United States Department of Agriculture

NRCS

Natural Resources Conservation Service
2614 NW 43 Street
Gainesville, FL 32606

http://www.fl.nrcs.usda.gov/

State Office
P.O. Box 141510
Gainesville, FL 32614-1510

Phone: 352-338-9555
FAX: 352-338-9578

June 17, 2009

NATIONAL ENGINEERING HANDBOOK SERIES
210-VI
AMENDMENT FL-14

SUBJECT: ENG – NATIONAL ENGINEERING HANDBOOK, PART 651, AGRICULTURAL WASTE MANAGEMENT FIELD HANDBOOK FLORIDA AMENDMENT

Purpose. To supplement Section 651.1004 "Agricultural Waste Management System Component" of the National Engineering Handbook Series (NEH), Part 651, Agricultural Waste Management Field Handbook (AWMFH).

Effective Date. This amendment is effective when received.

Explanation of Changes. Section FL 651.1004 was updated to incorporate Technical Note ENG FL-24 – Concrete Vat Solids Separator Dairy Waste Management System into NEH, Part 651, AWMFH Chapter 10 Agricultural Waste System Component Design.

Filing Instructions. The attached amendments are to be filed in the Part 651, AWMFH.

Remove and Destroy	Insert Pages
-----	NEH, Part 651, AWMFH Florida Amendment FL-14 (June 2009)
-----	FL10-i (June 2009)
-----	FL10-64a – FL10-64f (June 2009)

Make pen and ink changes on the directive tabulation sheet

Questions regarding the attached amendment should be directed to the State Conservation Engineer.

Jesse T. Wilson
State Conservation Engineer

Enclosure

DIST: A, F, ENG

Chapter 10 Agricultural Waste Management System Component Design

FL651.1004(h) Concrete Vat Solids Separator

Dairy waste solids may pose a significant problem in operating an animal waste management system. Many dairy facilities flush manure from the heavy use areas and barns to waste storage ponds and then distribute the solids and effluent to land via an irrigation system. Solids have the potential to clog components of the manure transfer system especially the waste distribution system. When the solids and liquids are collected together, all available nutrients must be applied in an agronomic balance at the same time and location.

The concrete vat solids separator can address several issues dealing with solids collection and separation. A concrete vat solids separator is a concrete structure with a concrete access ramp, storage pad, solids filtering structure, cells for manure storage, and discharge outlet box. The structure is designed to filter and store a large percentage of the dairy solids for a specified number of days. If operated properly, the concrete vat solids separator can capture a percentage of the manure solids which will minimize clogging of manure transfer components. Capture of the nutrients within the collected solids allows the operator more flexibility in utilizing the manure solids (nutrients) either on-farm or off-farm. It also allows more flexibility in the timing of land application, depending on the days of storage, of the manure solids.

(1) Description

The concrete separator consists of two (2) cells of equal size separated by a common interior wall with a ramp into each cell and an access pad. The interior dividing wall is either constructed lower (approximately 4 inches) than the outside walls or a "V" notch is constructed into the top of the wall for emergency overflow into the adjacent cell. Each cell is fitted with an offset outlet box with a vertical timber skimmer, a picket fence (minimum 8 feet long) to filter the discharge, and a pipe outlet in the bottom of the offset outlet box discharging into a waste storage and/or treatment facility. See Figure 10-39a. Figure 10-39b is an alternative layout for the vat-type solids separator with the picket fence or guard rails in the middle to share the discharge pipe to the waste storage or treatment facility. Also, Figure 2 depicts the waste water flow from a pipe instead of from a lined-water way. The vat-type solids separator can be configured with the combination of Figure 10-39a and Figure 10-39b.

The following standards drawings of the concrete vat type solids separator can be downloaded from the NRCS Florida eFOTG web site (http://efotg.nrcs.usda.gov/treemenuFS.aspx).

FL-801A1, Manure Solids Separator - Plan and Section
FL-801A2, Manure Solids Separator - Details Picket Fence Screen,
FL-801A3, Manure Solids Separator Inlet Details

(2) Sizing

Several publications recommend 0.96 cu. ft. of solids per 1000 pound (EAU) dairy cow confined 24 hours per day. The 0.96 cu. ft. of solids per EAU was confirmed to work in Florida based on a case study. The minimum manure storage requirement for a dairy operation will be determined by applying the following formula:

$$EAU = \frac{\text{Avg. weight of animals x Number of Animals}}{1000}$$

$$\text{Volume } (ft^3) = (\#\ EAUs)(\%\ C.T.)(\%\ C.A.)(\text{days of storage})(0.96\ ft^3/EAU/day)$$

% C.A. is percentage of confinement area contributing waste to solids separator.

% C.T. is percentage of confinement time per day in C.A. contributing waste to the separator.

(3) Design Considerations

Ensure that adequate storage is available in each cell to temporarily store the total volume of flush. This will allow the solids separator to slowly discharge. Studies show that the longer the retention time is (recommend a minimum of 60 minutes), more of the solids will settle out. This volume of storage for the inflow should be available in the cell when filled with solids.

Add additional storage as needed when bedding material from free stall barns will enter the system. If the dairy has total confinement barns, the type of bedding such as sand and or composted solids will affect the size of the vat solids separator.

To the greatest extent possible, prevent clean storm runoff from entering the concrete solids separator.

Install the outlet pipe from each cell vertically into the bottom of the outlet box. This is to maximize out flow

Figure 10-39a Concrete Vat Separator – Side Outlet Boxes

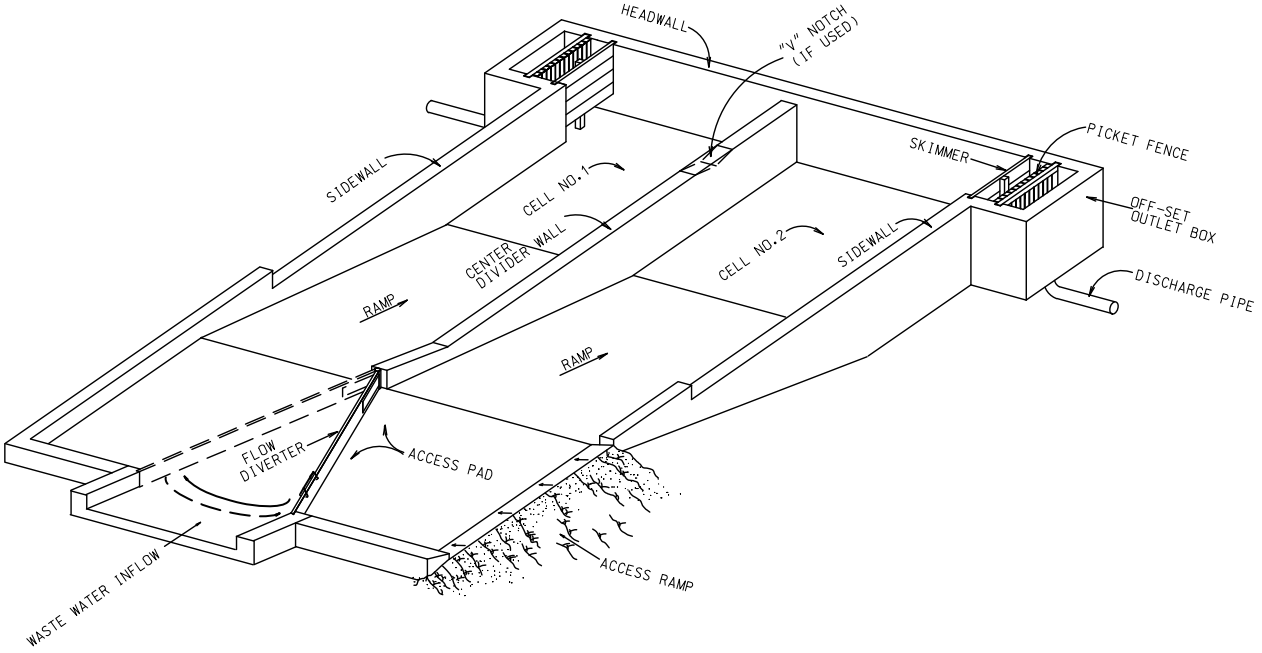
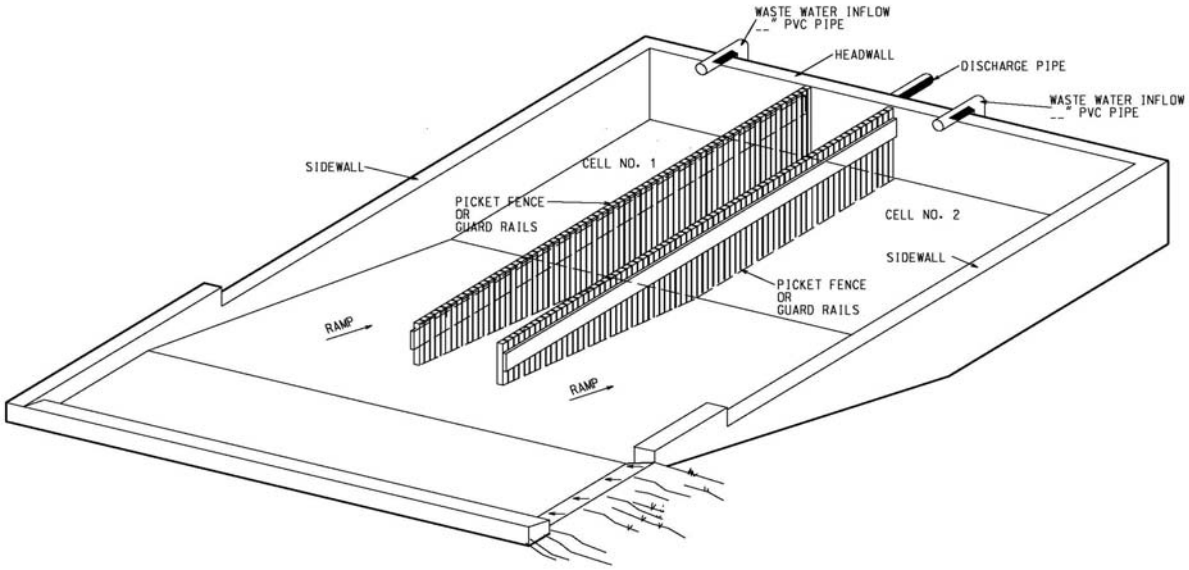


Figure 10-39b Concrete Vat Separator – Shared Picket Fence or Guard Rails



with minimal head after the wastewater has discharged through the picket fence.

Construct the bottom of each cell with a slight positive grade to the pipe outlet. Allowing most of the liquid to discharge will enhance drying of the stored solids and easier removal.

(4) Determining nutrient retained in solids separator

Determining the amount of nutrients in the solids from the vat-type solids separator is important in developing a nutrient management plan. The amount of nutrients retained in the vat-type separator ranges from 10% to 50%. It is highly dependent on the operation and maintenance of the vat solids separator. To determine the amount of nutrients retained in the solids separator the following information is required:

- volume of solids retained,
- weight of solids retained,
- bulk density of solids,
- number of days the waste is collected in the solids separator cell,
- number of cows,
- average weight of the cows,
- confinement time per day
- percentage of confinement area (CA) contributing waste to the solids separator,
- nutrient content of the feed, and
- lab results with nutrient content of the solids from the solids separator.

Volume of solids retained is obtained by measuring the dimensions of the solids in the solids separator and calculating the volume. Normally, the dimensions of the solid separator are a known value for each cell.

Example

volume of a full cell is 7,560 ft^3

number of days waste is collected in the solids separator = 14 days

average weight of cows = 1,300 lbs

number of cows = 1,000

confinement time = 10 hours

% CA contributing to the solids separator = 100%

bulk density of the solids in the solids separator is assumed to be 62.4 lbs/ft^3

Knowing the volume and bulk density,

weight of solids = volume of solids retained (ft^3) x bulk density (lbs/ft^3))

W = weight of solids retained = (7,560 ft^3) x (62.4 lbs/ft^3) = 471,744 lbs

$$\% \text{ waste retained} = \frac{\text{confinement time (hrs)} \times \% \text{ CA in solids separator}}{24 \text{ hours}}$$

$$= \frac{10 \text{ hours} \times 100\%}{24 \text{ hours}} = 41.7$$

$$\text{EAU} = \frac{\text{no. of cows} \times \text{avg. weight of cows (lbs)}}{1{,}000} =$$

$$= \frac{1{,}000 \times 1{,}300 \text{ lbs}}{1{,}000} = 1{,}300$$

Total nutrient produced that will go through the solids separator

The nutrient content of the waste is based on the feed diet of the cows. For this example, cows are fed a high protein, high P, and high K feed. The waste characteristics for lactating cow with milk production of 50 pound per day from the AWMFH Table 4-5b are:

Total N	0.66 lb/day/EAU
Phosphorus	0.11 lb/day/EAU
Potassium	0.30 lb/day/EAU

% waste = percent waste retained in vat solids separator

No. = number of days of separation

$$\text{Total N} = \frac{\text{EAU} \times \% \text{ waste} \times \text{No.} \times \text{N produced}}{100}$$

$$= \frac{1{,}300 \text{ EAU} \times 41.7\% \times 14 \text{ days} \times 0.66 \text{ lb N/day/EAU}}{100}$$

= 5,009 lbs N for every 14 days

$$\text{Total P} = \frac{\text{EAU} \times \% \text{ waste} \times \text{No.} \times \text{P produced}}{100}$$

$$= \frac{1{,}300 \text{ EAU} \times 41.7\% \times 14 \text{ days} \times 0.11 \text{ lb P/day/EAU}}{100}$$

= 835 lbs P for every 14 days

$$\text{Total K} = \frac{\text{EAU} \times \% \text{ waste} \times \text{No.} \times \text{K produced}}{100}$$

= 1,300 EAU x 41.7%x 14 days x 0.30 lb K/day/EAU
100

= 2,277 lbs K for every 14 days

Nutrient retained in solids separator.

The following information was obtained from the lab for a typical well operated concrete vat separator. Samples should taken after the system is in operation to verify nutrients retained.

Total Nitrogen N -	4,375 mg/kg	8.8 lbs/ton
Total Elemental P -	806 mg/kg	1.6 lbs/ton
Total Elemental K -	596 mg/kg	1.2 lbs/ton

W = weight of solids retained (lbs)

N = W x N content of solids from lab (lbs N/ton)
2,000 lbs/ton

N = 471,744 lbs x 8.8 lbs N/ton = 2,076 lbs N
2,000 lbs/ton

P = W x P content of solids from lab (lbs P/ton)
2,000 lbs/ton

P = 471,744 x 1.6 lbs P/ton = 377 lbs P
2,000 lbs/ton

K = W x P content of solids from lab (lbs P/ton)
2,000 lbs/ton

K = 471,744 x 1.2 lb K/ton = 283 lbs K
2,000 lbs/ton

Percentage of nutrient retained in solids separator.

N retained, % = N retained in vat separator x 100
Total N produced in 14 days

= 2,076 lbs = 41.4%
5,009 lbs

P retained, % = P retained in vat separator x 100
Total P produced in 14 days

= 377 lbs = 45.2%
835 lbs

K retained, % = K retained in vat separator x 100
Total K produced in 14 days

= 283 lbs = 12.4%
2,277 lbs

(5) Operation and Maintenance

The effectiveness of the concrete solids separator to collect solids and nutrients is dependent upon an effective operation and maintenance program. The number of days for collecting solids that work well is 10 - 20 days per cell. If the vat-type solids separator is designed for 14 days of storage but during operation and maintenance, the number of days of operation is greater than 14 days, then the efficiency of the solids separator in retaining solids and nutrient retained would decrease. The efficiency of a vat-type solids separator in capturing a greater percentage of the manure solids is unknown for systems with more than 20 days of storage per cell. Additional case studies are needed to determine the effectiveness of capturing solids and retaining nutrients for storage periods greater than 20 days per cell.

The vat-type concrete solids separator slows the flow to a very slow velocity allowing most of the fines to settle out of the effluent. As the manure solids are collected in the cell, the existing solids act as a filter for new solids introduced into the cell.

The wastewater entering the vat-type solids separator should be diverted to only one cell at a time. This is accomplished by using a flow diverter or pumping the wastewater into the individual cell. The cell in use should continue being used until the waste accumulation has reached the designed level below the top of the divider wall or below the “v” notch whichever is lower, or the cell has operated for the design days of storage.

Once the waste has reached the design level, sufficient storage should remain that will contain the minimum inflow volume of storage within the cell.

At this time, change cells by swinging the flow diverter into place diverting the flow or pump the wastewater into the other cell.

The cell that is full of solids should be emptied before the cell collecting inflow is half full.

A critical element of the solids separator is the timber picket fence, which retains the solids in the cell and allows liquids to discharge. It should be checked daily to ensure

blockages are not excessive. Some blockage is desirable because it enhances the efficiency of the solid retention. It is important to keep the picket fence in good working order to ensure a large percentage of the manure solids are retained in the cells. Any damage or deteriorated wood or bolts should be promptly replaced.

The wood skimmer at the outlet box should be inspected at the same time as the picket fence. Repair or replace the boards or hardware as needed. Ensure that the opening at the bottom of the skimmer is not blocked.

Inspect the discharge pipe from each cell when inspecting the picket fence. Remove any solids accumulation around the inlet of the pipe and pipe blockage.

.

THIS PAGE INTENTIONALLY LEFT BLANK