Flushing: A New Concept in Swine Management

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TWO TYPES OF FLUSH TANKS are shown in this growing-finishing facility. The two tanks on the left were made in the MSU blacksmith shop. They dump automatically without any mechanical devices. The tanks on the right are manufactured commercially. The water is released through a door in the front that is opened by a hydraulic cylinder operated off a compressor.

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FLUSHING • A NEW CONCEPT IN • SWINE WASTE MANAGEMENT

By E. C. Miller - Extension Swine Specialist
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Researchers at Michigan State University have adopted the following assumptions in their search for practical solutions to critical problems in handling and disposal of swine waste.

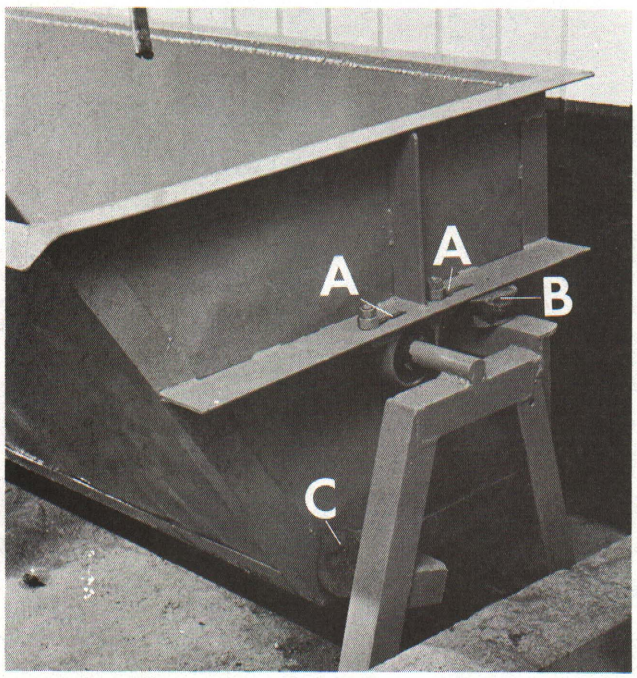
1. An increasing percentage of commercial hogs will be produced on completely slotted floors.
2. Hogs can effectively tramp manure through a slotted floor when there is the correct concentration of hogs per pen.
3. Odors are best controlled by daily removal of waste from the building before odor-causing bacteria can decompose the organic matter.
4. Water is the most economical and efficient conveyor of swine wastes from a building.
5. From the standpoint of disease control, hogs should not come in contact with the flush water.

SINCE 1970 when research on the flushing of swine waste was started, two facilities on the Michigan State University Swine Farm have been converted to this system of waste removal. They are a 26' x 180' sow gestation barn and a 33' x 112' growing-finishing building. Waste removal has been excellent in both facilities and odors have been kept to a minimum.

The system consists of (1) a flushing tank which dumps automatically when full and (2) a sloped trench under a slotted floor. Good flushing action is a combination of slope and volume of flush water.

FLUSHING TANK

The tank is constructed of 16-gauge steel sheet metal and framed with 2" x 2" x 1/8" angle iron. A 3" x 3" x $\frac{1}{4}$" angle iron is welded across each end to serve as a mount for a pillow block bearing. The bearing is bolted through two horizontal slots (A) cut in the upper surface of the angle iron (see Figure 1). The slots permit the bearing to be shifted to the right or left in locating the desired pivot point. The bearing rotates on a 1 $\frac{1}{4}$" steel axle welded to an angle iron support frame.



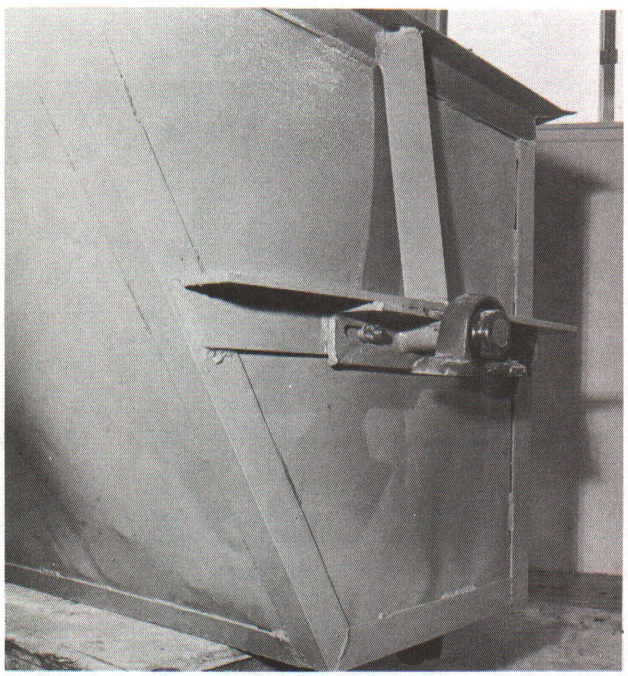


Fig. 1. Two methods of mounting bearings are illustrated in these pictures. Both are equally satisfactory. A $3\frac{1}{2}$" diameter hard rubber bottle stopper makes an ideal bumper. Rubber acts as a shock absorber and eliminates the noise caused by the tank dumping.

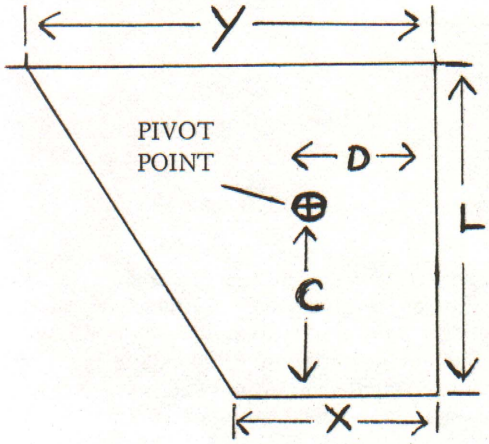


Table 1. - Locating the Pivot Point.

Gal./ft. of tank length	Trench length (ft)	Tank Dimensions in Inches				
		X	Y*	L	C	D
40	80-120	18	36	30	$15\frac{1}{2}$	$14\frac{1}{2}$
30	60-80	18	33	24	$12\frac{1}{2}$	13
24	Less than 60	18	30	20	$10\frac{1}{2}$	12

*Excluding angle iron frame.

The location of the pivot point is critical to the proper filling and dumping of the tank. The measurements listed in Table 1 are approximate because of variation in weight of metals used in construction. Note that the center of the axle is located $\frac{1}{2}$ inch above the center of the tank when measured from top to bottom. This is a constant figure regardless of tank depth. If the tank dumps before it is full, shift the bearing towards the front edge. If it overflows without dumping, move the bearing towards the back edge.

For the tank to fill properly and return to an upright position after dumping, two hard rubber stoppers or bumpers are needed. The back stopper (B) supports the tank in a horizontal, upright position for filling. Considerable pressure is applied to this support until just before dumping. The front bumper (C) stops the tank 5 inches below the horizontal level at the dumping position. If allowed to rotate beyond this point, the tank will not return to an upright position for refilling.

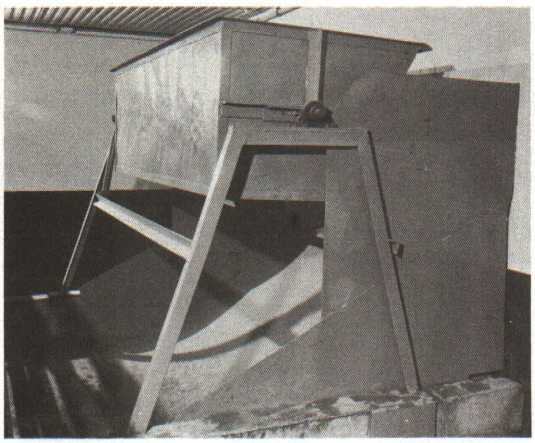
The length of tank will depend on the width of the flushing trench. Allow 5 or 6 inches of clearance on each side for mounting the bearing and axle.

When properly adjusted, the tank will dump and return to the refilling position automatically. The frequency of dumping can be controlled by regulating the flow of water into the tank.

The tank should be rust-free. Apply two or three coats of a good rust preventive paint before using.

When two $7\frac{1}{2}$' trenches side-by-side are to be flushed, it is usually more economical to construct two tanks than to pay the extra cost of heavier materials in one long tank.

IN THE FLUSHING SYSTEM at the MSU Sow Gestation barn, the two rows of sows stand with their hind legs on an 8' slotted floor. The front part of the stall is a solid strip of concrete. The trench under the slats is flushed once or twice a day by the tank shown at the top of the photo.



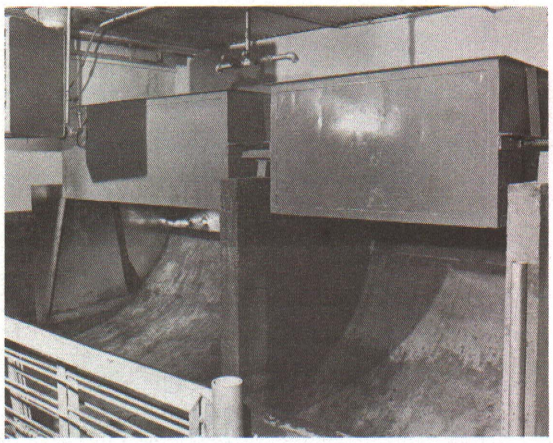


Fig. 2. Tanks can be mounted on a steel frame, poured concrete wall or a 6" concrete block wall. Likewise, the curved spillway can be constructed of concrete or metal. Use the material that fits your capabilities best.

MOUNTING THE TANK

The tank can be mounted to dump forward into the trench or elevated and dump backwards against a wall. Which method to choose will depend on the distance to be flushed and the space available for mounting the tank.

Because of the greater water velocity, waste can be flushed a longer distance by elevating the tank 4 to 6 feet off the floor and dumping the water back against a wall onto a curved spillway. The spillway can be formed out of metal or concrete.

Mount the tank to allow 16 inches of clearance between the wall and the lip of the tank when it is in an upright position. The minimum distance between the wall and first slat should be 6 feet.

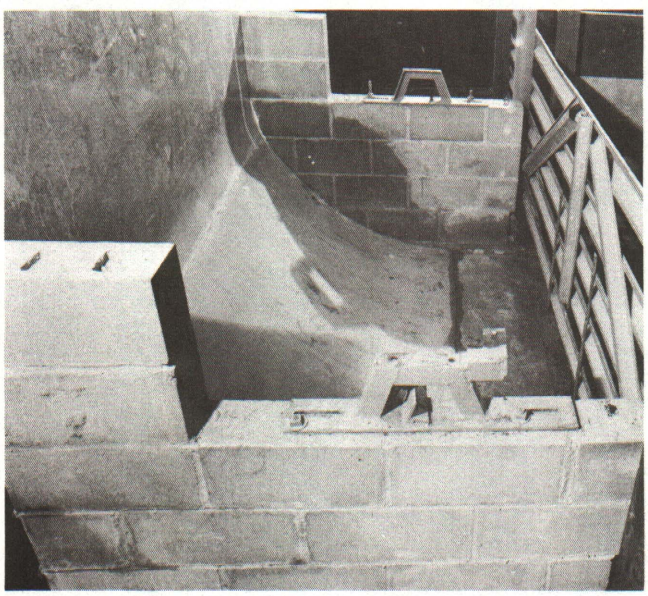


Fig. 3. It is difficult to pour a curved concrete spillway higher than 30" to 36". Extend the spillway upward with a thin piece of sheet metal and caulk where it overlaps the concrete.

A forward tipping tank should be mounted 6 inches from the wall and 4 inches off the floor. The distance between the lip of the tank in a dumping position and the first slat must be at least $3\frac{1}{2}$ feet to allow the head of water to clear without hitting the slat.

FLUSHING TRENCH

Experience has shown that the flushing trench under a slotted floor should have a minimum of 2% slope (24" in 100'). The surface of the trench should be troweled as smooth as possible and a good urine resistant concrete sealer applied (we use a polyurethane product). Most manufacturers recommend that new concrete be etched with a muriatic acid solution before applying the sealer.

The floor of the trench must be level from side to side to prevent the flush water from veering to the right or left. Allow at least an 9" clearance between the bottom of the first slat and

Fig. 4. A concrete sealer helps prevent manure from adhering to the surface of the trench. Make sure the building is well ventilated when applying a polyurethane product.

the surface of the trench so that the flow of water will not be impeded.

The last 6 feet of the flushing trench should be formed into a collection basin capable of holding approximately three quarters of the volume of flush water. Install a 6" or 8" drain to carry the waste quickly to an outside pit or lagoon.

POURING THE SLOPED TRENCH

A sloped surface can be poured in a new facility or in an existing, conventional pit. If remodeling, fill the old pit with washed sand to the desired grade level. Wet the sand and tamp to obtain good compaction.

Starting at the top of the slope, measure down 9 inches from the slat support and mark the point. This will be the finished floor level. Do not skimp on this distance or the flush water will hit the first slat.

With the aid of a transit, drive 2" x 4" stakes at 8 foot intervals along each side of the trench so there will be a uniform 2 percent slope (see Figure 5). Cut the stakes $1\frac{1}{4}$" below the desired finished floor level. Place a 20' length of 1" pipe on each of the two rows of stakes and drive nails to hold the pipe loosely in place. The concrete can be skirted on the two pipes (see Figure 6). Pull the pipes to the next support as pouring progresses (see Figure 7). The stakes can remain imbedded in the concrete.

The floor of the trench need not be more than 3 inches thick. A 5-bag concrete mix using a pea gravel aggregate will aid in obtaining a smooth surface and a power trowel will eliminate much of the hard work.

HOW FAR CAN WASTE BE FLUSHED?

Research has not completely answered this question. Theoretically there is no limit if enough flush water is provided. However, practical limits appear to be somewhere between 100 and 150 feet. Buildings over 100 feet in length should be flushed from both ends toward a center drain.

FREQUENCY OF FLUSHING

The more frequently a trench is flushed the less accumulation of waste and less water is required.

Experience has shown that flushing night and morning in a sow gestation building, farrowing house and nursery is adequate for controlling odors. But in a growing-finishing building where more waste accumulates, it is best to flush 3 times a day on 8-hour intervals. This can easily be done by using a time clock to activate the flow of water and a pressure switch mounted on the dump tank to shut the water off.

Fig. 5. Stakes in place to give a 2% slope to the floor of the trench.

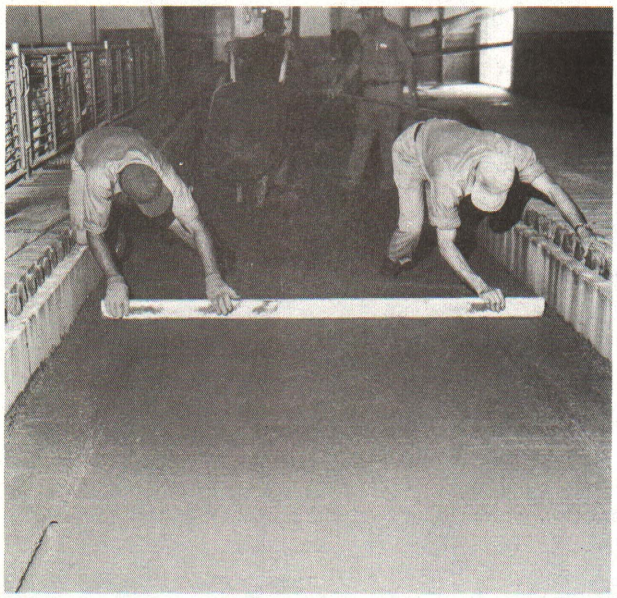


Fig. 6. Skirting concrete on two 1" pipes resting on the 2" x 4" stakes. Since the pipes have an outside diameter of $1\frac{1}{4}$", the length of the stakes must be reduced by this amount to give the desired floor elevation.

Fig. 7. Moving the pipes as pouring progresses. To maintain an even slope, make sure the pipes are always resting on 3 stakes.

WHERE TO GO WITH THE WASTE

It is easy to remove waste from a building, but where to go with it is the real problem. Much research is needed to find the most practical solution to this question. Obviously, it is impractical to haul and spread all the diluted waste material from a flushing system.

A lagoon can be a satisfactory solution under certain circumstances. The subsoil must be impervious or capable of being sealed, and it is advantageous if the slope of the land lends itself to gravity flow. Lagoons will cause some odor problems, particularly in the spring following months of bacterial inactivity.

In the lagoon system of waste disposal currently used on the MSU Swine Farm, waste is flushed directly into the lagoon through a six-inch corrugated black plastic pipe. The water in the lagoon is recycled back into the building and used to fill the flush tanks. Although the water is somewhat odorous, by filling and dumping the tanks quickly, the odor is rapidly dissipated.

By spring it is anticipated that the lagoon will be filled with the winter accumulation of waste. The level of water in the lagoon will be lowered by pumping it on adjacent pasture land.

For swine producers who desire to irrigate cropland, the lagoon can be the ideal solution. By using fresh water to flush the building the lagoon would become a temporary storage for the diluted waste materials. The cropland would be irrigated from the lagoon as weather conditions warranted. The building could be flushed as frequently as needed to meet the water demand for irrigation.

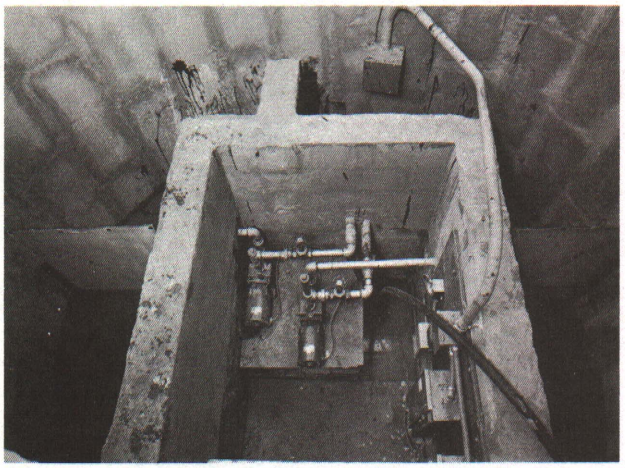


Fig. 8. These two pumps are used to recycle water from a lagoon back into the building for flushing or to pump water for irrigation. The water is taken 4' off the bottom of the lagoon and passed through a screen before reaching the pump.

Various types of new aerators and digestors being developed lend themselves to the flushing method of waste handling. Most of these devices employ the principle of passing the waste through a series of treatment tanks outside the hog building. Time will tell how practical and effective these systems will become.

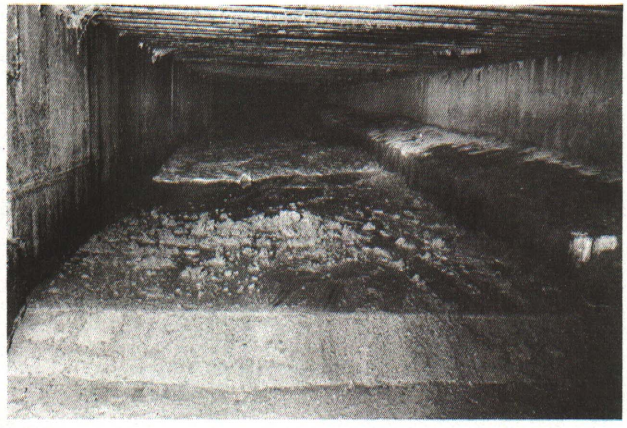


Fig. 9. Before (left) and after (right) flushing. The raised surface (right in both photos) is directly under the center alley of a completely slotted floor. A row of concrete blocks laid the length of the trench and capped to form a sloped surface permits the alley to be hosed off as needed. By narrowing the trench, the flush water is confined to the manure area and less water is required.

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