NATURAL RESOURCES CONSERVATION SERVICE
MONTANA CONSERVATION PRACTICE STANDARD

WASTE SEPARATION FACILITY (NUMBER)

CODE 632

DEFINITION

A filtration or screening device, settling tank, settling basin, or settling channel used to partition solids and/or nutrients from a waste stream.

PURPOSE

To partition solids, liquids and/or their associated nutrients to:

- improve or protect air quality
- improve or protect water quality
- improve manure handling methods or serve as a pre- or post-treatment for other processes

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where the waste separation facility will:

- remove solids from a liquid waste stream as a primary treatment process and facilitate further treatment processes.
- reduce problems associated with solids accumulation in liquid waste storage facilities.
- reduce solids content in waste stream so liquids can be recycled for other uses.
- reduce solids content in a waste stream, to better facilitate land application of liquids using irrigation techniques.
- assist with partitioning nutrients in the waste stream to improve handling and application of nutrient management.

CRITERIA

Laws and Regulations. Plan, design and construct waste separation facilities to meet all Federal, state, local and tribal regulations.

Location. Position waste separation facilities so that the waste stream can be safely routed to and from the facility.

Safety. Include in the design appropriate safety features to minimize the hazards of the facility. Provide warning signs, fences, ladders, ropes, bars, rails, and other devices, as appropriate, to ensure the safety of humans and livestock. Ensure that proper ventilation **is provided** to prevent explosion, poisoning, or asphyxiation. Warning signage **shall be** provided for waste separation equipment in an enclosed facility or confined area stating, at a minimum:

- "Warning: Confined Space and Hazardous Gas"

  and

- "No Smoking"

Waste Separator Selection. Table 1 provides guidance on different types of solid/liquid separators available. Capture efficiency varies widely for each type of separator and consistency of the waste to be treated. Base the type of waste separator selected, whether mechanical or non-mechanical, on site specific data for the waste streams and specific management objectives. A combination of separation unit processes may be necessary to achieve the desired or required results.

Separation Efficiency. Base the volume or percentage of solids separated on estimates of daily waste water (if applicable) and the total solids capture efficiency for the type of separation device selected. Manufacturer separation equipment performance is generally reported as concentration reduction or dry mass capture efficiency. Where manufacturer information or local data concerning total solids capture efficiencies are not available, Table 1 can be used to estimate the amount of separated material.

NOTE: This type of font **(AaBbCcDdEe 123..)** indicates NRCS National Standards.
This type of font (AaBbCcDdEe 123..) indicates Montana Supplement.

Chemical Amendments. To enhance the separation process, chemical amendments, such as metal salts and polymers, can be used to flocculate manure solids to enhance the separation process. Addition of chemicals to the liquid waste stream for improving total solids capture efficiencies must be done according to the criteria in Conservation Practice Standard 591, Amendments for Treatment of Agricultural Waste.

Table 1

Solid/Liquid Separators	Total Solids Capture Efficiency
Static Inclined Screen	10-20%
Vibratory Screen	15-30%
Rotating Screen	20-40%
Centrifuge	20-45%
Screw or Roller Press	30-50%
Settling Basin	40-65%
Weeping Wall	50-85%
Sand Settling Lanes	50-70%
Mechanical Sand Separator	50-95%

CRITERIA FOR MECHANICAL SEPARATORS – Screens, Presses, Filtration Methods

Performance. The performance of mechanical separators is generally reported for a given throughput/flow rate **and solids concentration**. If different flow rates are required, obtain separator efficiencies from the manufacturer. **Where manufacturer information or local data is not available, efficiencies in Table 1 can be used.**

Screw press efficiencies were measured in Montana at two individual facilities. Results for 4% total solids inflow concentrations revealed dry mass capture efficiency of approximately 30%.

Rotating drum efficiency was measured at one facility. It treated liquor from a screw press separator. The rotating drum had a 10% dry mass capture efficiency with a total solids inflow concentration of 3%.

Flow Rate and Velocity. Follow manufacturer's recommendations for the design flow rate and waste stream velocity.

Structural Design. Design structural supports for filtration and screening devices in accordance with the requirements of Conservation Practice Standard 313, Waste Storage Facility.

For proper functioning of mechanical separation equipment, environmental conditions may require roofing and or a building enclosure. Design roofs and enclosures in accordance with requirements of Conservation Practice Standards 367 Roofs and Covers and 313, Waste Storage Facility.

Storage of Separated Solids. Provide adequate storage areas for separated solids unless they are transported directly from the separator to the final utilization location in accordance with Conservation Practice Standard 313, Waste Storage Facility.

Discharges. Capture seepage or discharge from solid or sand storage, waste separation facility, or associated appurtenances in a waste storage or treatment structure unless it meets local, state, and federal regulations regarding discharge to surface or ground water.

Conveyance System. Design waste transfer components for separated solids in accordance with requirements of Conservation Practice Standard 634, Waste Transfer.

For conveyance systems, maintain sufficient velocities to keep solids in suspension until material reaches desired separation process or storage area.

Warranties. If a manufactured waste separation device is installed, the manufacturer shall provide a warranty that describes the design life of the device and the warranty cover**age**.

CRITERIA FOR SETTLING BASINS WITH LOT RUNOFF

The settling basin shall be sized to flood-route the peak discharge from a 25 year frequency, 24 hour duration storm to a storage area or vegetated treatment area. Flood routing shall assume a water depth in the basin equal to that stored after a runoff event.

TR-20 or the short-cut, flood-routing procedure in TR-55, Figure 6-1, can be used to estimate the storage and outflow rate for a given inflow rate.

Most feedlot sediment will settle after a detention time of 30 minutes. The solids settling rate shall be 4 feet per hour for basin liquid depths greater than

2 feet, and 2 feet per hour for depths less than or equal to 2 feet.

The following procedure shall be followed for routed settling basins.

Basin volume (cf) = routed storage requirement (cf) + residual liquid and accumulated sediment volume (cf).

Basin surface area (sf) = inflow rate (cfs) x 3,600 (sec/hr) / solid settling rate (ft/hr).

Basin liquid depth (ft) = solid settling rate (ft/hr) x detention time (hr).

Basin width = Basin width shall be at least 10 feet wide to accommodate equipment access to remove accumulated sediment.

Basin length (ft) = Basin surface area (sf) / Basin width (ft).

Basin sediment volume (cf) = 92 (cf/ac-in) x accumulated runoff volume (ac-in) from a 25 year-24 hour rainfall event.

Total basin depth (ft) = Basin liquid depth (ft) + sediment accumulation depth (ft) + freeboard (one foot min.).

Basin outflow (cfs) = less than or equal to the basin inflow (cfs).

Liners. Settling basins do not require a liner when the feedlot runoff is held for less than 48 hours and the cylinder intake family of the soil is 0.5 or less (see Montana Irrigation Guide, Appendix A).

Basin liners comprised of flexible membrane or compacted clay shall meet the conservation practice standard Pond Sealing and Lining (Code 521, Parts A or D). Concrete lined basins shall be designed in accordance with liquid tight slabs on grade as discussed in Conservation Practice Standard 313, Waste Storage Facility.

Outlets. Provide adequate outlet capacity for a waste separation facility to safely convey the design flow/load to a storage or utilization location.

Outlets may include perforated riser pipes, weirs, porous plank walls (picket fence), or screened walls. Provide at least 10% open area for screening used to separate solids at the outlet of settling basins.

The inflow capacity of perforated riser pipes shall be increased by 50% over the design flow to account for plugging. Basin outflow shall be controlled using an orifice plate set at the elevation of the basin bottom.

Average flow rate through the basin outlet can be computed by assuming a headwater depth of 0.7 times the basin liquid depth.

Provisions for emergency overflow shall be provided. Use emergency overflow appurtenances such as notched weirs, or pipe bypasses to control flows exceeding design capacity.

Top Width of Earthen Embankments. Establish the minimum top width of earthen embankments at 15 feet when equipment access is needed for clean out. When no access is required, base the minimum top width on the equipment width used to construct the embankment, but not less than 4 feet.

Construct the side slopes of earthen embankments no steeper than 2 horizontal to 1 vertical (2:1). For earthen embankments greater than 3 feet in height, construct the side slopes no steeper than 3:1 on the outside and 2:1 on the inside of the embankment.

Ramps. Design access ramps to allow entry into the basin for clean out by normal front end loading equipment at no steeper than 10:1. Allow steeper sloped access ramps where special surfacing, **i.e., textured concrete or 6 inches of road mix/gravel,** of the ramp is done for traction purposes and the equipment used can accommodate the increased slope but in no case steeper than **8:1.**

Fencing. Fencing shall be provided where livestock have access to the basin and associated structural features.

CRITERIA FOR SAND SEPARATION AND REUSE

Separation processes that remove sand from water and organic material fall into this category.

Capacity. Provide adequate capacity for the system design to handle the required manure and sand loadings.

Volume. Provide a minimum settling area storage volume to correspond to the maximum cleanout period. Design the bottom width to be

compatible with the removal equipment, but not be less than 8 feet.

Hydraulic Retention Time. Design the hydraulic retention time to be between a minimum of 3 minutes and a maximum of 5 minutes. Make adjustments according to sand size and distribution.

Dilution. Provide adequate dilution water for sand laden manure to keep organic solids in suspension for proper sand separation. Use a minimum water to sand laden manure dilution ratio of 2:1 (volume basis).

Velocity. Design the waste stream velocity between 1 and 2 feet per second. Adjust flow velocity according to sand size and distribution.

Sand Storage. Provide adequate storage of separated sand to allow for additional liquid drainage from the sand.

CONSIDERATIONS

Location. When locating waste separation facilities, consider elevation **as drop is typically required to assure gravity flow away from the facility. Consider the** distance from the source of material to be separated and the location of long-term liquid and solid waste storage facilities. Take advantage of gravity flow wherever possible.

Other considerations for locating waste separation facilities include vehicle access, wind direction, neighboring dwellings, proximity of streams and floodplains, and visibility.

Outlets. Where excessive clogging of perforated pipe or slotted outlet structures is anticipated, consider adding additional features to increase the screened surface area. A picket fence box, wood slotted wall, or frame structure with No. 9 expanded metal screen are all alternatives.

Bottom Width and Materials. Consider concrete floors to facilitate solids removal.

Weeping Walls. To maximize drainage and solid/liquid separation, install weeping walls around the entire perimeter of the waste to be treated and maintain drainage paths to and through the walls. Consider waste particle size, particle size distribution and length of flow paths when selecting screen opening size and spacing. Ensure drainage is transferred to a liquid storage facility.

Sand Bedding. When sand bedding is reused, select a uniformly sized sand to improve separation efficiency.

Solid/Solid Separation. When separating poultry litter into fine and coarse fractions, a higher percentage of the nutrients is partitioned with the fine fraction. The coarse material, consisting mostly of shavings and feathers, has a lower nutrient content and could be reused as bedding or as an energy source.

Visual Screening. Consider using vegetative screens or other methods to shield waste separation facilities from public view and for more aesthetic conditions.

Sand System Abrasion Resistance. Where sand is a major component of the liquid waste stream, encourage the use of abrasion resistant waste transfer piping and pumps to reduce frequency of repairs.

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard and good engineering practice. Include all details necessary for construction and completion of the waste separation facilities in the plans and specifications.

As a minimum, provide the following in the plans and specifications:

1. Layout of **the waste separation facility,** waste production facilities, waste collection points, waste transfer pipelines, waste treatment and storage facilities.
2. Location of all inflow and discharge pipelines and a description of pipeline materials, diameter and slope.
3. Details of support systems for waste separation devices.
4. Fencing and signage as appropriate for safety purposes.
5. Operating characteristics.

OPERATION AND MAINTENANCE

Develop and review an operation and maintenance (O&M) plan with the owner and operator prior to constructing the waste separation facility. Ensure that the O&M plan is consistent with the purposes of the waste separation device

chosen, its intended life, safety requirements, and the criteria for its design. As a minimum, include the following elements in the operation and maintenance plan:

1. Documentation of design factors related to operation and maintenance.
2. Design capacity for the facility.
3. A description of normal operation of the facility, safety issues, and normal maintenance items.
4. Alternative operation procedures in the event of equipment failure.
5. Daily and/or periodic (as described in the plan) inspection of the following:

    - Separation device and support structure.
    - Screens and outlets.
    - Remaining capacity in storage facilities.
    - **A marker, such as a staff gage, should be provided within a settling basin to indicate the elevation to which the basin should be cleaned and maximum elevation to which solids should allowed to accumulate.**

Ensure that the owner and operator understand the level of operation and maintenance (O&M) required for the type of separator selected to operate as intended.

REFERENCES

APL Solid Separation Study. 2002. Part B – Case Studies of Solids Separation Systems. FSA Environmental. Australian Port Limited.

Burns, R.T. and Moody, L.B.. 2003. Development of a Standard Method for Testing Mechanical Manure Solids Separators. ASAE-CIGR Meeting Paper No. 034131. St. Joseph, MI.: ASABE.

Ford, Mary and Fleming, Ron. 2002. Mechanical Solid-Liquid Separation of Livestock Manure Literature Review. Ridgetown College – University of Guelph.

Manure Management System Series – Outdoor Air Quality. Mid West Plan Services Handbook 18, Section 3. 2004.

Mukhtar, Saqib and et. al.. 1999. Solid-Liquid Separation of Animal Manure and Wastewater. Texas Agricultural Extension Service.

Solid-Liquid Manure Separation. 2009. Livestock and Poultry Environmental Learning Center.

USDA – NRCS, National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook.1992, Last revised, October 2010.

USDA – NRCS, Montana Irrigation Guide, 1987.