KSU

KSU Aerobic Swine Waste Handling System - A Progress Report

B. A. Koch, R. H. Hines, G. L. Allee and R. I. Lipper[1]

Summary

At the KSU swine research unit, the aerobic oxidation waste-disposal system continues to function satisfactorily. Though problems and maintenance are mimimal, routine observation and maintenance are necessary to prevent development of problems. Odor is not a problem. Waste fluid can be spread on fields any time that soil is not too wet and--regardless of wind direction or humidity conditions--nearby neighbors do not complain. Pigs are performing satisfactorily in all buildings. Flies are easily controlled, suitable sanitation is easily maintained, and working conditions are satisfactory.

Introduction

Confinement-type swine-research facilities designed specifically to accomodate an aerobic waste-oxidation system were built at Kansas State University in 1968. Structural details, equipment used, and operational problems of the first 6 years are described in the 1975 Swine Day publication (Report of Progress - 1975). We here summarize the day-to-day operation of the system during 1975 and 1976 and a part of 1977.

Procedures

On a log sheet that hangs over each oxidation ditch, we record routine maintenance procedures and, once each week, fluid pH and fluid-temperature readings. Foam presence or absence and condition are noted and visually evaluated. We read our one electric meter (which periodically we move from pit to pit) over whichever pit it is installed. Fluid samples are chemically analyzed once a year, in January or February.

Every other day we add a prescribed amount of Puritan Liquid Live Microorganisms* to each pit (250 ml. in each finishing barn pit; 150 ml. in each nursery pit and the farrowing house pit). Each load or partial load of fluid removed from overflow pits is noted in the log book.

Approximately once a month we use an oak slat, 1" x 4" x 8' (2.54 cm. x 10.16 cm. x 2.44 m.), to probe the fluid for build-ups of solid material. To break any solid areas we insert the slat downward through floor slots and stir. We replace motors or propellers and perform other maintenance as needed.

Results and Discussion

Data collected in 1975 and 1976 are summa-

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[1]Department of Agricultural Engineering.

*Commercially available from Puritan Chemical Company.

rized in figures 1 and 2 ; in table 45 data collected from each of the 5 pits in January 1975 are compared with data collected in February 1977. Data collected both prior to 1975 and at intervals between 1975 and 1977 show that the pit fluid develops a rather constant environment if dry-matter percentage is kept nearly constant.

Dry-matter content of fluid in the pits varies, depending on number of pigs in pens and on how much water is wasted by pigs or used by attendants in cleaning pens and alleys. We consciously try to keep dry-matter content below 3.0%, by diluting the fluid if necessary. (Table 45 shows fluid composition and fluid overflow for each of the pits in January 1975 and February 1977.)

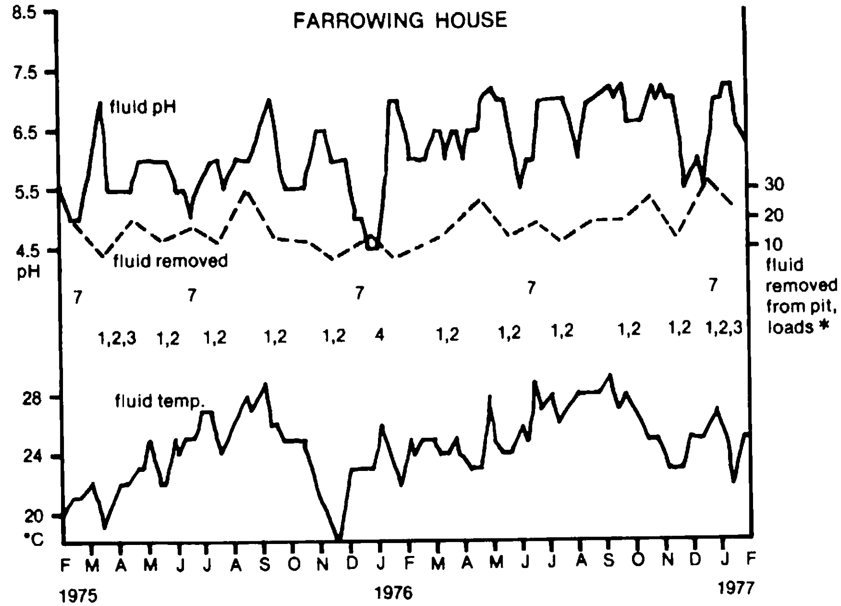
The amount of fluid removed from overflow pits is measured grossly by recording the number of loads hauled from each pit each week. Our liquid-manure wagon holds 1,100 gallons (4,153 liters), but a load is considered to be 1,000 gallons (3,785 liters). Our overflow tanks are small (1,500 gallons, or 5,676 liters) and occasionally pits do overflow but such spillage has not been measured, so our figures probably err on the low side. Overflow from the farrowing house is always more dilute and greater in quantity than that from other pits (figure 1) because (1) the septic tank at the headquarters building drains into that pit; (2) all liquid from two animal laboratories in the headquarters building also drains into that pit; and (3) sows in the farrowing house waste an excessive amount of water when drinking from the automatic waterers provided.

Energy consumed by the various Aerob-A-Jet units in pits is measured by a standard watt meter, moved from one building to another periodically (table 45). Finishing-house values represent consumption for two units operating side by side. Readings for the same pit apparently vary in different years, primarily because of the condition of the propellers being driven. When 1977 readings were made, all units had relatively new propellers, which are replaced when fluid flow slows or foam on fluid increases--normally after 4 to 8 months of use. (With continuous use outside edges of propeller blades wear and face area may be reduced by as much as 40%.)

Fluid pH (figures 1 and 2 has always been lower in the farrowing house pit than in others probably because of the acidity of liquid (pH 5.5-6.5) coming from the septic tank at the headquarters building. As the figures indicate, pH values for fluid from the various pits fluctuated during the years. Those for the farrowing-house fluid ranged between 6.0 and 7.0, those from fluid in other pits were higher, usually between 7.0 and 8.0.

Recordings revealed that fluid temperature varied widely over the 2 years, apparently in part because of seasonal changes and water added to the pits (fresh water used in the buildings comes from the tap at 54.0°F., or 12.0°C.). Since air temperature inside the nursery and farrowing barns remains almost constant (80.0°F. or 27.0°C., in the nursery; and 82.0°F., or 28.0°C., in the farrowing house), in those barns bacterial activity in the fluid must cause fluctuation. Fluctuations do not appear to be directly related to flow of pigs through the barns or to amount of fluid removed from the pits.

Foam builds up on the fluid for unknown reasons at unpredictable times, and if not dispersed it does stop surface flow. We use small amounts of a commercial foam-dispersing agent at such times (obtained from Feed Flavors, Inc.), and we also probe the pits for a build-up of solids. If the problem persists longer than a few days, we flush several loads of fluid out of the pits. Foaming, however, has not been a serious problem at any time, perhaps because we routinely check for solids (monthly), carefully control fluid solid content, and maintain or replace propellers when indicated.



[1]Pigs moved out. [2]Pigs moved in.
[3]New propeller on Aerob-A-Jet.
[4]New propeller and new motor on Aerob-A-Jet.
[5]Pit drained - new barn floor installed. [7]Foam problem.
[6]Pit filled with water.
[8]New shaft on Aerob-A-Jet.
*One load equals approximately 3,785 liters.

Figure 1 . Fluid pH, fluid temperature, volume of fluid removed from pit, and management factors affecting aerobic oxidation pit under swine farrowing house at KSU Swine Research Unit, 1975 through January 1977.

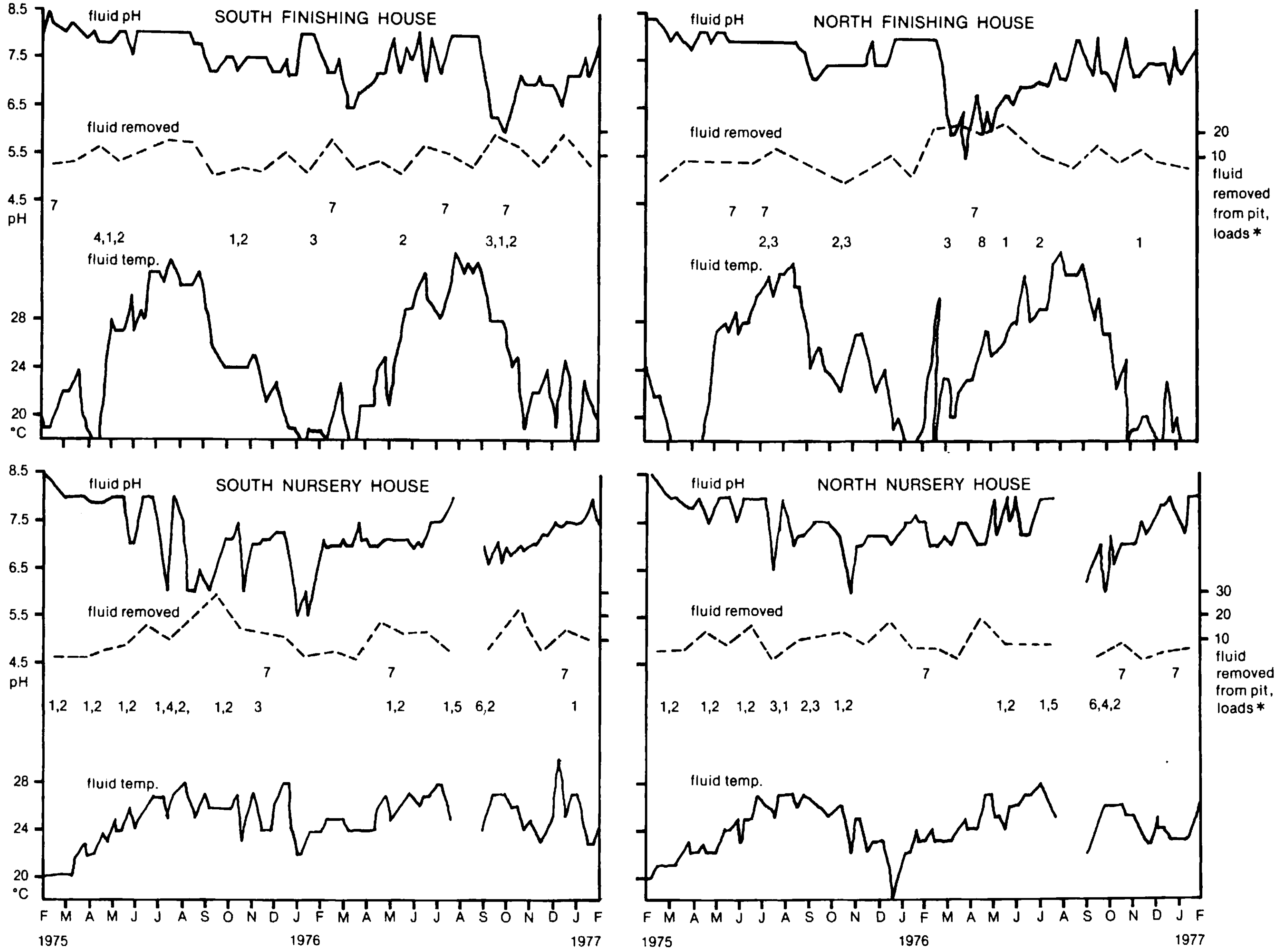


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Figure 2. Fluid pH, fluid temperature, volume of fluid removed from pit, and management factors affecting aerobic oxidation pits under swine nursery and finishing houses at KSU Swine Research Unit, 1975 through January 1977.

Table 45. Selected data collected from aerobic oxidation pits at KSU Swine Research Unit; February 1977 and January 1975 compared.

Item	February 1977					January 1975				
	Pit no.[1]					Pit no.[1]				
	1	2	3	4	5	1	2	3	4	5
Energy used, kWh/day	70.1	59.8	--	97.4	--	60.5	32.6	--	69.6	--
Pit fluid temp, deg. C	25.0	26.0	26.0	17.5	16.0	20.0	20.0	20.0	18.0	20.0
Pit fluid pH, paper	6.5	8.0	7.8	7.8	8.0	5.0	8.2	8.2	7.8	8.5
Pit fluid D.M.[2], percent	0.41	1.64	1.06	2.04	1.99	0.55	1.34	1.05	2.15	2.81
C.P.[3] in D.M., percent	30.4	41.3	38.5	29.6	39.1	27.1	39.6	30.4	31.7	32.8
C.F.[4] in D.M., percent	7.4	2.8	1.7	4.2	2.0	7.5	3.2	2.4	1.9	4.5
Total ash in D.M., percent	36.1	27.3	31.7	41.6	35.5	35.2	31.9	42.4	42.6	32.7
Ash Composition, PPM[5]										
Phosphorus	24,000	25,600	27,400	29,500	30,600	21,590	30,120	36,960	39,690	29,430
Calcium	37,100	31,600	36,400	38,900	34,600	39,950	40,010	37,450	38,010	34,120
Iron	5,300	3,990	4,260	4,450	3,460	4,117	2,930	6,010	3,170	2,750
Magnesium	8,020	7,680	8,290	9,080	8,140	11,290	11,090	15,090	15,960	12,050
Manganese	618	814	875	836	814	459	798	1,074	773	572
Zinc	801	844	846	944	855	445	683	657	556	600
Copper	122	107	110	130	105	92	118	92	102	107
Potassium	41,100	46,300	59,900	85,400	64,300	44,290	46,310	75,560	75,530	59,280
Sodium	20,500	13,300	18,000	29,000	20,000	22,250	19,601	25,950	24,150	19,960
Dry matter per 3,785 liters[6],kgms.	15.42	61.74	39.92	76.79	74.93	20.68	50.44	39.55	80.92	105.78
C.P. per 3,785 liters,kgms.	4.67	25.49	15.39	22.72	29.30	5.62	19.96	12.02	25.67	34.70
Nitrogen per 3,785 liters,kgms.	0.75	4.08	2.46	3.64	4.69	0.90	3.19	1.92	4.11	5.55
Phosphorus per 3,785 liters,kgms.	0.37	1.58	1.09	2.26	2.30	0.44	1.56	1.46	3.21	3.11
Potassium per 3,785 liters,kgms.	0.64	2.86	2.39	6.56	4.82	0.89	2.32	2.99	6.11	6.27
Calcium per 3,785 liters,kgms.	0.57	1.95	1.45	2.99	2.59	0.83	2.02	1.48	3.08	3.61
Sodium per 3,785 liters,kgms.	0.32	0.82	0.72	2.23	1.50	0.45	0.99	1.03	1.94	2.11
Fluid pumped from pit (loads)	23.2[7]	6.6	5.5	7.6	6.4	7.9	2.8	7.8	2.7	2.6

[1]Pit no. 1 = farrowing; 2 = south nursery; 3 = north nursery; 4 = south-finishing house; and 5 = north-finishing house.

[2]D.M. = dry matter

[3]C.P. = crude protein

[4]C.F. = crude fiber

[5]PPM = parts per million

[6]Assuming 1 load = 3,785 liters and one liter = 0.995 kg.

[7]Two metabolism laboratories drain into this pit. During February 1977, 18 digestion stalls and the mechanical "Pig Mamma" were used constantly. The septic tank in the headquarters building also drains into this pit.