Issue 10

Addressing Waste Management Problems with Micro-Aid®

Micro-Aid®

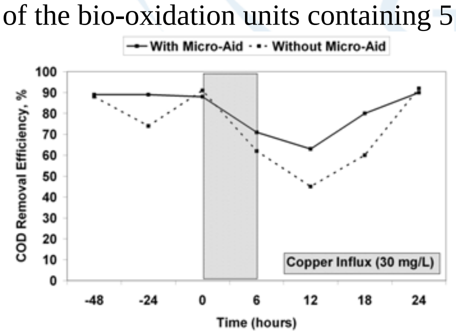
Micro-Aid® is an all-natural, environmentally-safe additive whose biological activities are due to the naturally occurring saponins in the plant extract. Micro-Aid® Feed Grade concentrate is a dry, granular product that is produced by drying the phytogenic extract in combination with a unique blend of ingredients; whereas, Micro-Aid® Liquid is made from high-quality, liquid, plant extract. Micro-Aid® has been university researched and commercially proven as being effective in controlling noxious gases (e.g., ammonia, hydrogen sulfide, etc.) and accelerating waste breakdown in storage systems, along with improving cleanup of building pens and equipment.

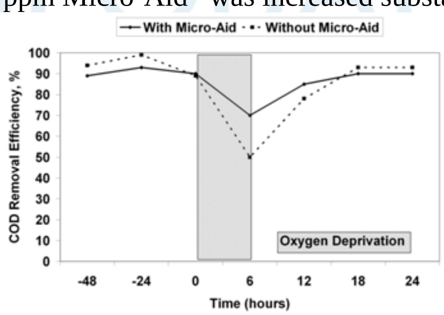
Industrial and Municipal Wastewater Management

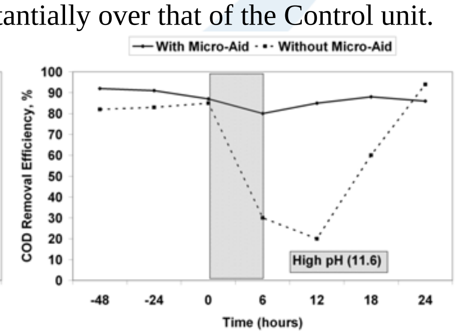
Wastewater includes not only sewage, but all the water used in a home that goes into the sewage collection system. As well, water from storm drains is added in some municipal systems. Therefore, there is wide variation in both the composition and volume of the waste treated. Such variation tends to create stress conditions for the microorganisms feeding on organic materials in the waste. This will result in inefficient digestion of the organic waste and the occurrence of objectionable odor levels, excessive sludge accumulation, and a reduction in chemical oxygen demand (COD) removal efficiency. No biological waste treatment facility is immune to these conditions.

Most wastewater treatment plants have primary (physical removal of floatable solids) and secondary treatment (biological removal of dissolved solids) processes. An example of a secondary treatment process is a lagoon, which relies on the interaction of microorganisms, algae, oxygen, and sunlight to dissolve solids. After the primary and secondary treatment of wastewater, it is typically disinfected using chlorine or other disinfecting compounds.

A study was conducted to evaluate the effects of Micro-Aid® on digestion efficiency during three adverse chemical conditions (i.e., stresses) that were administered for a 6-hour duration to bio-oxidation units. These conditions were: 1) excessive copper influx (influent contained 30 mg/L of copper sulfate); 2) oxygen starvation achieved by bubbling nitrogen through the units rather than air; and 3) high-pH influent (pH = 11.6). As shown in the figures below, during and after each of the three stresses, the COD (i.e., measurement of the amount of oxygen that will be consumed by microorganisms during the biological reaction of oxygen with organic material) removal efficiency of the bio-oxidation units containing 5 ppm Micro-Aid® was increased substantially over that of the Control unit.







Micro-Aid® can be used to reduce the length of time required for a biological treatment process to recover from a stressful environment. Additionally, the use of Micro-Aid® in biological waste treatment facilities can reduce organic sludge accumulation and odors to acceptable levels and enhance COD removal efficiency.

Animal Waste Management

Lagoons, pits, and slurry stores are common waste storage systems used in the livestock industry. These waste storage systems treat manure biologically with numerous types of bacteria that form a fermentation biomass and work together to decompose organic material. Protozoa are also present in most fermentation biomasses. Protozoa engulf bacteria in the fermentation biomass and breakdown their cellular proteins into ammonia. Reducing the number of protozoa in a fermentation biomass will reduce the amount of ammonia produced and increase the number of bacteria present, which subsequently increases the conversion of released ammonia into bacterial protein and the rate of solids breakdown. Adding an effective amount of Micro-Aid® to a fermentation biomass, both directly in the form of Micro-Aid® Liquid or by feeding Micro-Aid® Feed Grade Concentrate to the animal, will decrease ammonia production and increase solids digestion.

Loading rate is defined as the amount of manure that will be added to a waste system on a daily basis. The long-term rate of manure addition should not exceed the rate at which stabilization can occur. Because the rate of organic matter breakdown is regulated by lagoon or pit temperature, biological activity in an anaerobic lagoon is dramatically reduced and organic matter is incompletely digested during winter months. As the lagoon warms in spring, bacteria are presented with excess organic matter to digest. At this time, very vigorous activity is observed on the lagoon surface and large amounts of biogas are produced. This is referred to as lagoon "turnover" and can produce highly offensive gases. The use of lower loading rates, especially during winter and early spring, will help to reduce the potential for odor production. As well, lagoons or pits should not be pumped below the minimum design volume to ensure that the necessary bacteria population for biological activity is retained.

A large portion of the nitrogen entering a waste system is converted to ammonia. The nitrogen in urine will convert to ammonia rapidly whereas the transformation of nitrogen to ammonia in organic matter will occur over an extended time period. The greater part of ammonia will then volatilize from the lagoon or pit surface over time. Volatilization will increase as lagoon or pit temperature, pH, and surface air movement increase.

Micro-Aid® Liquid in Action

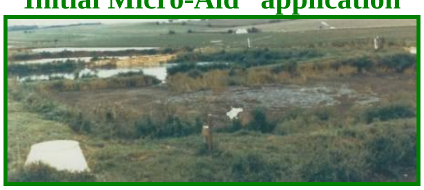
Micro-Aid® Feed Grade Concentrate is recommended in conjunction with the use of Micro-Aid® Liquid. Once the desired level of solids breakdown has been achieved, the use of Micro-Aid® Liquid can be discontinued. Mix Micro-Aid® Liquid with water at a rate of 1 part Micro-Aid® Liquid to 5 parts water.

For pits, simply add four ounces of Micro-Aid® Liquid per 100 cubic feet of sludge per week. The application rate will decrease as sludge breakdown occurs.

Example: 2 ft. sludge x 10 ft. wide x 50 ft. long = 1,000 cu. ft.
(1,000 cu. ft. / 100 cu. ft.) x 4 oz. = 40 oz. Micro-Aid® Liquid

For treatment of waste ponds or lagoons, initially apply 10 gallons of Micro-Aid® Liquid per 1 million gallons of waste. Then, apply 4 gallons of Micro-Aid® Liquid per 1 million gallons of waste every week to maintain proper solids digestion. Mix Micro-Aid® Liquid with water and spray along the windward side. Excessive solids buildup may require maintaining initial application rates for an extended period.

Initial Micro-Aid® application



After 3 months of Micro-Aid®

After 9 months of Micro-Aid®

Issue 29

Animal Wastewater Lagoon Management

Introduction

Wastewater treatment lagoons are commonly used in the livestock industry for the treatment of animal waste. In a lagoon, organic waste is diluted with water and then decomposed by various microorganisms. This effective degradation of organic compounds differentiates them from wastewater storage or holding ponds. The treated liquid and dilution water resulting from the decomposition process is known as effluent and used by producers as fertilizer. Effluent can also be recycled for manure handling in a flush system. However, those solids that cannot be liquefied by microorganisms settle out as sludge and present a problem for the producer to manage.

Wastewater Lagoon Design

Livestock wastewater treatment lagoons are designed to receive manure from a set number of animals in a given phase of production. The calculations used in the design of a lagoon have been determined by the climatic conditions of its location, strength of the manure entering the containment, dilution of the treatment volume (i.e., amount of water that must be added to a lagoon system between each dewatering period to ensure proper waste decomposition and minimize odors), and the hydraulic retention time of the manure (i.e., measure of the average length of time that a soluble compound remains in a wastewater system). Thus, lagoons are sized based upon sludge storage volume, minimum design volume (i.e., treatment volume to ensure bacterial decomposition), volume of total waste entering the lagoon, and freeboard volume (i.e, precipitation and runoff volumes). Freeboard volume is included in a lagoon design to account for large or sudden amounts of rainfall, which minimizes the chance of overflowing once it has reached its total design volume.

Wastewater Lagoon Microbiota

Bacteria are the primary microorganisms responsible for waste degradation in all types of lagoons. In a properly functioning lagoon, acid- and methane-producing bacteria are the two types that predominate. Acid-producing bacteria (i.e., acidogens) convert biodegradable organic matter to volatile acids while methane-producing bacteria (i.e., methanogens) then convert these volatile acids to methane (CH_4) and carbon dioxide (CO_2). In optimal conditions, the biological activity of these two classes of bacteria is in equilibrium.

Acidogens are much more robust, less sensitive to temperature fluctuations, and have a wider working pH range of 5 to 8. As well, they tolerate oxygen and feed on a wide variety of organic material. In comparison, methanogens are more environmentally sensitive, are anaerobes (i.e. they cannot tolerate oxygen), need simple organic acids for food, and have a stricter functioning pH range of 6.5 to 7.5. Methanogen growth can be grouped into three temperature regimes: 1) psychrophilic range, which grow in temperatures less than 68°F and produce the least biogas per unit of time; 2) mesophillic range, which have an optimum temperature for growth of about 100°F and is the most common temperature for methane digesters; and 3) thermophillic range, which grow at about 130°F and produce more biogas per unit of time, but there is difficulty in achieving this high temperature within systems. Ultimately, lagoons need to retain enough methanogens to complete the breakdown of acids and produce methane.

Other types of bacteria also reside in anaerobic lagoons, including purple sulfur bacteria. Lagoons containing these microbes turn pink, purple, or red in warm months. These bacteria have environmental significance because they are capable of oxidizing sulfides, thereby reducing odors. Research has demonstrated that growth of purple sulfur bacteria is impacted by certain micro-minerals like zinc in a positive fashion and copper in a negative manner.

Wastewater Lagoon Types

Because of the microbial populations present in wastewater treatment lagoons, they are often categorized into three types based on the presence or absence of oxygen for these bacteria: 1) aerobic, 2) facultative, and 3) anaerobic.

Aerobic lagoons are fairly shallow and bacteria utilize oxygen provided by natural surface aeration and algal photosynthesis to breakdown waste. Under aerobic conditions, various bacterial species work in conjunction to first convert nitrogenous compounds to ammonium (NH_4), then to nitrite, and finally into nitrate. As well, sulfur compounds are converted to elemental sulfur or sulfate instead of odor-causing gases like hydrogen sulfide (H_2S).

Facultative lagoons are a combination of aerobic and anaerobic degradation reactions. Waste is treated by bacteria specific to the upper aerobic layer, facultative middle layer, and lower anaerobic layer. In the top layer, dissolved oxygen is present in the water to sustain aerobic bacteria. Undigested solids that settle to the bottom of the lagoon are degraded by anaerobic bacteria. Facultative bacteria in the middle layer function as anaerobes when dissolved oxygen is available and as anaerobes when it is not.

Anaerobic digestion is the breakdown of complex organic material by microorganisms in the absence of oxygen. The anaerobic digestion process is initiated by liquefying bacteria that hydrolyze insoluble fibrous material into soluble material. However, not all the material can be converted and inorganic solids and other hard to digest organic material will come through the digestion process intact. Next, acidogens convert the soluble carbohydrates, fats, and proteins to short-chain organic acids. These acids are the food for methanogens, which convert the acids into CH_4 and CO_2. Methane, which has very low solubility in water, is readily emitted into the atmosphere as soon as it is formed, whereas CO_2, NH_3, and H_2S are all soluble gases. Unfortunately, the digestion process is incomplete in most natural situations and results in many intermediate products that are quite odorous.

Anaerobic Wastewater Lagoons

Anaerobic lagoons digest solids in manure. The solids can be divided into total solids (TS), which include the volatile solids (VS), typically 70% of the TS, and the remaining inorganic fraction. The VS can be further divided between biodegradable volatile solids, typically 50%, and non-biodegradable solids. Because of the high organic content of animal wastewater, primary lagoons used for the treatment of wastewater are essentially anaerobic. Lagoons are designed to receive manure at a calculated strength and flow rate, which is typically expressed as the amount of volatile solids in pounds loaded per 1,000 cubic feet of lagoon treatment volume per day (lb VS/1,000 ft^3/day). The following figure is adapted from the American Society of Agriculture Engineers (1999) and details the loading rate of anaerobic lagoons in lb VS/1,000 ft^3/day. Note that as you move from North to South across the United States, the loading rate capacity increases due to increasing environmental temperatures. Treatment lagoons have not been popular north of the Mason-Dixon Line because they require a large land area and treatment is seasonal.

Optimizing Lagoon Lifecycle

Proper management of the anaerobic lagoon during the start-up stage is extremely critical because it may take more than one year for bacterial populations to reach the optimum level to treat waste. As well, because warmer temperatures stimulate bacterial growth, it is recommended that manure be added to a new lagoon in the spring when bacterial populations are increasing. Once the treatment lagoon is functioning properly, biological activity is optimized by maintaining pH (6.5 to 7.5), salt content, and dilution volumes in acceptable ranges. Biological activity of microbiota is the most aggressive between pH 6.5 to 7.5.

Other Factors Affecting Lagoon Performance

Numerous factors can affect the performance of wastewater lagoons. Not all materials entering the lagoon are biodegradable. It is highly recommended to keep sand and supplies like metal containers, plastic, glass, and other non-degradable material from entering the lagoon. Furthermore, you should not dispose of organic material such as afterbirth and dead animals into a lagoon because these have an extremely high biological demand.

The calculation for lagoon loading rate is generally determined assuming excreted materials that have passed through the digestion system of animals. When undigested feed is included in wastewater entering the lagoon, the designed treatment volume is inadequate to keep up with the biological requirements resulting in sludge buildup. Feed waste typically runs from 3 to 6% with well-designed feeders, but under some conditions may be as high as 20%. Conservative estimates of feed waste on typical swine farrow-to-finish operations are about 0.25 lb per farrowing crate per day and 1 lb per 60 animals per day with dry feeders for the nursery through finisher phase. Thus, 190 farrowing crates and 10,000 animals in the nursery to finisher phase could result in 215 lb of feed being added to the lagoon per day as undigested waste. In one years' time, approximately 78,475 lb may be added to the lagoon. One semi-load of ground swine feed weighs approximately 22 ton. Any wasted feed over and beyond this example would compromise the waste treatment lagoon and accelerate sludge buildup rate.

"Slug loading" is also a compromise that will occur when manure transfer systems are not operated as designed or are out of service for a period of time. The result is irregular inflow of higher than designed volatile solids loading; thus, compromising the treatment efficiency and increasing the probability of resident sludge buildup.

Excessive feeding levels of antibiotics or minerals such as copper (Cu) can result in a significant increase in the total quantity excreted during a pig's entire production cycle and subsequent buildup of excess in waste storage systems. Within these waste storage systems, excess antibiotics, disinfectants and Cu are harmful to the microbial populations responsible for forming a fermentation biomass and breaking down solids and sludge.

All bodies of water including lagoons experience a natural phenomenon known as thermal inversion or lagoon turnover. Thermal inversion is due to seasonal temperature changes and is the vertical movement of the lower anaerobic zone contents towards the lagoon surface. Thermal inversion occurs when the cold weather begins and lagoon surface temperature drops below 55°F and reoccurs after the temperature rises to 55°F again. When lagoon temperature is high enough, the proper mix of bacteria will break down solids and produce CH_4 and CO_2. However, the bacteria won't function properly at low temperatures and neither does the lagoon. The result of an improperly functioning lagoon is an accumulation of solids, an overloaded lagoon, and potential odor problems when lagoon temperatures rise in the spring.

Managing Lagoon Solids and Odor

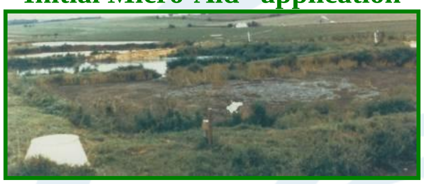
Even with good bacterial digestion, significant amounts of sludge accumulate in an anaerobic lagoon. At some point, the treatment capacity of most lagoons will be severely diminished by sludge accumulation. Regular monitoring and sludge removal will improve the operational capabilities of the lagoon. Mechanical or biological sludge reduction should be implemented when the designed sludge storage volume is reached. However, it is essential that the draw down of a lagoon should not be below the minimum design volume level.

TECHNICAL BULLETIN

Research correlating the effects of diet on manure odors has focused on concepts such as increasing dietary nutrient utilization or manipulating the diet to alter microbial fermentation in the lower gastrointestinal tract and thus reduce excretion of odor-causing compounds. The ability of Micro-Aid® to reduce odors starts within the gastrointestinal tract where it creates a microbial environment that aids in nutrient utilization and results in less excretion. Furthermore, because Micro-Aid® is not absorbed by the gastrointestinal tract, it is excreted along with fecal matter to continuing working within the waste management system to enhance the microbial population responsible for nutrient digestion.

Micro-Aid® is an all-natural, biological option to manage odors and solids. It has been university researched and commercially proven as being extremely effective in controlling noxious gases (ammonia, hydrogen sulfide, phenols, etc) and accelerating waste breakdown in storage systems (pits, lagoons, slurry stores, etc), as well as, in improving cleanup of building pens and equipment. Adding an effective amount of Micro-Aid® to a fermentation biomass, both directly in the form of Micro-Aid® Liquid or by feeding Micro-Aid® Feed Grade Concentrate to the animal, will decrease ammonia production and increase solids digestion.

Initial Micro-Aid® application



After 3 months of Micro-Aid®

After 9 months of Micro-Aid®

Key Technical Points

- Lagoons are designed to handle wastewater from a predetermined flow of animals under given conditions. Any change in phase of production or increase in animal population can create more manure volume than the treatment capacity was designed to handle and result in challenges.
- Bacteria are responsible for waste degradation in lagoons, and, in optimal conditions, acidogens convert biodegradable organic matter to volatile acids, which are then converted to CH_4 and CO_2 by methanogens.
- Wastewater treatment lagoons are categorized into one of three types based on the presence or absence of oxygen for the microbial populations: 1) aerobic, 2) facultative, or 3) anaerobic.
- Anaerobic lagoon loading rate is expressed in lb VS/1,000 ft^3/day and increases due to increasing environmental temperatures.
- Lagoon biological activity is optimized by maintaining pH (6.5 to 7.5), salt content (electrical conductivity of 4,000 to 8,000 micro mohs per centimeter), and dilution volumes in acceptable ranges.
- Numerous factors hinder the performance of wastewater lagoons including non-degradable material (e.g., metal containers, plastic, glass, etc), organic material (e.g., afterbirth, dead animals or wasted feed), excessive feeding levels of antibiotics or Cu, and any system malfunction that will result in slug loading.
- High concentrations of intermediate degradation compounds, such as organic acids, amino acids, sulfides, etc. are present in lagoon water and contribute to the foul odors; however, increasing dietary nutrient utilization or altering microbial fermentation in the lower gastrointestinal tract to reduce odor-causing compounds excreted into the lagoon will help minimize these aerial odor emissions.
- Adding an effective amount of Micro-Aid® to a fermentation biomass will decrease ammonia production and increase solids digestion.

Issue 34

Caution – Hydrogen Sulfide is a Killer that Lurks in Liquid Manure

by Jim McFarlane, Ph.D.[1], November, 2008

Of the handful of harmful gases bubbling up from livestock manure pits and holding tanks, hydrogen sulfide (H_2S) poses the greatest threat to life. It seems no manure-hauling season goes by without a report from somewhere in the country of accidental death to pigs or humans overcome by this toxic pit gas.

Hydrogen sulfide is given off as microorganisms digest manure under anaerobic (without oxygen) conditions. A deep manure pit or any containment where manure is stored undisturbed for long periods of time is the perfect factory for H_2S production. While small (generally safe) amounts of H_2S bubble out of stored manure on a daily basis, lethal levels can be reached during times when manure is stirred or agitated for purposes of removal.

The more manure is stirred, the quicker the rate of H_2S release and the higher its concentration in the air space above. Concentrations of 200 to 300 ppm have been reported in hog buildings after just a few minutes of manure pumping while concentrations as high as 800 ppm can be reached during vigorous agitation of manure. Even the more mundane task of draining a shallow pit or gutter can produce H_2S gas in the range of 800 to 1,000 ppm—levels toxic enough to cause pigs and unwary workers to collapse and die from respiratory paralysis in just minutes.

Avoiding the dangers of H_2S requires a three-pronged management effort. First, keep the production of H_2S in manure to a minimum. Second, safely manage the H_2S gas that is released during pump and haul events. Third, employ practical safety measures when working with stored livestock manure.

Minimize H_2S Production in Manure

It stands to reason that if there is less H_2S produced in stored manure in the first place then less is available for release into the air when that manure is stirred or moved.

Pulling the plug more frequently in shallow pits (thereby shortening storage time) is a proven method for lowering H_2S release, as is adding some recharge water after emptying. Reducing pigs' sulfur intake is also an effective way to lower H_2S production—although this may be unavoidable in cases where drinking water is high in sulfates to begin with or when byproducts high in sulfur, such as distillers dried grains with solubles (DDGs), are fed.

Adding Micro-Aid® to swine diets is one promising way to head off H_2S production. Well known for its ability to keep a lid on harmful ammonia gas— Micro-Aid® is equally effective in reducing H_2S gas and other sulfur-bearing compounds. In recent university work, dietary Micro-Aid® reduced the production of five different sulfur-containing gases in stored pig manure by more than 87%, while two commercial studies reported that Micro-Aid® dropped H_2S gas in finishing units and nurseries by 49% and 80%, respectively.

Further helping reduce H_2S gas is the unique ability of Micro-Aid® to enhance manure flowability. Making manure more flowable lessens the need for vigorous stirring or agitation at pump-out. This in turn reduces H_2S release to

[1]Dr. Jim McFarlane is an independent consultant assisting pork producers in the design and management of production environments. He can be contacted at jmcfar@metermall.com.

the air, lowering the risk to pigs and humans. Recent work showed that Micro-Aid® decreased the viscosity (stickiness) of manure from pigs fed a DDGs high-fiber diet by 17%.

In a different study, Micro-Aid® increased the proportion of dissolved solids (i.e, liquefied) by 4.3%. This amounts to the potential removal of 25,500 additional gallons of liquefied manure from a typical 1,000-head finishing pit. Like increased flowability, greater liquefaction reduces the need for agitation and helps pits pump down further, thereby creating more headspace for heavy H_2S gas to pool safely away from pigs and workers.

Safely Manage H_2S Gas in the Air

No matter how well H_2S production in stored manure is controlled, the release of H_2S gas during manure pumping, draining or agitation is inevitable. Rarely is there opportunity to remove manure when buildings are empty of animals, and in some cases humans. Their only protection is adequate ventilation to keep H_2S gas diluted to a safe level.

Pit and wall fans should be set to run at full capacity before pumping or agitation begins, even during cold weather. With tunnel-ventilated buildings, dial in as much tunnel capacity as the pigs can stand without causing undue chilling. In naturally ventilated buildings run the pit fans on high and lower side curtains as much as possible. Always turn off heaters and pilot lights to avoid accidentally igniting methane gas bubbling off the manure.

Employ Practical Safety Measures

Be alert. Pigs and humans can fall prey to H_2S gas very quickly. Watch animals closely when agitation begins. Pay particular attention to animals nearest the area where agitation disturbs the manure surface the most. Stop agitating if animals show signs of distress.

Never enter manure pits, sumps, or storage tanks until adequate ventilation has been applied. Wear a safety harness and rope and have at least two people standing by who can pull you to safety if necessary. Never rush in to save animals or humans in distress without first protecting yourself.

Remember to increase ventilation in nursery or farrowing rooms when pressure washing equipment or draining shallow pits. Wear a personal gas detector when performing any task that could expose you to high H_2S levels. Priced today at under $300, these little monitors issue an audible alarm when H_2S reaches 10 ppm, giving you plenty of opportunity to take corrective action.

Take the time to develop a contingency plan for manure-related emergencies. Keep first-aid and rescue equipment at the ready. Learn and practice how to safely rescue and resuscitate a victim of H_2S exposure. Know the enhanced 911 address for your farm so emergency crews can arrive quickly when called.

With a little planning you can keep killer H_2S gas at bay. Minimize H_2S production in the first place. Use plenty of ventilation when draining, pumping or agitating manure. Employ practical safety measures to protect pigs and workers.

This cell-phone-sized personal gas detector alerts workers to dangerous levels of hydrogen sulfide gas.

Issue 36

Use of Micro-Aid® to Limit Gas Problems in Waste Management Systems

Gas Problems

Flash fires, explosions, and accidental death to animals or humans overcome by toxic gases originating from a livestock building's waste management system are just a few of the risks during manure handling. These concerns are even greater when agitating and pumping manure from pits beneath buildings. In a typical pit, microorganisms slowly digest manure under anaerobic conditions (i.e., without oxygen), which creates several gases including ammonia (NH_3), methane (CH_4), and hydrogen sulfide (H_2S). While small (generally safe) amounts of gas bubble out of stored manure on a daily basis, lethal levels can be reached during times when manure is stirred or agitated for purposes of removal. This increase is especially true for hydrogen sulfide as concentrations of 200 to 300 ppm have been reported in hog buildings after just a few minutes of manure pumping, while concentrations as high as 800 ppm can be reached during vigorous manure agitation. Flammability is an added concern with methane and hydrogen sulfide.

Typically, these gases would volatilize from the pit surface and form tiny bubbles that readily burst. However, these gases can become trapped in some instances and result in foaming. The primary reason for foaming is a change in surface tension of the liquid so that the thin layer of surface liquid atoms that form the bubbles now has sufficient chemical bonding ability to cling together.

Foaming may occur all summer long; however, as pits near capacity in late fall, foam may begin to appear through the slats into the pig's area. Foaming is also likely increased in late fall because of increased biological activity in the pit due to warmer conditions and heat that has accumulated from the summer months. One would expect the foaming problem to lessen as pits cool with the return of cold weather during winter months. The foaming issue will actually be exacerbated by any factor that increases gas production and could include such examples as increased manure output as pigs mature or the use of high fiber feedstuffs.

Recent reports would suggest that the incidence of pit foaming and resulting flash fires or explosions has increased within the swine industry. Some have speculated that changes in dietary ingredients such as an increased usage of distillers dried grains with solubles (DDGS) may be a contributing factor. Research has demonstrated that 20% dietary inclusion of the high-fiber ingredient increased fecal matter output by over 40%. This increased fecal matter output would significantly impact the composition and viscosity of the slurry in the pit, as well as the microbial population present for solids digestion and breakdown.

Micro-Aid®

Micro-Aid® is an all-natural, environmentally-safe additive that is used extensively in numerous agricultural industries to maximize health and performance by creating a better environment. The phytogenic extract used in the manufacturing of Micro-Aid® is a natural surfactant that reduces surface tension and the subsequent propensity for foam production in pits.

In addition to its surfactant properties, the impact that Micro-Aid® has on the pit microbial population is also important. Micro-Aid® research reports that its addition to diets containing 20% DDGS increased organic nitrogen (i.e., microbial protein) by 44% as a result of improved microbial efficiency (Figure 1). There was also a corresponding reduction in ammonium nitrogen and aerial ammonia (Figure 2). If methane and hydrogen sulfide were measured in this study, there likely would have been a reduction in these gases as well because excess carbon and sulfur compounds would have been incorporated into the microbial protein.

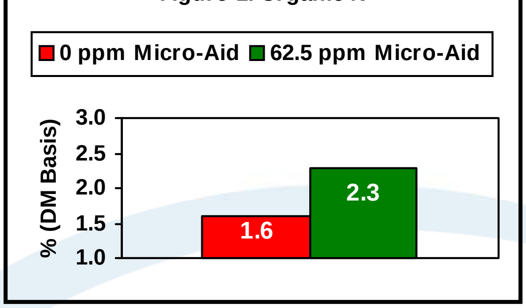


Figure 1. Organic N

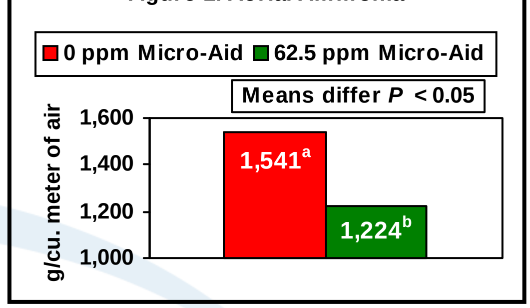


Figure 2. Aerial Ammonia

Other research with Micro-Aid® has also demonstrated a reduction in these carbon and sulfur compounds. Figure 3 shows that adding 110 ppm of Micro-Aid® consistently reduced ($P < 0.002$) *in vitro* methane production in a diet containing 10% forage and 90% concentrate and using several different forage types. Other swine research demonstrated that Micro-Aid® reduced sulfur and phenol gas production by over 90% (Figure 4). The reductions in gas production in both of these studies are again due to the effect Micro-Aid® has on the microbial population to promote the better utilization of these nutrients and convert them into microbial protein.

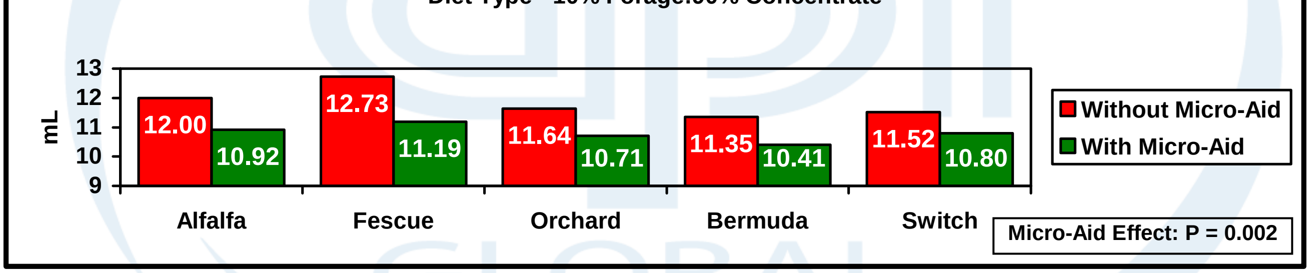


Figure 3. Effect of Micro-Aid and Forage Type on *In Vitro* Methane Production, Diet Type - 10% Forage:90% Concentrate

Key Technical Points

- Pit foaming results from a change in surface tension and a trapping of gases such as methane and hydrogen sulfide. Agitation or pumping when these gases are in excess is a serious health risk for animals and workers.
- Increased usage of DDGS in swine diets is thought to be a contributing factor to foaming issues because of its impact on the slurry composition and microbial population of pits.
- Not only is Micro-Aid® a natural surfactant, but extensive research has proven that Micro-Aid® improves microbial efficiency to increase organic nitrogen (i.e., microbial protein) in manure and reduce excess gas (i.e., NH_3, CH_4, and H_2S) volatilization. In addition, it is more effective when high fiber ingredients like DDGS are fed.

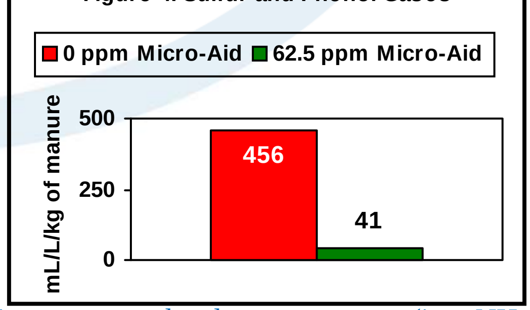


Figure 4. Sulfur and Phenol Gases