*FARM*A*SYST*

Farmstead Assessment System

Worksheet #21

Assessing the Potential for Emissions of Volatile Organic Compounds (VOCs) from **Dairy Facilities and Activities**

Why should I be concerned?

The San Joaquin Valley is one of the nation's most impacted areas for ozone (smog) pollution. Elevated levels of ozone are a public health issue, being associated with increased respiratory problems in certain population groups, especially children and the elderly. The valley is currently classified by United States Environmental Protection Agency (USEPA) as in serious non-attainment for the federal 8-hour ozone standard. This requires the San Joaquin Valley Air Pollution Control District (SJVAPCD) to develop and implement a plan to reduce gases that form ozone in order to improve the valley's air quality. This must be accomplished according to a strict and enforceable timeline.

Volatile Organic Compounds (VOCs) are gaseous precursors to ozone (which in turn, causes 'smog'). In the presence of sunlight, VOCs react with other gases called oxides of nitrogen (NOx) to form ozone. All sources (e.g., vehicles, dry cleaners, factories, agriculture) will be required to do their share to reduce the main ingredients (VOCs and NOx) to reduce the valley's ozone problem.

The Federal Clean Air Act has established Ambient Air Quality Standards for several gases including ozone. VOCs are not directly regulated on the federal level, since ozone is not yet considered a problem in other areas of the U.S. However, under California state law, it is required to curb these so-called 'ozone precursors', namely VOCs and NOx, in the San Joaquin Valley. Dairy facilities produce very little NO_x, so the focus for gaseous reductions on dairy farms is on VOCs. More than 700 VOCs can be formed. The two main VOC forming processes on dairies are thought to be (1) fermentation and (2) decomposition of organic materials. These processes occur prior to organic materials entering animals (feed), in animals (enteric processes in the digestive system) and in manure excreted by animals.

It should be noted the some practices that reduce VOC emissions may require tradeoffs by dairy producers as well as regulators. For example, controlling emissions of VOCs may call for little or no shade for animals to keep corrals dry; this however, could result in increased heat stress and might be a conflict in Conservation Management Plans to reduce dust (Rule 4550). As you review this Farm*A*Syst worksheet, you will quickly recognize that all the various consequences of each management alternative will need

to be carefully considered and evaluated before management practices are selected for implementation.

How will Farm*A*Syst help me to protect our air quality?

- It will help you recognize the general environmental conditions at each emissions source on your dairy that you should try to avoid, as they might lead to increased VOC emissions
- It will provide you with descriptions of goals and options that can be applied at the various emissions sources to help mitigate the conditions you want to avoid, and conversely, describes those circumstances that can lead to unfavorable conditions
- It will provide you with necessary background information as you review your dairy's environmental conditions so that you may choose the appropriate practices to reduce your emissions potential and avoid adverse conditions
- It will help you determine where your priority problem areas are, so you can focus your primary attention on those

How do I complete the worksheet?

- Follow the instructions at the top of the next page to complete the worksheet.

What do I do with the results?

- It should assist you to take note of and focus your attention on conditions that could lead to increased VOC emissions as you conduct and observe the daily activities on your dairy.
- Use the worksheet to consider the impact on VOC emissions when considering facility improvements and expansions.
- Use what you have learned through Farm*A*Syst to choose appropriate practices to include in your Mitigation Measures Plan for VOCs.
- The sources are listed in order of importance according to the current state of scientific knowledge. Corrals/Open Lots and Feed have been identified as potential major sources if they are not appropriately managed. So, if you find that you have some high emissions potential circumstances in the Corral/Open Lots source, or in the Feed source, it naturally follows that it might be wise to make these areas a higher priority in your thinking.

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Dairy Facilities and Activities: Assessing the Potential for Volatile Organic Compounds Emissions

How do I complete the worksheet?

This Farm*A*Syst worksheet is a little different than others you have used. The emissions of VOCs are chemical precursors to ozone formation, and are not a directly emitted or discharged pollutant like particulate matter or manure water that can be physically observed. Therefore, this document is designed to identify those conditions and circumstances that can lead to increased emissions for you to note as you assess conditions on your facility.

1. Simply read the chart and note the conditions to avoid for each emissions source. Consider your facility under fall, winter, spring, and summer conditions.
2. Then take a look at the low potential circumstances on the left, and the high potential situation on the right, and see where you fit.
3. If you wish, circle the one that best fits your farm.
4. Or, you can make an X to mark the spot on a sliding scale between the two that best suits your dairy's status.

Emission Source	CONDITIONS TO AVOID	LOW EMISSIONS Potential	HIGH EMISSIONS Potential	Improvements planned or areas needing attention
CORRALS AND OPEN LOTS				
Corral surface characteristics	Persistent wet spots in corrals, leading to anaerobic conditions.	• Maintain corrals smooth, dry • Maintain adequate slope (3%) to promote drainage. • Clean corral thoroughly before winter.	• Standing water in corrals. Wet spots or ponding occurs regardless of season. • Manure remaining in corrals over winter.	
Corral surface under shade structures	Anaerobic conditions exist as described above.	• Shades constructed to allow corral surface to be maintained smooth and dry throughout the year. • Semi-permeable shades used to allow sun penetration for manure drying.	• Shades interfere with maintenance and drying of corral surface.	

Emission Source	CONDITIONS TO AVOID	LOW EMISSIONS Potential	HIGH EMISSIONS Potential	Improvements planned or areas needing attention
FEED				
Diet formulation	Excessive nitrogen and starch excretion in manure.	• Feed protein and energy at NRC recommended levels.	• Overfeeding of protein in diets; feeding energy in a form that is not well digested, such as dry rather than steam rolled corn.	
Making silage	Spoilage of and off-gassing from wet feeds during the ensiling process.	• Cover pile quickly with non-permeable material after the completion of harvest.	• Pile left uncovered; outer crust used to seal pile during ensiling process and is permeable to rainfall.	
Silage leachate	Uncontrolled leachate drainage can result in emissions. Avoid all standing liquids around silage piles.	• Ensile forage at appropriate moisture to minimize leachate formation. • Keep silage area clean and well drained.	• Ensile forage with too much moisture. • Drainage system inadequate to transfer silage liquids to a proper storage or removal area.	
Silage use and management	Overly-exposed or uneven silage pile face, and/ or large amounts of loose silage knocked down and exposed to the air.	• Maintain smooth face when unloading. • Knock down silage just before loading into feed mixer. • Peel back pile in minimal increments.	• Uneven silage face management. • Large amounts of loose silage remains after feeding. • Large silage area exposed when peeling back cover.	
Wet by-product feed use and management	Spoilage of wet feeds prior to use. Standing liquids around by-product feeds.	• Limit feed on hand to minimize spoilage. • Keep storage area clean and well drained.	• Large piles vulnerable to spoilage and decomposition; storage area with poor drainage.	
Dry feed management	Wetting of dry grains resulting in uncontrolled fermentation.	• Protect dry feed ingredients from rainfall.	• Dry feed ingredients exposed to rainfall and/or other conditions that can cause them to become wet.	

Emission Source	CONDITIONS TO AVOID	LOW EMISSIONS Potential	HIGH EMISSIONS Potential	Improvements planned or areas needing attention
Wasted and/or spoiled feed	Accumulation of spoiled feed resulting in uncontrolled fermentation and decomposition.	• Remove spoiled feed frequently from feed storage area, feed bunks, and feed lanes, and dispose of quickly. See mitigation measures for frequency of removal.	• Wasted and spoiled feed allowed to accumulate in feed storage area, feed bunks, and feed lanes. Piles of spoiled feed uncontrolled.	

ANIMAL HOUSING

Freestall beds	Wet freestall beds; low spots that allow accumulation of feces and urine and create anaerobic conditions	• Maintain dry freestall beds regardless of bedding materials.	• Moist or manured spots in freestall beds. • Freestall beds subject to wetting from wind blown rainfall.	
Concrete feed aprons, freestall lanes and transfer lanes	Emissions from uncollected fresh manure and its decomposition.	• Remove manure at each milking for lactating cows and on a regular basis for other animals.	• Infrequent or irregular removal of manure.	

Emission Source	CONDITIONS TO AVOID	LOW EMISSIONS Potential	HIGH EMISSIONS Potential	Improvements planned or areas needing attention
SOLID MANURE				
Solid manure storage	Anaerobic circumstances (wet conditions without oxygen).	• Manure well dried prior to storage and stored in a manner to prevent re-wetting.	• Manure stored in a moist condition or exposed to circumstances that might allow re-wetting.	
Separated solids management	Anaerobic circumstances (wet conditions without oxygen).	• Solids removed regularly (within 72 hours) and quickly dried when weather permits.	• Solids stored in large piles for long periods under moist conditions.	
Separated solids storage	Anaerobic circumstances (wet conditions without oxygen).	• Store to prevent re-wetting (Oct through May). Methods include tarps, pole barns or other structures.	• Re-wetting occurs during storage (Oct. through May).	
LIQUID MANURE				
Liquid storage ponds and / or treatment structures	Incomplete breakdown of solids can result in VOC emissions.	• Solid loading rate managed to optimize pond function. • Pond pH maintained between 6.5 and 7.5. • No floating islands of solids, dark tea color of pond water, water-like consistency of pond liquid.	• Pond pH above 7.5 (ammonia smell may be more prevalent) or below 6.5. • Excessive solid loading rate with floating solids, rapid sludge and solids accumulation, dark, oily consistency of pond water. • Pond may have offensive odors.	

Emission Source	CONDITIONS TO AVOID	LOW EMISSIONS Potential	HIGH EMISSIONS Potential	Improvements planned or areas needing attention

LAND APPLICATION

Liquid manure application	Rapid off-gassing due to direct exposure of liquid manure to the air.	• Liquid manure applied to fields with crop canopy. • Liquid manure well diluted with fresh water.	• Liquid manure applied to bare soil surface. • Liquid manure applied at pond strength, without dilution.	
Liquid manure application	Anaerobic conditions (wet soils without exposure to oxygen).	• Irrigations managed to avoid standing water.	• Irrigations result in standing water.	
Solid manure and slurry application	Anaerobic conditions (wet without oxygen).	• High moisture or slurry manures incorporated into soil within 72 hours after land application.	• High moisture or slurry manures allowed to remain on soil surface for more than 72 hours after land application.	