Phosphorus Best Management Practices

Protecting Water Quality

Treating Poultry Litter with Aluminum Sulfate (Alum)

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Definition:

Aluminum sulfate (alum) is added to poultry litter in the poultry house to precipitate soluble phosphorus.

Purpose:

Poultry litter contains high concentrations of water-soluble phosphorus. Research has shown that phosphorus runoff is closely related to the soluble phosphorus content of manure. Alum additions to poultry litter precipitate phosphorus into a form that is not water-soluble. This greatly reduces phosphorus runoff from fields fertilized with poultry litter, as well as phosphorus leaching. Alum additions also reduce ammonia emissions from poultry litter. Lower ammonia levels in poultry houses due to alum additions result in heavier birds, better feed conversion and lower mortality. Alum additions also reduce the number of pathogens in litter.

Surface applied dry alum in a boiler house.

How Does This Practice Work?

Alum should be applied to poultry litter at a rate equivalent to 5-10 percent by weight (alum/manure). For typical broiler operations growing 6-week-old birds, this is equivalent to adding 0.1 to 0.2 pound alum per bird, or 1-2 tons of alum per house per flock if 20,000 birds are in each house.

Aluminum from alum reacts with phosphorus to form an insoluble aluminum phosphate compound that is far less susceptible to runoff or leaching. The reduction in ammonia emissions is due to the acid produced when alum is added to the litter. This acid converts ammonia to ammonium, which is not subject to volatilization. The reduction in litter pH also causes pathogen numbers to decrease.

Where This Practice Applies and Its Limitations:

This practice applies to all poultry operations that have dry litter (broiler, breeder and turkey houses). There are no known limitations of this practice.

Effectiveness:

Treating poultry litter with alum is one of the most effective methods of reducing phosphorus runoff from fields fertilized with litter. Alum applications to poultry litter have been shown to reduce phosphorus runoff by 87 percent from small plots and by 75 percent from small watersheds.

Alum additions also result in less nitrogen being lost due to ammonia volatilization. Ammonia fluxes from alum-treated litter have been shown to be 70 percent lower than normal litter. This results in a higher nitrogen content of this litter, which boosts crop yields. Lower ammonia levels in the rearing facilities also improve poultry production and make the environment safer for agricultural workers. Reducing atmospheric ammonia emissions will also result in less air pollution, such as particulate matter less than 10

Application of liquid alum in a broiler house.

microns (ammonia is a precursor to PM-10s), acid precipitation and atmospheric nitrogen deposition. The long-term effects of applying alum-treated litter to land have indicated that this practice is sustainable. Soluble phosphorus levels in soils fertilized with alum-treated litter are significantly lower than that in soils fertilized with normal litter. Hence, there is less phosphorus leaching with alum-treated litter. Long-term studies have also shown that exchangeable aluminum levels in soils fertilized with normal and alum-treated litter are low (less than 1 mg Al/kg soil) and are not significantly different, whereas plots fertilized with the same amount of nitrogen from ammonium nitrate have very high exchangeable aluminum (up to 100 mg Al/kg soil). Results from long-term studies indicated that tall fescue yields were highest with alum-treated litter, followed by normal litter and lowest with ammonium nitrate.

Cost of Establishing and Putting the Practice in Place:

Treating poultry litter with alum is a cost-effective best management practice, due to the economic returns from improved poultry production and reduced energy costs. Alum costs about $250 per ton. As mentioned earlier, two tons of alum should be applied to a typical broiler house after each flock. Studies showed that the economic returns from this practice were $308 for the grower and $632 for the integrator (company), for a combined return of $940. This is almost twice the cost ($500) to treat the house, resulting in a benefit/cost ratio approaching 2.

Operation and Maintenance:

Alum is normally applied between each flock of birds. Dry alum can be applied with a number of different spreaders, such as de-caking machines, fertilizer spreaders, manure spreaders or drop spreaders. Applicators should always wear goggles for eye protection and a dust mask to avoid breathing alum dust. Gloves should also be worn to prevent skin irritation. To insure the chickens do not consume the granules of alum, it is best to till the product into the litter. This can be done with a litter de-caker or with any other device that physically mixes the alum into the litter. Liquid alum is normally only applied by a certified professional applicator. There are two types of liquid alum – normal liquid alum (48.5 percent alum) and acid alum (36.5 percent alum). Acid alum is preferred in situations where the litter is very dry, since it activates quickly. To add the equivalent of one ton of dry alum, 370 gallons of liquid alum or 512 gallons of acid alum are needed.

Applicators should wear appropriate safety gear.

References:

Moore, P.A., Jr., S. Watkins, D.C. Carmen and P.B. DeLaune. 2004. *Treating poultry litter with alum*. University of Arkansas Cooperative Extension Fact Sheet (FSA8003-PD-1-04N).

Moore, P.A., Jr, T.C. Daniel and D.R. Edwards. 1999. *Reducing phosphorus runoff and improving poultry production with alum*. Poultry Sci. 78:692-698.

Moore, P.A., Jr, T.C. Daniel and D.R. Edwards. 2000. *Reducing phosphorus runoff and inhibiting ammonia loss from poultry manure with aluminum sulfate*. J. Environ. Qual. 29:37-49.

Moore, P.A., Jr., T.C. Daniel and D.R. Edwards. 2003. *Long-term effects of alum-treated poultry litter, normal litter, and ammonium nitrate on soil chemical properties*. Poultry Sci. Abstract No. 54.

Shreve, B.R., P.A. Moore, T.C. Daniel, D.R. Edwards and D.M. Miller. 1995. *Reduction of phosphorus runoff from field-applied poultry litter using chemical amendments*. J. Environ. Qual. 24:106-111.

For Further Information:

Contact your local conservation district, USDA-NRCS or Cooperative Extension Service office.