Poultry Layer Production Facility Manure Management: Undercage Flush - Lagoon Management

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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 costs is to recognize that regardless of the collection, storage, or pretreatment 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 treatment facilities should be located as remotely as possible from areas of high environmental sensitivity such as drainage ditches, streams or estuaries. Buildings in flat, high water table areas should be built on pads of earth fill excavated from the lagoon. Elevating these buildings several feet above ground routes surface drainage away from them and allows flushed manure to flow by gravity to the lagoon.

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 facilities 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 An orderly system for manure collection and storage or treatment reduces potential pockets of odor production. Regular inspection and maintenance of bird watering systems should be performed to prevent leakage. Building sidewall screens should periodically be cleaned of debris such as dust, spider webs and vines to allow maximum warm season cross ventilation to promote dry conditions. All components of the total production and waste treatment system should be operated and maintained in good functional order. Accumulations of solids and wastewater should be removed from these systems expediently. Proper disposal of dead birds and a good fly and rodent control program are essential.

FLUSH SYSTEMS

Advantages The use of flushing gutter manure removal systems is a proven successful manure management technique which involves moving large quantities of recycled lagoon liquid through the building daily. Advantages of the flush system include a clean in-house environment with positive control of gases and odors and an effective control of flies. A reduction of corrosive gases decreases metallic equipment deterioration.

Design Criteria Manure collection gutters underneath the cages should be formed about 6 - 12 inches deep with a slick concrete finish and perfectly level from side to side. Although a floor with no slope lengthwise of the building can be cleaned, a slope of 1 inch in 20 feet is generally recommended to account for uneven concrete construction and prevent ponding of water between cleanouts.

A 6-inch underground PVC pipe transports lagoon liquid from the pump to the upper end of each manure collection gutter. A 6-inch butterfly valve connects this pipe with a 6-inch PVC header pipe extending across the gutter width. This header pipe is equipped with four 3-inch tee nozzles or two 4-inch nozzles for uniform flow distribution.

Recycle Pumps High volume, low-pressure, self-priming centrifugal pumps are used to pump lagoon liquid back into the houses. These pumps may either be trash or solids handling pumps, or they may be centrifugal irrigation pumps provided large solids are screened. Electric pump housings must be well grounded to reduce the buildup of salt deposits on the housing and impeller. Intakes may be screened by a 1-inch mesh wire fence or basket with a diameter at least 5 times the suction pipe diameter. The pump intake is generally an open-ended suction pipe floating approximately 18 inches beneath the liquid surface of the lagoon. The pump should be located as remotely as possible from the waste input. Approximately 80-100 gallons of water per minute per foot of gutter width (gpm/ft) is needed for sufficient cleaning. For a typical high-density house (5.5-ft wide gutter, 100 gpm/ft), a pump capable of delivering 550 gpm would be required. A 15-hp electric motor-driven pump will provide that flow rate aga inst approximately 53 feet of pressure head (23 psi). Three-phase electrical power must be available for motors over 7.5-10 horsepower.

Gutters are usually flushed daily with each gutter requiring about 15 minutes for cleaning. More frequent flushes may be desirable in the summer for the added benefit of evaporative cooling. Total energy usage for pumping is relatively low, however, an additional demand charge will be added to the electric bill because of the high horsepower pump motor. To reduce this demand, as many other electrical requirements, particularly large motors, as feasible, should be switched off while the pump is operating.

Drains A narrow gutter 24 inches wide and 12 inches deep across the drain end of the alleys directs waste to an outside collection box which couples with a smooth-walled drainpipe at least 8 inches in diameter. The top of this drainpipe should be 4 inches or more below the bottom of the cross gutter so that water flow to the lagoon will not be restricted. The drainpipe should have a minimum grade of 1%, preferably 2%, extending approximately 25 feet beyond the top edge of the lagoon.

LAGOONS

Capacity Unless a producer has adequate supplies of fresh water and is equipped to handle the additional water being added to the lagoon, recycling of lagoon liquid for flushing is recommended. Lagoons must be sized properly to achieve odor control and a water quality suitable for flushing. North Carolina recommendations currently are 15 cubic feet of liquid volume per bird for caged layers for a single anaerobic lagoon. Table 1 gives equivalent volumes for pullet operations. A two-stage lagoon would have 12 cubic feet of volume per bird in the first stage and another 3 cubic feet in the second stage. The tendency to expand production capacity adding more manure to an existing lagoon without expanding lagoon treatment capacity should be avoided.

Location It is suggested that a lagoon be located at least 1000 feet from any residence or inhabited dwelling not owned by the producer. This separation distance should be evaluated on a case-by-case basis. Aggravating factors such as potential for development downwind might increase the separation while mitigating factors such as wooded buffers might decrease the distance. Lagoons should be located on soils of low permeability or soils which seal through biological action or sedimentation to avoid groundwater contamination.

Startup New lagoons should be filled at least half full with water before manure loading begins to nurture bacteria establishment. When possible, manure loading of a new lagoon should begin in the spring to permit a stable bacterial population to develop during the warm season. Under no circumstances should dead birds, molded feed, plastic gloves, egg flats, long stemmed vegetation, or other foreign material be allowed to enter a lagoon. Maintain strict vegetation, rodent and varmint control around lagoon edges.

Management Lagoons usually fill to capacity within 2-3 years of startup due to the added waste volume and a rainfall excess over evaporation. North Carolina has an annual moisture surplus ranging from 8 inches in the Coastal Plain to 18 inches in the Mountains. While the lagoon is progressing through the filling process, some seepage might be occurring. When the the interior soil surfaces have biologically sealed and the lagoon is full, liquid overflow will occur unless the operator is in a position to land apply the excess liquid. Since no overflow is permitted, excess liquids will need to be applied to grassland, cropland, or woodland at rates within the soil infiltration capacity and the fertilizer requirement of the vegetation. Sampling and analysis of the lagoon liquid is suggested to determine its nutrient content. Table 1 provides information on average annual lagoon liquid accumulation rates and estimated available nutrient contents. Table 2 estimates application rates and minimum land ar eas needed for lagoon liquid application for various cropping schemes.

Lagoons should be pumped during the growing seasons such that there is adequate wastewater storage during the cool season. Always maintain at least two-thirds of the liquid volume in a lagoon to allow continuous bacterial digestion of the organic matter. If a high groundwater table exists, do not lower the lagoon liquid level below the seasonal water table. Irrigation is the most cost-effective method of applying lagoon liquid to land. Irrigate on days with low humidity and when breezes are blowing away from neighboring residences. Also irrigate in the mornings and early in the week when odors are apt to be least offensive.

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 ANAEROBIC LAGOON LIQUID FERTILIZER NUTRIENTS *

Type of Production Unit	Bird Age	Bird Live Weight			Total Anaerobic Lagoon Liquid Capacity, ft3/birdper capacity		Total Lagoon Liquid to be Irrigated,a 1000-bird capacity/year	
		initial	final	average	single stage	2-stage 1st+2nd	gallons	acre-inches
	weeks	----------lbs----------						
Pullets								
Nonlaying	0-20		3.0	1.5	5.6	4.5+1.1	9110	.34
Laying	20-52	3.0	4.0	3.5	13	10.5+2.5	22201	.82
Layers	52-	4.0	4.0	4.0	15	12.0+3.0	25373	.93

Table 1. (continues..)

Type of Production Unit	Plant Nutrient	Total Nutrients	Plant Available Nutrientsb	
			Irrigated	Soil Incorp.

		lbs/ acre-inch	lbs/ acre-inch	lbs/ 1000-bird cap/yr	lbs/ acre-inch	lbs/ 1000-bird cap/yr
Pullets						
Nonlaying	N	179	90	30	128	43
	P2O5	46	34	11	37	12
	K2O	266	199	67	213	71
Laying	N	179	90	73	128	105
	P2O5	46	34	28	37	30
	K2O	266	199	163	213	174
Layers	N	179	90	84	128	120
	P2O5	46	34	32	37	34
	K2O	266	199	186	213	199

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

a Estimated total lagoon liquid includes total liquid manure plus average annual lagoon surface rainfall surplus; does not account for seepage.

b Irrigated: sprinkler irrigated liquid uncovered for 1 month or longer. Soil incorporated: sprinkler irrigated liquid plowed or disked into soil within 2 days.

Table 2. LAND APPLICATION OF LAYER ANAEROBIC LAGOON LIQUID *

Type of Production Unit	Rate-Limiting Nutrient	Lagoon Liquid Application Ratea				
		--Grain--		----Grazed Pasture--		Hayland
		Cereal	Corn	Fescue--Tifton44 --range-- control irrigated @		Bermuda-
	# N/ac/yr =	100	150	200275	325	400
	# P2O5/ac/yr =	50	60	75 75	85	100
	# K2O/ac/yr =	80	100	100225	260	300
		-----------inches/year-----------				
Pullets						
Nonlaying	N	1.1	1.7	2.23.1	3.6	4.5
	P2O5	1.5	1.8	2.22.2	2.5	2.9
	K2O	.40	.50	.501.1	1.3	1.5
Laying	N	1.1	1.7	2.23.1	3.6	4.5
	P2O5	1.5	1.8	2.22.2	2.5	2.9
	K2O	.40	.50	.501.1	1.3	1.5
Layers	N	1.1	1.7	2.23.1	3.6	4.5
	P2O5	1.5	1.8	2.22.2	2.5	2.9
	K2O	.40	.50	.501.1	1.3	1.5

Table 2. (continues..)

Type of Production Unit	Minimum Land Area for Liquid Applicationa					
	--Grain----		--Grazed Pasture--			Hayland
	Cereal	Corn	Fescue	--Tifton44		Bermuda-
			--range--		control	
			irrigated @			
	100	150	200	275	325	400
	50	60	75	75	85	100
	80	100	100	225	260	300
	-----------acres/1000-bird capacity----------					
Pullets						
Nonlaying	.30	.20	.15	.11	.093	.075
	.23	.19	.15	.15	.14	.11
	.84	.67	.67	.30	.26	.22
Laying	.73	.49	.37	.27	.23	.18
	.56	.47	.37	.37	.33	.28
	2.0	1.6	1.6	.72	.63	.54
Layers	.84	.56	.42	.30	.26	.21
	.64	.53	.43	.43	.38	.32
	2.3	1.9	1.9	.83	.72	.62

*** 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.

EBAE 130-88

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