Farm Structures
FACTSHEET

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CIRCULATORY AGITATION SYSTEMS FOR DAIRY MANURE STORAGE TANKS

The agitation of a liquid manure storage tank is a serious problem when access around the perimeter is limited. Circulatory agitation storage facilities (sometimes called "racetrack storage tanks") have solved this problem. This Factsheet describes in detail the design and management considerations.

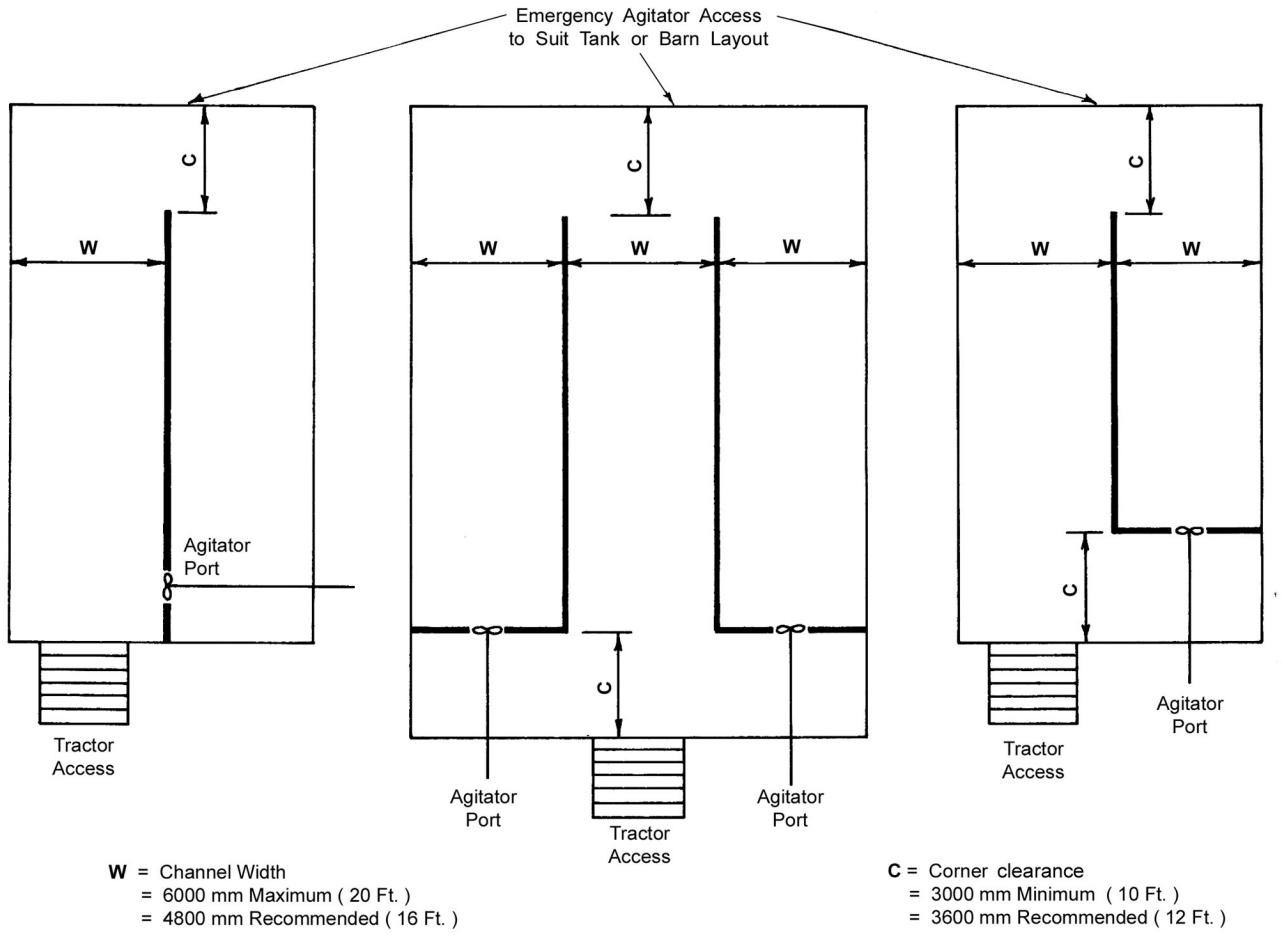

Figure 1

ADVANTAGES OF CIRCULATORY AGITATION:

- Liquid manure is easily handled mechanically by agitator, vacuum tanker, augers and pumps.
- Circulatory agitation systems fit well into an integrated, farm manure management system.
- Circulatory agitation systems eliminate the need for tractor access about the perimeter of the manure storage tank.
- Circulatory agitation systems allow for rapid mixing of manure, which in turn provides for timely field application. If weather is good, the operator can agitate and begin spreading the same day.

DISADVANTAGES OF CIRCULATORY AGITATION:

- In slotted floor or covered pits, a gas buildup can reach hazardous levels. An increased awareness of these hazards is required for safe operation of these circulatory agitation pits. See Factsheet #380.750-2 "Manure Gas".
- Frequent agitation (once or more per month) is required to prevent crust buildup on the surface of the manure.

DESIGN OF CIRCULATORY AGITATION PITS:

There are two basic types of circulatory agitation systems: under-floor storage, such as the case in slotted floor dairy housing and outside the barn storage tanks. Figure 1 illustrates recommended racetrack configurations.

In slotted floor barns, manure is continually added along the length of the channel. This makes the slotted floor concept ideally suited to circulatory agitation. In the case of outside manure tanks, manure is usually added at a single location either by conveyor, pumps, auger, gravity flow cross channel or tractor scrape to a drop slot. When manure is added at a single location, solid/liquid separation occurs as the liquid flows away from the point of addition (see Figure 2). This means that the manure tends to be thicker and builds up near the point of addition. The result of this buildup is that, without frequent agitation, it can be difficult to get the manure to circulate properly.

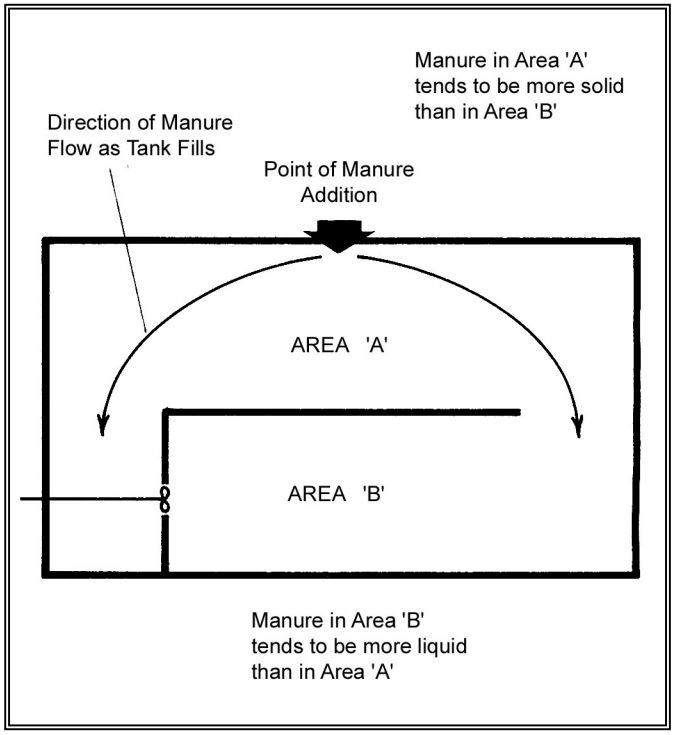

Figure 2

One of the design objectives of a circulatory agitation system is to add manure at as many points as practical. This means the manure does not have to flow as far while the pit is filling and the tendency for solid/liquid separation to occur is reduced. A good rule of thumb is to have at least one point of addition for every channel. With outside pits, it is not often practical to have more than a single point of addition. In these cases, a simple pit without agitator channels, and having tractor access on all sides may be preferred by the farmer who does not wish to agitate as frequently as is required with circulatory systems.

Additional design considerations are listed below:

1. The storage tank must be designed to withstand soils, manure and vehicle loads plus uplift if a high water table exists. To prevent uplift of the concrete floor slab, the floor of the tank should not generally be located more than 600 mm (24 inches) below the highest expected groundwater table.

2. Since the depth of the storage tank is limited by the highest expected water table, the storage capacity of the tank will be affected. A 2400 mm (8 ft) depth is a practical design depth. Tanks that are very shallow have a high cost of construction

per cubic metre of storage; tanks that are very shallow have a high cost of construction per cubic metre of storage; tanks that are very deep are difficult to agitate. A more serious problem is that most vacuum tankers cannot pump out tanks that are deeper than 3000 mm (10 ft). The tank should not be shallower than 1800 mm (6 ft) and not deeper than 3000 mm (10 ft).

3. Sediment buildup is a potential problem for circulatory agitation systems. If possible, provide a tractor entrance to the tank to allow for complete cleanout of heavy sediments that may accumulate over a period of several years. This access is not meant to be used without proper safety equipment; a covered pit should not be entered unless the person entering is equipped with a self-contained breathing apparatus. For more information on manure gas hazards, see the BC Ministry of Agriculture and Food Factsheet #380.750-2 "Manure Gas".

4. Locate the agitation and manure access so that it does not interfere with future barn or farm expansion, such as minimum distance to a milkroom. It is a good idea to check this item with your dairy inspector to prevent conflict in the future.

5. Install a fence around all open tank areas. This should be a sturdy fence built at a minimum 1050 mm (42 inch) height. Use of chain link fencing for protection of small children is recommended.

6. Outside tanks, which incorporate a scrape ramp or suspended slab over the tank for tractor scraping of manure, require a heavy-duty protective fence in this area. It should be impossible for the tractor to accidentally fall into the tank. This protective fence should be constructed of 100 mm (4 inch) welded steel pipe set in concrete. For most tractors, the fence should be 900 mm (36 inches) in height. Do not use chain instead of pipe as tractors are capable of climbing right over a chain safety rail.

7. The tank is designed with a series of circulatory (racetrack) manure channels. To ensure vigorous manure flow and to prevent plugging and crust blockage problems, a 4900 mm (16 ft) maximum channel width is ideal. Channel widths up to 6000 mm (20ft) are acceptable.
8. A minimum clearance of 2400 mm (10 ft) is required for corners or turns in the channel. Openings smaller than this will result in crust blockage problems.

9. Channel length is not extremely important. As a general rule, lengths greater than 60 m (197 ft) should be avoided.

10. The channel should be as free from obstruction as possible. In order to maximize the storage volume, under floor storage systems are frequently designed to utilize the area beneath both free stalls and slotted alleys. In such cases, posts with beams are required to support the suspended floor slab and are located in the channel. Posts disturb flow patterns and make it more difficult to break up crust. Design the circulatory agitation system to avoid posts in the channel.

11. Most slotted floor barns are designed with a circulatory agitation tank on both sides of the central drive through alley. An overflow pipe is installed between the two tanks to allow the tank levels to equalize. This overflow pipe should be a large, 600 mm to 900 mm (2-3 ft) diameter concrete pipe and be located at the top of the tank wall.

12. Manure drop slots are best located over the centre of the channel. Proper steel and concrete reinforcing of floor slabs near the drop slots is essential. Make sure the drop slot has been engineer approved.

13. It is important to provide agitator access at **both** ends of the channel. The extra agitator port is essential for breaking up crust that may build up at the end of the channel opposite the main agitator port.

14. Select a reversible agitator. Being able to reverse the direction of flow can be very helpful in breaking up crust and unplugging the channel.

15. The agitation system is a very important aspect of the system design. In all cases, the main agitator fits through a bulkhead wall. The agitator opening should be sized to meet the manufacturer's specifications and should be located at the base of the bulkhead wall. See Figure 3 for a typical cross-section of the agitator access port. It is good design for the agitator area

to be 300 mm (12 inches) lower than the rest of the tank. This provides a sump area for the vacuum tanker to drain the tank completely.

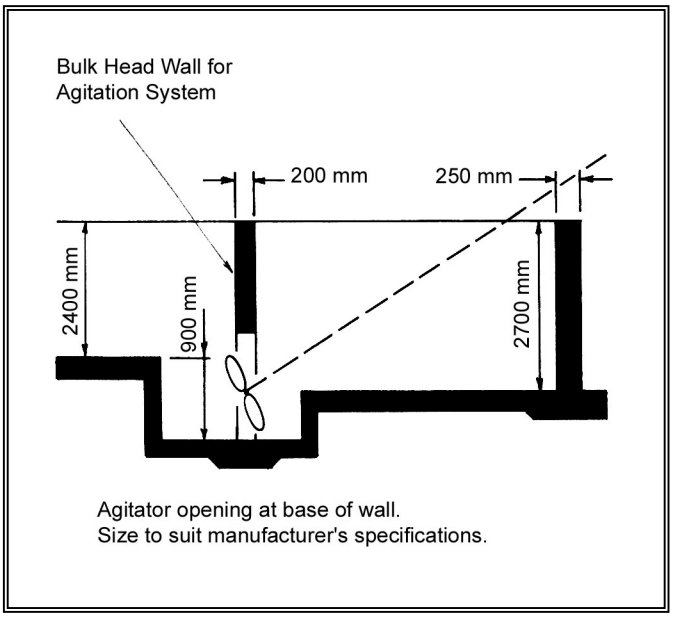

Figure 3

16. In addition to the bottom agitator which provides the pumping energy for manure flow, a surface agitator is required. The surface agitator is needed for breaking up crust buildup, which is the result of not agitating often enough. There are several ways to provide surface agitation. If a PTO driven, three point hitch agitator is used, the agitator assembly can be lifted to run at the manure surface. Other systems include a permanently mounted electric agitator. It is best to design this part of the system with the help of your equipment dealer.

MANAGEMENT POINTS

1. The most important point to remember about manure tanks of any kind is safety. Manure gases are released by all stored manure. These gases can be deadly and the producer must adhere to proper precautions. For more details on this subject, refer to the BC Ministry of Agriculture and Food Factsheet # 380.750-2.

   i) During agitation, bubbles contained in the manure are released. Manure gas hazard is highest during agitation of manure. Install a warning sign at all agitator port locations. Refer to Factsheet #380.750-2 for the information that should be included on this warning sign.

   ii) **Never** enter a manure tank unless equipped with a self-contained breathing apparatus. A safety rope should be attached to the person entering the pit and held by an observer located in a safe position, ready to pull the person out if any problems occur.

   iii) During agitation of slotted floor structures, provide the maximum possible barn ventilation by opening all doors, side vents and ridge ventilators. No person should be allowed in the building during agitation. If possible, all animals should also be removed from the barn.

2. Sand bedding should not be used in the stalls. The sand will accumulate in the bottom of the tank and eventually plug it.

3. Agitate at least once a month. This will save time in the long run. Frequent, one-hour agitation periods keep the crust down and the manure well mixed. Neglecting to agitate for long periods leads to a thick, heavy crust which is much harder to break up. If agitation is left for three or four months then it becomes a big chore, defeating one of the main advantages of circulatory agitation.

4. Never pump the manure out of the tank before it has been well agitated. This removes the liquid layer at the bottom of the tank and eventually leads to plugging problems.

5. If a heavy crust buildup does occur, the bottom agitator alone will not be effective at breaking up a surface crust. Surface agitation is required to do this. The best solution is to have a separate

surface agitator running at the same time as the bottom agitator. Failing this, the bottom agitator should be raised to the manure surface to break up the crust which has been drawn toward the agitator port.

6. To break up crust which is hanging up, try reversing the direction of flow. If this does not work, use the extra agitator port.

7. If no amount of agitation seems to get the manure moving, there is probably not enough water in the manure. Extra water can be added by vacuum tanker at both port locations or can be sprayed over the surface to help soften the crust.

FOR FURTHER INFORMATION CONTACT
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