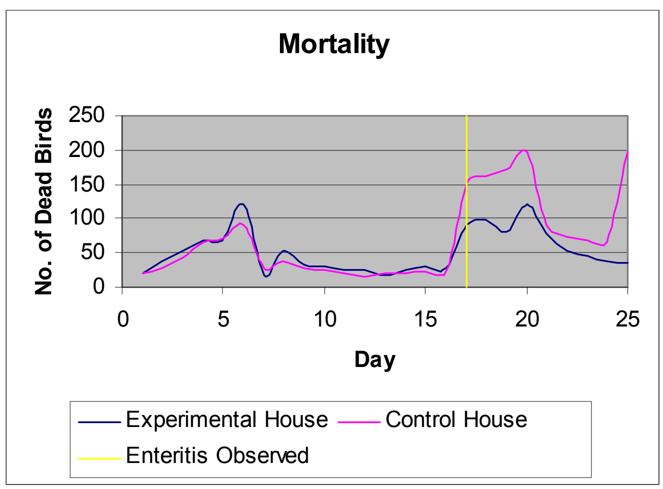


Figure 4.



Mortality

Daily mortality was logged in both the experimental and control houses. Analysis of this data shows mortality within the houses staying consistent until 17 days after flock placement. At 17 days, the flock began to show signs of the poultry disease Necrotic enteritis. This farm had a long history of enteritis which was one reason for it's inclusion in this study. Necrotic enteritis is caused by the obligate anaerobic bacteria *Clostridium perfringens* which is commonly found in soil, dust, feces and feed and is a normal inhabitant of the intestines of healthy chickens. Historically, *Clostridium perfringens* was managed through antibiotics delivered in the feed. However, the trend in the poultry industry—driven by consumer demand—is the reduction or elimination of antibiotics in commercial poultry. This trend has meant that the management of enteritis, and other common poultry diseases, is more critical now than in the past.

The difference in mortality between the experimental and control houses after the onset of the disease is illustrated in Figure 4 with considerably lower mortality in the experimental house.

Nutrients

Comparing the analysis of the litter in the control house and that in the experimental house showed no significant difference in the nutrient value of the litter. Composting can result in reduced nitrogen levels but the relative short duration of the revitalization process did not significantly decrease the nutrient value of the litter.

Energy Usage

Heat for the poultry houses was provided by propane furnaces. Analysis of the propane usage in the houses indicated that the experimental house used approximately 350 gallons more propane than the control house. This was due to the increased need for ventilation caused by higher ammonia levels in the experimental house. Increased ventilation requires more energy to replace the heat lost exhausting the additional ammonia. The increased ammonia was a result of mixing the litter during windrow construction and the retention of the high moisture litter (cake) which would normally be removed during crusting (machine removal of caked litter).

Flock Settlement

Perhaps the most dramatic result of the study is the comparison of the two flocks of birds when they were processed as shown in Table 1. The flock in the experimental house had a greater average weight, better feed conversion, greater livability, and less condemnation. This resulted in the production of 8,553 more pounds of poultry meat.

Table 1.

Flock Settlement Results

	Experimental	Control
No. Birds Started	36,700	36,900
Lbs. Feed Used	272,650	268,390
No. of Head Sold	34,864	34,154
Gross Pounds Sold	154,280	145,640
Less Condemn Lbs.	218	305
Net Pounds Sold	154,062	145,335
Average Weight	4.43	4.26
Feed Conversion	1.77	1.84
Net Pound Value	21.28	22.27
Liveability	95.00%	92.56%
% Condemned	0.14%	0.21%

ECONOMIC CONSIDERATIONS

The traditional litter management program requires the complete removal of all litter once every year or two to be replaced with 3 to 4 inches of fresh shavings. Fresh shavings to fill a 600-foot house cost about $2,400. Replacing litter with shavings is not required with litter reconditioning.

Birds grown in the experimental house were heavier, healthier, less susceptible to disease and converted feed to muscle better. This improved performance resulted in the production of over 8,500 pounds more chicken, which translates into a direct financial benefit to the poultry company and an additional $1,998 for the farmer.

On the negative side of the economic equation, the experimental house used more propane than the control house. Based on the price of propane in November of 2007, the additional propane cost the producer approximately $700 more in the experimental house than in the control house.

Litter reconditioning requires the use of a skid loader or a skid loader aerator attachment such as the Brown Bear aerator used in this experiment. Traditional litter management practices require the removal of the wet litter (cake) by a process often call crusting. Crusting generally cost about $225 per house when completed by a custom operator. Litter reconditioning by a custom operator would likely cost $300 per house. In addition to the cost of the custom operator, the producer would need to level out the windrows with a tractor and blade at the end of the composting process. Cost of time and fuel for this operation would be approximately $100 per house.

Poultry producers who own a skid loader could save some of the cost of hiring a custom operator or purchasing aeration equipment by forming windrows with their own equipment. However, when using a skid loader to form windrows, there is still a need to use crusting equipment to remove the cake since the skid loader does not break up the cake as well as the aeration equipment.

With the cost of aeration attachments such as those pictured for skid loaders ranging from between $15,000 and $20,000, it may not be feasible for individual growers to own the equipment. Alternative business models for implementing the litter reconditioning strategy might include the purchase of the aeration equipment by an industry group or an entity such as a local Soil & Water Conservation District. These organizations could then lease the equipment to individual farmers. Another possibility is that the integrated poultry company could purchase the equipment for use by their producers.

CONCLUSIONS
To be effective, litter reconditioning must be implemented as a long-term management strategy. A single treatment demonstrated benefits, but multiple treatments during the production year may be needed to break the cycle of persistent poultry diseases. Timing of the treatments is critical to avoid increased energy cost. Our experiment demonstrated the economic benefits of better bird health but the economic advantages of reconditioning could have been increased by timing the treatments to minimize increased heating cost. Litter reconditioning should be timed for use with flocks placed between late spring and early fall to minimize these increased costs.

Litter reconditioning has the potential to ease the impact of the shortage of bedding material. However, the real benefit of this litter management strategy is in its potential to help manage persistent disease problems within the commercial poultry industry. Safe, cost-effective disease management strategies are becoming more important as the use of antibiotics in commercial poultry production decreases or is eliminated.

Finally, the environmental and health benefits of litter reconditioning appear to be significant when litter is land applied as a soil amendment. The reduction of pathogens in land applied litter can minimize the negative impact on grazing animals, as well as the potential for impacts on humans and aquatic life from application field runoff.