Appendix C - *Manure Storage & Treatment*

Impermeable Cover

Description: This practice consists of a cover over the manure storage surface with an impermeable (air and water tight) barrier that prevents gases from escaping. This can be accomplished using an impermeable geomembrane, inflatable cover, or a rigid cover. Impermeable cover systems may include structural support braces, floats, blower systems, which maintain a net positive internal air pressure to suspend the cover.

Rationale: This practice provides a physical barrier to contain and trap air emissions.

Conventional Baseline Practice: The baseline practice for comparison is an uncovered manure storage basin.

☒ Established ☐ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☐ Housing
- ☒ Storage & Treatment
- ☐ Open Lots/Corrals
- ☐ Land Application

Notes:

Animal Type:

- ☒ Bovine
- ☒ Swine
- ☒ Poultry

Notes: Applies primarily to liquid manure

Air Toxic Emission Reductions - specific to farm component

☒ Ammonia	90	%	Notes:
☒ Hydrogen Sulfide	90	%	Notes:

Other Air Quality Considerations VOCs, GHGs, odors

Engineering, O&M requirements: Emission reductions to be prorated based on the percent of basins that receive an impermeable cover. Gas must be drawn off from under the cover and treated (biofiltered, flared, etc) and water from precipitation needs to be occasionally pumped off top of cover. Ensure the cover is tightly fitted with no noticeable gaps at the attachment point to the manure storage and no damage (rips, punctures or cracks) to the cover.

Covers should be selected in terms of important physical properties such as tensile strength and resistance to elongation and puncture. Other factors to consider in selecting this type of material are related to attachment methods, long-term maintenance, ease of repair, useful life of the material and final disposal. These floating fabrics are not recommended for storages that are pumped frequently or require rigorous agitation.

Confirmation that BMP is working:

- ☒ Record Keeping Notes:
  - ☒ O&M Frequency:
  - ☒ Design/construction documents
  - ☐ Other specify Frequency:

☒ Visual Inspection Frequency: Weekly

☒ Monitoring Notes:
Parameter: Varies Frequency: as recommended by manufacturer
Parameter: Frequency:

Additional Considerations, references: See NRCS Consevation Practice Standard 367 - Waste Facility Cover.

Permeable geotextile and bio-covers, including natural crust

Description: This practice consists of a variety of permeable covers installed on the manure storage basin surface.

A geotextile cover is a flexible, often nonwoven, synthetic fabric, often with added floatation. The geotextile material must float and cover the entire surface of a waste storage basin and is appropriately specified for the purpose of reducing ammonia and hydrogen sulfide emissions.

A bio-cover may be created using a variety of natural materials. These include, but are not limited to, straw, pumice rock, and air-filled clay balls. Practice requires a cover on the surface of the manure storage basin with varying thicknesses determined by the type of covers. (e.g., 8 to 12” of wheat or barley straw, a12-inch cover will require about 100 bales of straw per acre of surface).

A natural crust is a cover that occurs, naturally, on the surface of stored liquid bovine manure when organic bedding is used. Bedding materials could include wood shavings, sawdust and straw. Straw bedding is probably best because it is more apt to float to the surface of the storage. A natural crust must be a least 4 inches thick on average for a majority of the year (80% of the time). At least 95% of the basin surface area should be covered by the natural crust.. Infrequent removal of manure will encourage natural crust as a result of infrequent agitation.

Rationale: Floating permeable covers can be formed naturally or artificially. Permeable covers create a physical barrier to prevent mass transfer of gases from the liquid by covering manure storage facilities to decrease wind velocity, and reduce radiation onto the manure storage surface. Permeable covers act as biofilters at the manure/air interface by physically limiting the emissions of ammonia, and other gases, from the surface of storage lagoons and create a biologically active zone where the emitted ammonia and other gases will be aerobically decomposed by microorganisms. Natural covers usually are formed by the fibrous material in the manure and are dependent upon animal diet and bedding material. Dairy cattle manure with organic bedding and high fiber diets will typically form a natural, permeable crust.

Conventional Baseline Practice: The baseline practice for comparison is no natural crust, bio-cover, or geotextile cover present on manure storage basin.

☒ Established ☐ Demonstration

Farm Component:

☐ Nutrition and/or Feed Management
☐ Housing
☒ Storage & Treatment
☐ Open Lots/Corrals
☐ Land Application

Notes:

Animal Type:

☒ Bovine
☒ Swine
☒ Poultry

Notes: primarily used on liquid manure basins

Air Toxic Emission Reductions - specific to farm component

☒ Ammonia 70 % Notes: 40% dairy natural crust

☒ Hydrogen Sulfide 80 % Notes: 40% dairy natural crust

Other Air Quality Considerations Odors

Engineering, O&M requirements:

Geotextile covers should be selected in terms of important physical properties such as tensile strength and resistance to elongation and puncture. Other factors to consider in selecting this type of material are related to attachment methods, long-term maintenance, ease of repair, useful life of the material and final disposal. These floating fabrics are not recommended for storages that are pumped frequently or require rigorous agitation.

Bio-cover is expected to last six to eight months, at which time the organic matter begins to degrade and lose effectiveness. For this reason, organic covers are most effective when applied just prior to the warmest, most odor producing months. For straw covers, additional straw typically is required every 2 to 3 months to maintain the appropriate thickness. These types of covers are difficult to apply on structures greater than 2 acres in size. The natural cover must cover 100% of manure storage surface area.

A natural crust requires 80% manure basin surface area coverage existing within a month after beginning to fill an empty basin. The emission reductions are proportional to the number of basins and surface area.

Confirmation that BMP is working:

☒ Record Keeping Notes: For natural crusts, record when manure basin pumped, so crust formation duration & recovery can be determined

- ☒ O&M Frequency:
- ☐ Design/construction documents
- ☐ Other specify Frequency:
- ☒ Visual Inspection Frequency: Weekly to verfiy coverage

☐ Monitoring Notes:

Parameter: Frequency:

Parameter: Frequency:

Additional Considerations, references: NRCS Conservation Practice Standard 367 - Waste Facility Cover.

Biofilter

Description: A biofilter is a system receiving exhaust air from animal housing, head space air from enclosed manure storage, or any other mechanically-ventilated structure, and passes it through some type of moistened porous media, so microorganisms can biologically treat the airstream.

Rationale: Biofilter media treats contaminated air both physically and biologically. Physical treatment occurs when contaminants (such as gases, aerosols and small particles) are trapped on the media surface and/or absorbed into the moist biofilm. Biological treatment occurs when microbes in the biofilm degrade contaminants into carbon dioxide (CO2), water (H2O), mineral salts, volatile organic compounds (VOCs) and microbial biomass. The microbial action is what differentiates a biofilter from a simple filter or scrubber.

Conventional Baseline Practice: The baseline practice for comparison is untreated air from mechanically-ventilated systems.

☒ Established ☐ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☒ Housing
- ☒ Storage & Treatment
- ☐ Open Lots/Corrals
- ☐ Land Application

Notes: Applicable to mechanically ventilated or targeted to pit fans

Animal Type:

- ☒ Bovine
- ☒ Swine
- ☒ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component

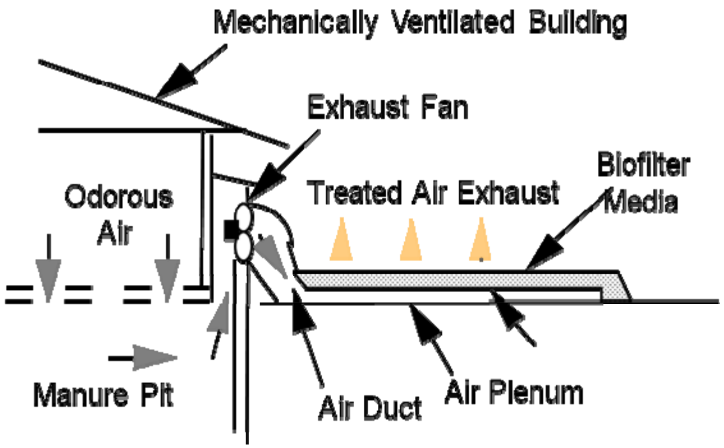
- ☒ Ammonia 60 % Notes: of air treated by the biofilter
- ☒ Hydrogen Sulfide 90 % Notes: of air treated by the biofilter

Other Air Quality Considerations Potential reductions in particulare matter, VOCs, and odors

Engineering, O&M requirements: The percent control must be prorated according to the volume of air treated. Applicable to mechanically ventilated buildings or other facilities including animal housing, manure handling (such as solids separation), head space above impermeable storage basins, pit fans. See design information published by University of Minnesota Extension referenced below.

In general, the air should be in contact with this porous media from 3 to 5 seconds (defined as empty bed contact time) and the media should be maintained between 30 to 50% moisture by weight. Biofilters used to treat air from livestock barns include moist biofilm, covered support media, ductwork, distribution plenum, and fans. The below figure shows a flat-bed biofilter treating air from a livestock barn with a below ground manure pit. The moist, biologically-active biofilm is where gases in the air are absorbed and broken down before the air leaves the biofilter. Ductwork connects the fan to the air source and a plenum where the air is distributed evenly to the media. Fans are required to draw air from the barn and push it through the ductwork and media.

Develop and implement an operation and maintenance plan that is consistent with the purposes of this practice, its intended life, safety requirements, and the criteria used for its design. Operate and maintain the device or system in accordance with the manufacturer's recommendation if applicable. Biofilters need to have required maintenance, especially moisture added in warm weather plus weed control periodically. Prevent rodents and burrowing wild animals from digging holes which can short circuit airflow from source directly to outside without being treated.



<u>Confirmation that BMP is working:</u>

☒ Record Keeping Notes:

- ☒ O&M Frequency:
- ☒ Design/construction documents
- ☐ Other specify Frequency:
- ☒ Visual Inspection Frequency: Quarterly for verification and performance

☒ Monitoring Notes:

Parameter: pressure drop per manufactuers specification Frequency:semi-annually

Parameter: ammonia and/or hydrogen sulfide Frequency:as needed

<u>Additional Considerations, references:</u> NRCS Conservation Practice Standard 371 - Air Filtration and Scrubbing

Composting Manure with Proper C:N ratio

Description: Composting manure can reduce emissions of both hydrogen sulfide and odor, if done correctly. Properly managed compost piles will maintain aerobic conditions, which will be unfavorable for the production of hydrogen sulfide. (Composting increases ammonia emissions relative to a stacked manure pile.)

Rationale: A higher carbon to nitrogen (C:N) ratio creates bulking, which allows air to be incorporated into the compost. This, in turn, creates aerobic conditions, reducing the formation of hydrogen sulfide and not increasing the formation of ammonia, relative to other composting methods.

Conventional Baseline Practice: The baseline practice for comparison is solid manure stacked outdoors and not turned or actively managed for composting. Liquid manure slurry is a baseline for comparison as well.

☒ Established ☐ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☒ Housing
- ☒ Storage & Treatment
- ☐ Open Lots/Corrals
- ☐ Land Application

Notes: Could apply to compost barns or other housing with combined manure storage

Animal Type:

- ☒ Bovine
- ☒ Swine
- ☒ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component

☐	Ammonia		%	Notes:
☒	Hydrogen Sulfide	30	%	Notes: Keeps manure aerobic and hence H2S reduced

Other Air Quality Considerations Composting, even with proper C:N ratio compost, has substantial nitrogen loss; especially ammonia. In general, composting, when compared to a static heap or pile, may increase ammonia emissions, particularly if carbon to nitrogen ratios are not adjusted as described above. The greater the C:N ratio, the less ammonia will be emitted.

Engineering, O&M requirements: This practice must be prorated based on the percent of the manure waste stream composted, on a dry matter basis.

Composting manure at the proper carbon-nitrogen ratio requires laboratory testing of manure, recipe formulation, compost monitoring, management of the composting process, and proper record keeping to track the composting process. Because manure nitrogen, carbon, and moisture contents vary dramatically from one farm to another, manure samples should be collected and submitted to a Wisconsin-certified laboratory for analysis at least annually. The manure sample submitted for lab analysis should be a composite of multiple samples. Manure should be thoroughly mixed prior to collection of subsamples. When possible, collect manure samples from hauling equipment rather than from in the barn. If samples are not immediately shipped, they should be frozen or refrigerated to minimize losses or changes in nutrient content. For more information on manure sampling see publication A3769 Recommended Methods for Manure Analysis.

Manure test results can be used to determine compost recipes using computer spreadsheets, such as the Spartan Compost Optomizer, or by using compost recipe formulas like those described in the On-Farm Composting Handbook (NRAES-54). Regardless of recipe formulation method, the final mixture prior to composting should have the following characteristics: carbon to nitrogen ratio 25:1 to 40:1, moisture content 40 to 65%, pH 5.5 to 9, and bulk density <40 pounds per cubic foot.

After recipes are determined, materials mixed, and composting operations begun, the temperature of the compost should be monitored and recorded weekly. During active composting, internal compost pile temperatures should range from 130 to 150 degrees Fahrenheit. Lower temperatures indicate either that the composting process is complete, or there are problems with the composting process, such as excess moisture. Active composting can be complete in a matter of days for rotating drums, or two years for passive composting. Detailed guidance on manure composting methods is described in On-Farm Composting Handbook (NRAES-54) and The Art and Science of Composting.

Confirmation that BMP is working:

☒ Record Keeping — Notes: See monitoring note below
- ☐ O&M — Frequency:
- ☐ Design/construction documents
- ☐ Other specify — Frequency:
- ☒ Visual Inspection — Frequency: Monthly

☒ Monitoring — Notes:
- Parameter: C:N ratio — Frequency: Direct measurement on a monthly basis
- Parameter: — Frequency:

Additional Considerations, references: NRCS Conservation Practice Standard 317 - Composting Facility, and s. NR502 Wisconsin Administrative Code.

Vegetative Environmental Buffer (VEB)

Description: This practice is a shelterbelt or windbreak of vegetation (trees and shrubs) that deflects and/or adsorbs air contaminates that are emitted from either an animal building or a manure storage basin or pad.

The following are design and maintence considerations for a vegetative environmental buffer.
- A three row vegetative environmental buffer (shelterbelt) incorporating three different tree species is best. Using a row of shrubs (e.g., chokecherry and elderberry), a row of tall growing conifers (e.g., eastern white pine and northern white cedar), and a row of fast growing deciduous trees (e.g., hybrid poplar) is recommended..
- Trees and shrubs should be vigorous and well-suited for the site.
- Locate the vegetative shelterbelt 75 to 100 feet both upwind and downwind from the source (no more than 200 feet away). Ideally the VEB should extend around the entire perimeter of the source of emissions i.e., housing, manure storage or open lot/corral.
- Plants should have 40% to 60% porosity. Porosity expresses how dense the foliage is and is quantified by the simple ratio of plant surface area to the total area.
- Irrigation and weed control are essential to insure plant survivability and maximize early growth
- Trees and shrubs, used as a VEB, must be replanted after 10-15% total plant mortality occurs.
- A long-term plan shall be in place for maintaining the vegetative shelter belt

Rationale: Vegetative environmental buffers can filter, trap, and disperse air pollutants.

Conventional Baseline Practice: The baseline practice for comparison is the absence of any vegetative environmental buffer (trees or shrubs) near the emission source

☒ Established ☐ Demonstration

Farm Component:
- ☐ Nutrition and/or Feed Management
- ☒ Housing
- ☒ Storage & Treatment
- ☒ Open Lots/Corrals
- ☐ Land Application

Notes:

Animal Type:
- ☒ Bovine
- ☒ Swine
- ☒ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component

☒	Ammonia	10	%	Notes:
☒	Hydrogen Sulfide	10	%	Notes:

Other Air Quality Considerations May reduce particulate matter, volatile organic compounds and odor

Engineering, O&M requirements: In addition to newly planted VEBs, existing, appropriately-designed, VEBs may be considered for emission reductions.

Confirmation that BMP is working:

☒ Record Keeping Notes:

- ☒ O&M Frequency:
- ☐ Design/construction documents
- ☐ Other specify Frequency:
- ☒ Visual Inspection Frequency:

☐ Monitoring Notes:

Parameter: Frequency:

Parameter: Frequency:

Additional Considerations, references: See NRCS Conservation Practice Standard for Wisconsin 380 - Windbreak/Shelterbelt Establishment, and Practice Standard 650 -Windbreak/Shelterbelt Renovation.

The design of the VEB should consider adverse impacts including snow deposition and restriction of natural air flow.

Bottom Filling, Minimizing Surface Agitation

Description: This practice applies to the transfer and discharge of liquid manure into manure storage facilities. Add manure liquid to a liquid storage structure from the bottom so as to limit disturbance to the surface of the stored manure. Discharge pipe(s) to basin(s) should be submerged 80% of the time on an annual basis.

Rationale: Bottom filling storage basins reduces surface agitation and therefore, emissions

Conventional Baseline Practice: The baseline practice for comparison is a top loaded manure storage basin.

☒ Established ☐ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☐ Housing
- ☒ Storage & Treatment
- ☐ Open Lots/Corrals
- ☐ Land Application

Notes:

Animal Type:

- ☒ Bovine
- ☒ Swine
- ☐ Poultry

Notes: Mostly for bovine

Air Toxic Emission Reductions - specific to farm component

- ☒ Ammonia 10 % Notes:
- ☒ Hydrogen Sulfide 30 % Notes:

Other Air Quality Considerations Odors

Engineering, O&M requirements: Effectiveness will have to be prorated on a surface area basis for all manure basins. See WPDES permit for maximum depth at which point the basin surface area is calculated.

Confirmation that BMP is working:

☒ Record Keeping Notes:

- ☐ O&M Frequency:
- ☒ Design/construction documents
- ☐ Other specify Frequency:
- ☒ Visual Inspection Frequency: Weekly manure lagoon visual inspection and record keeping check list with comments

☐ Monitoring Notes:

Parameter: Frequency:

Parameter: Frequency:

Additional Considerations, references: NRCS Conservation Practice Standard 634 - Waste Transfer and Wisconsin Standard 313 - Waste Storage Facility.

Covering Solid Manure Storage - (poultry)

Description: This practice applies to solid manure from poultry raised in solid manure/litter/bedding production systems.

The manure must be stored under a roof or physical cover and located on a pad, which is positioned to prevent surface water from contacting the manure.

Rationale: Maintaining dry manure will reduce ammonia. Keeping solid manure (including bedding or litter) stored under a physical cover will minimize exposure to precipitation and wind, and reduce the formation, and volatilizing, of ammonia.

Conventional Baseline Practice: The baseline practice for comparison is stock-piled manure outside and not covered.

☒ Established ☐ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☐ Housing
- ☒ Storage & Treatment
- ☐ Open Lots/Corrals
- ☐ Land Application

Notes:

Animal Type:

- ☐ Bovine
- ☐ Swine
- ☒ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component

- ☒ Ammonia 40 % Notes:
- ☐ Hydrogen Sulfide % Notes:

Other Air Quality Considerations

Engineering, O&M requirements:

Confirmation that BMP is working:

- ☒ Record Keeping Notes: Manure storage records, measurement of reductions in manure moisture content
  - ☒ O&M Frequency: monthly
  - ☐ Design/construction documents
  - ☐ Other specify Frequency:
  - ☒ Visual Inspection Frequency:

☐ Monitoring Notes:
Parameter: Frequency:
Parameter: Frequency:

Additional Considerations, references: Also see NRCS Wisconsin Conservation Practice 313 - Waste Storage Facility.

Anaerobic Digesters

Description: For this practice, manure is subjected to biological decomposition within a sealed oxygen−free container ("digester"). A product of anaerobic digestion is value-added biogas. Anaerobic digestion must meet design and operational standards, including requirements for solids concentration, flow rates, retention time, minimum temperatures and biogas collection, treatment and/or combustion.

Rationale: Anaerobic digester systems vary widely by design and may have the potential to reduce ammonia & hydrogen sulfide, if appropriately designed and operated.

Conventional Baseline Practice: The baseline practice for comparison is an uncovered liquid manure storage facility.

☐ Established ☒ Demonstration

Farm Component:
- ☐ Nutrition and/or Feed Management
- ☐ Housing
- ☒ Storage & Treatment
- ☐ Open Lots/Corrals
- ☐ Land Application

Notes:

Animal Type:
- ☒ Bovine
- ☒ Swine
- ☐ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component
- ☐ Ammonia % Notes: Requires further investigation
- ☐ Hydrogen Sulfide % Notes: Requires further investigation

Other Air Quality Considerations Potential reductions of VOCs, GHGs

Engineering, O&M requirements: Varies by digester design

Confirmation that BMP is working:
- ☐ Record Keeping Notes:
  - ☐ O&M Frequency:
  - ☐ Design/construction documents
  - ☐ Other specify Frequency:
  - ☐ Visual Inspection Frequency:
- ☐ Monitoring Notes:
  Parameter: Frequency:

Parameter: Frequency:

Additional Considerations, references: See NRCS Conservation Practice Standard 366 - Anaerobic Digester; Wisconsin Agricultural Biogas Case Book; and Manure Gas Safety Review of Practices and Recommendations for Wisconsin Livestock Farms

Wet Scrubber/Bio Scrubber

Description: This practice treats the exhaust air from an animal building (or head space air from enclosed manure storage) and passes through a liquid (water or acid). A minimum contact time of the airstream is necessary to achieve the stated reduction, along with collection, storage and eventual treatment of the liquid (water or acid) used in the scrubber design. The air flowing through the scrubber may have either a counterflow or crossflow design.

Rationale: Wet scrubbers clean air by physically absorbing gases and trapping particulate matter in the liquid. In some cases, the gases react with chemicals in the liquid. Small liquid droplets are more effective per unit volume of scrubber liquid because they have more surface area than fewer, larger droplets. Very small liquid droplets, however, are difficult to remove from the airstream.

Conventional Baseline Practice: The baseline practice for comparison is untreated air from mechanically-ventilated systems.

☐ Established ☒ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☒ Housing
- ☒ Storage & Treatment
- ☐ Open Lots/Corrals
- ☐ Land Application

Notes:

Animal Type:

- ☒ Bovine
- ☒ Swine
- ☒ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component

- ☒ Ammonia % Notes: Up to 90% but requires further demonstration
- ☒ Hydrogen Sulfide % Notes: Up to 90% but requires further demonstration

Other Air Quality Considerations Particulate matter, VOCs and odor.

Engineering, O&M requirements: Gases are removed by absorbing the gases into the liquid, typically water. Gas solubility, which describes how easily a gas is absorbed in the scrubbing liquid, depends on concentration gradients, chemical compatibility, reactivity between gas and liquid phases, liquid temperature, pH, and contact time. Many problematic gases such as carbon dioxide, methane, and other volatile organic compounds are not readily captured by water alone due to low solubility at ambient conditions. Ammonia, an 'acid soluble' gas, is more easily absorbed in water at low (acidic) pH. Hydrogen sulfide is a 'base soluble' gas. To remove hydrogen sulfide, a base like hypochlorite, is added to raise water pH, increase hydrogen sulfide absorption, and react with (oxidize) the hydrogen sulfide in solution. The oxidation reaction is an important part of absorbing hydrogen sulfide. If both acid soluble and base soluble chemicals need to be removed from the air, two wet scrubbing stages may be required. The main drawbacks of adding an acid or base to the scrubbing water are chemical costs, increased corrosion potential and difficulties in handling chemicals safely. Plain water and a very long contact time could be used but this requires building a larger scrubber.

Verify that system is designed to match mist delivery to ventilation airflow rate, and that system is maintained to avoid clogging, corrosion, microbial growth. Scrubber needs to have required maintenance, especially if other than water (acid or base) is used.

Confirmation that BMP is working:

- ☐ Record Keeping Notes:
  - ☐ O&M Frequency:
  - ☐ Design/construction documents
  - ☐ Other specify Frequency:
  - ☐ Visual Inspection Frequency:

- ☐ Monitoring Notes:
  - Parameter: Frequency:
  - Parameter: Frequency:

Additional Considerations, references: NRCS Conservation Practice Standard 371 - Air Filtration and Scrubbing;
While adoption of this technology is limited currently in agricuture, the technology is well-established in other industries.

Wastewater Treatment

Description: This is a general category of technologies and practices for advanced treatment systems including, but not limited to, an aeration/aerobic lagoon (manure or process wastewater) or a phototrophic facultative circulating aerobic system. Practice would be an engineered treatment system that would use a physical, chemical, and/or biological process that could remove nutrients in the manure stream or other process wastewaters. The solids fraction (sludge) would need to be managed appropriately to reduce any air emissions from this waste stream as well.

Rationale: This category includes various technologies that may provide reduction benefits for ammonia and hydrogen sulfide but will vary based on design.

Conventional Baseline Practice: The baseline practice for comparison is no wastewater treatment system present.

☐ Established ☒ Demonstration

Farm Component:

☐ Nutrition and/or Feed Management
☐ Housing
☒ Storage & Treatment
☐ Open Lots/Corrals
☐ Land Application

Notes:

Animal Type:

☒ Bovine
☒ Swine
☒ Poultry

Notes: For liquid manure systems, generally

Air Toxic Emission Reductions - specific to farm component

☐ Ammonia % Notes: Requires further investigation
☐ Hydrogen Sulfide % Notes: Requires further investigation

Other Air Quality Considerations

Engineering, O&M requirements: Reductions case-by-case

Confirmation that BMP is working:

☐ Record Keeping Notes:
- ☐ O&M Frequency:
- ☐ Design/construction documents
- ☐ Other specify Frequency:
- ☐ Visual Inspection Frequency:

☐ Monitoring Notes:
Parameter: Frequency:

Parameter: Frequency:

Additional Considerations, references:

Chemical or Biological Manure Additives

Description: This practice includes the application or incorporation of chemically or biologically active products to accumulated or stored manure solids or liquids to reduce ammonia and/or hydrogen sulfide emissions. Typical modes of action are urease inhibitors, enzymes, pH regulators, oxidizers, and precipitation enhancers.

For poultry, controlling ammonia release from litter is commonly practiced for bird health. Binding ammonium in manure can also be accomplished with products, such as zeolite, or by treating litter/manure with additives such as enzymes. The method to apply and quantity used would depend on the product and would need to follow the manufacturer's recommendation. In this category are litter amendments which can include microbial products that may be applied to litter or incorporated in animal feed.

Alum addition to poultry litter is described separately as an established practice.

Rationale: Broadly, the application of chemical or biological manure additives may reduce ammonia or hydrogen sulfide emissions.

Conventional Baseline Practice: The baseline practice for comparison is no addition of chemical or biological additives to manure.

☐ Established ☒ Demonstration

Farm Component:

☐ Nutrition and/or Feed Management
☒ Housing
☒ Storage & Treatment
☐ Open Lots/Corrals
☐ Land Application

Notes:

Animal Type:

☒ Bovine
☒ Swine
☒ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component

☐ Ammonia % Notes: Requires further investigation
☐ Hydrogen Sulfide % Notes: Requires further investigation

Other Air Quality Considerations

Engineering, O&M requirements: Independent, third party scientific documentation, for the specific biological or chemical additive, must be provided.

Confirmation that BMP is working:

☐ Record Keeping Notes:

- ☐ O&M Frequency:
- ☐ Design/construction documents
- ☐ Other specify Frequency:
- ☐ Visual Inspection Frequency:

☐ Monitoring Notes:

Parameter: Frequency:
Parameter: Frequency:

<u>Additional Considerations, references:</u> See NRCS Conservation Practice Standard 591 - Amendments for Treatment of Agricultural Waste.

The use of strong acids by producers may require an additional safe handling certification. Sulfuric acid also increases the sulfur content of farm wastes.

pH reduction of liquid manure (acidification) could either involve a batch treatment (adding acid to the liquid manure storage) or a metering method (metering preferred, since this provides better mixing of the acid to manure) that adds a given rate as manure is transported to the manure storage. Application rate varies but final manure pH should be in the range of 4 to 5. Acidification is not a stand-alone practice for swine and bovine. This practice would likely require solids separation. The liquid portion would be treated with acid. Controlling ammonia by acidification will result in greater hydrogen sulfide emissions, especially for swine.

Some products bind ammonium or inhibit generation of hydrogen sulfide. Lower pH (goal of some chemical additions) leads to a lower proportion of aqueous ammonia and therefore, a lower potential of ammonia volatilization. Acidification does not reduce nutrients, but it does drive the formation of ammonium to ammonia (NH_3 + H^+ to NH_4^+) . Ammonium remains in aqueous solution.

Alum addition to bedded manure pack (for cattle) may also reduce ammonia emissions, but increase hydrogen sulfide emissions.

Manure Solids Separation

Description: A filtration or screening device, settling tank, settling basin, or settling channel used to separate a portion of solids from a liquid waste stream.

Solids separation techniques work in many ways for a variety of purposes and may have ancillary environmental benefits, when combined with a design or another practice to capture and/or reduce emissions. Primary purposes of solids separators include removal of sand bedding from liquid manure and producing manure solids for bedding. Solids separation is not to be confused with urine/feces segregation (which is immediate separation in the housing - see urine/feces segregation BMP). The solids can be composted or land-spread to cycle nutrients back into plants and minimize atmospheric loss of sulfur and nitrogen compounds. Similarly, separated liquids must undergo additional physical, chemical, or microbial treatment to minimize atmospheric loss of sulfur and nitrogen.

Rationale: Separate solid and liquid waste streams create a potential for better management and handling of the individual waste streams, with respect to ancillary environmental benefits.

Conventional Baseline Practice: The baseline practices for comparison are liquid manure systems without solids separation or existing open sand lanes, or other separation systems without additional practices to control emissions.

☐ Established ☒ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☐ Housing
- ☒ Storage & Treatment
- ☐ Open Lots/Corrals
- ☐ Land Application

Notes:

Animal Type:

- ☒ Bovine
- ☐ Swine
- ☐ Poultry

Notes: Could possibly be used for swine

Air Toxic Emission Reductions - specific to farm component

- ☐ Ammonia % Notes:
- ☐ Hydrogen Sulfide % Notes:

Other Air Quality Considerations Solids separation may achieve greater emissions reduction, when used in tandem with one or more treatment methods. Taken alone, it is difficult to predict the effect of solids separation on air emissions.

Engineering, O&M requirements:
Solid separation has three distinct categories:

Sand separation is designed to dewater and remove the inorganic, sand particles from the manure. Sand separation can occur mechanically where an inclined auger moves the sand up a trough while recycled waste water is sprayed on the auger/trough to wash organic matter off the sand. The other common method for sand separation is the use of a series of sand settling lanes. In this process the sand-laden manure is allowed to flow down a shallow lane at a speed that causes the heavier sand particles to drop out of suspension. Both processes typically do not change the ammonia, hydrogen sulfide, or volatile organic matter of the organic portion that remains after sand separation. The sand lanes may have a higher potential to increase emissions.

Weir wall solid separation (non-mechanical) is designed to separate manure into a medium, solids content (10% DM) and low solids liquid portion. Typically manure enters a channel holding area, which has one or more side walls that allow liquid to pass through, while solids are retained. The slots are typically larger than mechanical separation and thus are likely to result in less solids being separated from the liquid portion.

Mechanical presses for solid separation are designed to separate manure into a high, solids content (27-38%DM) and low solids liquid portion. Typically manure enters the mechanical press (roller or auger) and the liquid flows to storage and solids are stacked.

Additional practices that may be able to control air emissions from solid separators, and buildings in which they are housed, include biofilters, bioscrubbers or other capture and treatment technologies.

Confirmation that BMP is working:

- ☐ Record Keeping — Notes:
  - ☐ O&M — Frequency:
  - ☒ Design/construction documents
  - ☐ Other specify — Frequency:
  - ☒ Visual Inspection — Frequency:

- ☐ Monitoring — Notes:
  - Parameter: — Frequency:
  - Parameter: — Frequency:

Additional Considerations, references: See NRCS Conservation Practices Standard 629 - Waste Treatment, 632 - Solid/Liquid Waste Separation Facility, and 634 - Waste Transfer Practices.

See Manure Gas Safety Review of Practices and Recommendations for Wisconsin Livestock Farms (November 2008).