Poultry Layer Production Facility Manure Management: High Rise, Deep Pit

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Poultry production operations, particularly high-density large-volume units, must be planned as a total system beginning with site selection. With increasing emphasis on a cleaner environment, more attention must be given to methods of manure management. Location, land use patterns, size of operation, labor resources, soil type, land availability, crop scheduling and climate are factors entering into the decision of which waste system is the most efficient and environmentally acceptable. The system that works best for one operator with a particular set of constraints may not necessarily be best for another with different circumstances, management capabilities, or farm objectives.

PRODUCTION SYSTEM PLAN

Planning a group of buildings and their surroundings to present a wholesome image is as important as planning for productive efficiency. When the public sees a poultry farm, they see much more than buildings and grounds. They see an attitude -- an attitude of pride in the business or an attitude of indifference. They see an environmental protector or an environmental polluter. Farm operators who take pride in maintaining the farmstead are generally better managers than those who practice poor housekeeping. Employees take more pride in their jobs and work output improves (Morris et al., 1973).

Production Effects from Manure

Production advantages are also likely to be realized by proper in-house manure management. Manure anaerobic decomposition produces more than 40 different gases which may be detrimental to bird health and productivity, unhealthy to workers or offensive to neighbors. The levels of ammonia and other gases in poultry housing has been closely associated with ventilation and manure management. Airborne ammonia has been linked with several adverse effects on layers. In the 1950's, ammonia at levels exceeding 100 fg/L, was found the principal cause of keratoconjunctivitis. More recently, studies have indicated that ammonia also increases susceptibility to Newcastle disease and decreases feed intake and egg production.

Objectives

The manure management system should receive proper consideration in the planning stages from production and environmental perspectives for :

- *prevention of the direct discharge of manure or wastewater into surface waters or onto adjacent neighbors' land.* Water pollution control laws declare that it is illegal to discharge untreated wastewater without a permit.
- *enhancement of the operational efficiency of the production unit.* Advisory personnel must be familiar with management and production needs and maintain close communication with the poultry producer.
- *collection and utilization of manure and wastewater as fertilizer.* The best way to reduce the waste handling system costs is to recognize that the final step is land application regardless of the collection, storage, or treatment process, the final step in the overall system is land application.
- *prevention of nuisance conditions.* Nuisance is defined as anything that interferes with the normal use and enjoyment of property such as odors, rodents, flies or mosquitoes.

PRODUCTION UNIT LOCATION

Site Selection

When planning new facilities or significant expansion of older ones, avoid selecting sites near residential developments, commercial enterprises, recreational areas, or other prime areas for non-agricultural uses. A site may seem ideal with respect to transportation, feed supply, accessibility or land ownership, but may be inappropriate because of existing or proposed development. When possible, locate production facilities near the center of a tract of land large enough to allow manure to be applied at agronomic rates (Table 2). Pollution control and waste storage or treatment areas should be located as remotely as possible from areas of high environmental sensitivity such as drainage ditches, streams or estuaries.

Wind Direction and Air Drainage

Refer to wind direction probability diagrams available from most technical agencies to locate facilities downwind of the warm season prevailing winds. The strategic planting of rows of trees or hedges

serves both to shield the production and waste management areas from direct sight and to reduce the wind speed across these facilities allowing odorous gases more opportunity to rise vertically and dissipate into the atmosphere.

FACILITY MANAGEMENT

The high rise layer house with deep pit storage is generally regarded as one of the most labor efficient for manure management. It's success, however, is very dependent on good drainage, prevention of water spillage onto the manure, and good air circulation over the manure mass. *Proper disposal of dead birds and a good fly and rodent control program are essential.*

Drainage

The high rise house should be built above ground on a pad of gravel or other porous material or permeable, well-drained soil to prevent surface or groundwater intrusion into the manure collection area. The area surrounding the house should be graded to drain roof and surface water away to diversion terraces.

Moisture Control

Rows of cages mounted about 8 feet above ground cause droppings to be deposited uniformly in ridges or cones on an earth floor. Regular inspection and maintenance of bird watering systems should be performed to prevent leakage. Intermittent watering controlled by a time clock often reduces the chance of spillage. Excess water requires more evaporation and may overload the capability of drying systems. Pit manure which has become liquid generates excessive gases within the building and odors in the surrounding vicinity. It also becomes hard to contain, can cause severe stress on the building side walls, and handling during removal is difficult.

VENTILATION

Environmental Control

Ventilation of the high rise house is important for manure management. One method involves total enclosure of the house with thermostatically controlled exhaust fans located in the side wall of the manure storage area. Fresh air enters the building through slot inlets located at the roof line above the birds, passes down through the cages picking up body heat, and then circulates over the manure before being exhausted to the outside. The advantage of this method from a manure management standpoint is that it allows a high degree of control of air flow over the manure accumulation. The tradeoff is higher energy costs for fan operation.

Curtain Side-Walls

A second method of ventilating a high-rise house consists of providing curtain side walls adjacent to the cages and the manure storage area. Air moves across the manure mass by natural cross ventilation when the curtains are raised and upward around the birds by convection. Building side wall screens should periodically be cleaned of debris such as dust, spider webs and vines to allow maximum warm

season cross ventilation. The advantage of this system is lower operating costs. Disadvantages include updraft movement of gases and odors to the vicinity of the birds and less moisture removal from the manure during still, humid conditions.

Air Circulation over Manure Mass

Drying should be enhanced by forced air circulation underneath the cages using hanging 36-inch, 0.5-hp panel fans over the manure cones. These fans should face one direction on one side of the house and the opposite direction on the other side, causing air to flow in a circular pattern. Air circulation not only reduces moisture content and offensive odors, but also helps to maintain a uniform temperature throughout the cage area.

Bird Density

Another factor affecting the manure moisture content in a high rise house is the bird density or number of birds per unit area of manure storage. Lower bird densities increase the coning effect of the manure thereby exposing more surface area to air flow and increasing drying. As bird densities increase, manure cones become less pronounced and are exposed to drying conditions for a lesser period of time before being covered by fresh manure. Based on an extensive three-year study, Cornell University suggests the following initial design parameters for the high rise system:

- Bird density over 2.5
- manure storage area, birds/ft2
- Air flow, cfm/circulating fan 10,000
- Cross-sectional area 126
- of manure storage, ft2/circulating fan
- Average circulating air velocity, fpm 80
- Circulating air velocity/bird density, 32

MANURE MANAGEMENT

Manure is usually removed from the high rise house once per year. However, with proper moisture control, cleanouts have occurred as infrequently as once in seven years. This cleanout should be planned well in advance to allow time for arrangements to be made for equipment, operators, land accessibility and cropping schedules. The manure solids content is approximately 55% with very little house odor at cleaning time if the drying system has been operating properly. This represents a 60% reduction in manure weight as removed after one year when compared to the fresh manure production of the birds.

Doors at one end of the manure storage area should permit access by a tractor front end loader, a short-coupled four wheel drive vehicle, or a skid steer loader for cleaning. The material can be handled and spread with conventional solid or semi-solid manure handling equipment. If over-the-road hauling is necessary, care should be taken to avoid spillage and wind-blown debris. Spreading is usually done in the spring or fall when land is most accessible. Plowing or soil incorporation soon after spreading is advised to conserve nutrients, to prevent field odors, flies or pest problems, and to prevent pollution from rainfall runoff. Manure should be applied at rates within the fertilizer requirement of the crop. Sampling and analysis of the manure is suggested to determine its nutrient

content. Table 1 provides information on average manure production rates and estimated available nutrient contents. Table 2 estimates application rates and minimum land areas needed for manure application for various crop ping schemes.

SUMMARY

After weighing the important points of alternative manure management systems, a producer must decide which system appears best, then commit to providing the attention and management necessary to make the system function. No waste system will take care of itself. The appearance of buildings and grounds on poultry farms constantly generates images of the product, good or bad. A good poultry image helps sell the product. Portraying an attitude of success is contagious -- to employees, to neighbors, to consumers and to the general public (Morris et al., 1973).

REFERENCE

Morris, T.B., W.C. Mills,Jr., and D.G. Harwood. 1973. Profit From Improving Your Image. PS&T Guide #17, N.C. Agricultural Extension Service, Raleigh, NC. 2 p.

Table 1. LAYER UNPAVED DEEP PIT STORED MANURE FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age		Bird Live Weight initial	final	average	In-House Cage Space ft2/ bird	Recommended Manure Storage Capacity,a ft3/ 1000-bd capacity	
	weeks		lbs					
Pullets								
Nonlaying	0 - 20		3.0	1.5		0.33	255	
Laying	20 - 52		3.0	4.0	3.5	0.50	631	
Layers	52 -		4.0	4.0	4.0	0.50	721	
Pullets								
Nonlaying	6.5	N	38	14	93	24	152	
		P2O5	56	39	253	42	271	
		K2O	30	21	134	22	144	

Table 1. (continues..)

Type of Production Unit	Total Manurea tons/ 1000-bd capacity/ year	Plant Nutrient	Total Nutrients lbs/ ton	Plant Available Nutrientsb Broadcast lbs/ ton	Broadcast lbs/ 1000-bd cap/yr	Soil Incorp. lbs/ ton	Soil Incorp. lbs/ 1000-bd cap/yr
Laying	16	N	38	14	233	24	380
		P2O5	56	39	633	42	678
		K2O	30	21	336	22	360
Layers	18	N	38	14	267	24	435
		P2O5	56	39	723	42	775
		K2O	30	21	384	22	412

* References: Depts of Biological & Agricultural Engineering, Poultry Science; North Carolina State University; Jan 1990 Agronomic Division, North Carolina Department of Agriculture

a Annual manure accumulation.

b Broadcast: surface spread manure uncovered for 1 month or longer. Soil incorporated: surface spread manure plowed or disked into soil within 2 days.

Table 2. LAND APPLICATION OF LAYER UNPAVED DEEP PIT STORED MANURE *

Type of Production Unit	Rate-Limiting Nutrient	Manure Application Ratea ---Grain--- Cereal	Corn	--Grazed Pasture--- Fescue ---range---	--Tifton44 Bermuda- control	Hayland --------broadcast @--------	
		-soil inc @					
	# N/ac/yr =	100	150	200	275	325	400
	# P2O5/ac/yr =	50	60	75	75	85	100
	# K2O/ac/yr =	80	100	100	225	260	300

		tons/acre/year					
Pullets							
Nonlaying	N	4.2	6.4	14	19	23	28
	P2O5	1.2	1.4	1.9	1.9	2.2	2.6
	K2O	3.6	4.5	4.8	11	12	14
Laying	N	4.2	6.4	14	19	23	28
	P2O5	1.2	1.4	1.9	1.9	2.2	2.6
	K2O	3.6	4.5	4.8	11	12	14
Layers	N	4.2	6.4	14	19	23	28
	P2O5	1.2	1.4	1.9	1.9	2.2	2.6
	K2O	3.6	4.5	4.8	11	12	14

Table 2. (continues..)

Type of Production Unit	Minimum Land Area for Manure Applicationa					
	---Grain---		---Grazed Pasture--		Hayland	
	Cereal	Corn	Fescue ---range---	--Tifton44 control	Bermuda-	
	-soil inc @		--------broadcast @--------			
	100	150	200	275	325	400
	50	60	75	75	85	100
	80	100	100	225	260	300

	----------acres/1000-bird capacity---------					
Pullets						
Nonlaying	1.5	1.0	.47	.34	.29	.23
	5.4	4.5	3.4	3.4	3.0	2.5
	1.8	1.4	1.3	.60	.52	.45
Laying	3.8	2.5	1.2	.85	.72	.58
	14	11	8.4	8.4	7.4	6.3
	4.5	3.6	3.4	1.5	1.3	1.1
Layers	4.3	2.9	1.3	.97	.82	.67
	15	13	9.6	9.6	8.5	7.2
	5.1	4.1	3.8	1.7	1.5	1.3

* References: Depts of Biological & Agricultural Engineering, Soil Science, Crop Sci.; North Carolina St Univ; Jan 1990 North Carolina Agricultural Chemicals Manual Potash Institute of North America

a N leaching and denitrification and P2O5 soil immobilization unaccounted for.

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