The Ag forum
by JONES-HAMILTON CO.

Increasing the Fertilizer Value of Poultry Litter with PLT®

Poultry Litter—A Valuable Commodity

In the U.S., current poultry production practices not only result in valuable poultry meat products, they generate very valuable organic fertilizer in the form of poultry litter as well. Land application of poultry litter has been, and will continue to be, the predominant and most valuable use for this organic fertilizer in the foreseeable future. The value of poultry litter as a fertilizer source continues to rise as inorganic nitrogen for use as a fertilizer in crop production becomes increasingly expensive. Based on current inorganic nitrogen costs, poultry litter is currently valued at $105 per ton for its nitrogen content alone. When its value as a soil amendment due to the presence of trace minerals and organic matter is considered, the value of poultry litter rises farther above just the value of its nitrogen.

However, it's important to note that poultry litter value is significantly impacted by a number of decisions made during the live production process. Determining the end value of your litter as a fertilizer begins the moment new organic bedding and new chicks are added to a new facility or after a clean out program has been implemented in an existing facility. Litter values can vary from region to region based on how litter is managed from the start. Several major factors that impact litter value are over manipulation of the litter through decaking or tilling between and during the flocks, and litter moisture levels.

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Methods of Increasing Litter Value

Strategies that promote appropriate litter moisture levels and bind ammonia will conserve litter nitrogen by decreasing ammonia volatilization losses. Any increase in litter nitrogen content in relation to phosphorus levels will complement litter land application by better meeting crop nutrient requirements through an improved N:P ratio. As phosphorus-based nutrient management plans are implemented, finding alternative uses for litter will become more critical and litter sources with a high nutrient density will be sought after.

Alternative litter management and waste utilization technologies may be required in concentrated production areas where soil nutrient levels are high from continued land application of litter, or in areas that are sensitive to potential environmental impairment from surface runoff of nutrients from land applied litter. Depending on a number of farm or regional considerations, the alternatives may include:

- Transportation of litter to areas that can better use the nutritive value of this fertilizer
- Pelletizing litter into a form suitable for different market outlets
- Interest in thermo-conversion of litter into alternative energy

Litter management strategies that aid in balancing the ratio of nitrogen to phosphorus to better meet crop requirements will be especially beneficial for land application in environmentally sensitive watersheds. Some end-uses benefit from the more nutrient dense fecal component of multi-year reused litter, while the added carbon from the bedding of more frequently cleaned litter is advantageous to other uses like thermo-conversion to energy. Managing litter in a manner that provides a dry product will be useful for all alternatives since it reduces the added cost of transporting water and increases the nutrient density. In addition, the use of litter treatments during a flock should favor products that do not restrict the end-use of litter.

The Effect of PLT® on Poultry Litter Nitrogen / Phosphorus Ratios

Using the world's leading litter acidifier, PLT®, at placement to bind ammonia and improve flock performance greatly increases the fertilizer value of poultry litter without restricting its end-use in any way. For every 100 pounds of PLT® applied to a house, 55 pounds of ammonium sulfate is generated (see Figure 1). This formation of ammonium sulfate is non-reversible. Therefore, the nitrogen in the litter is not released as the pH increases (Ullman, et al., 2004). Over time, the use of PLT® can double the ammonium nitrogen content of your poultry litter. After using PLT® in the brood chamber for five flocks, the average size house will generate 2,750 pounds of free ammonium sulfate that would have otherwise been lost through. The use of a PLT® for ammonia binding will also improve the N: P ratio of poultry litter due to the retention of ammonia as ammonium sulfate.

100 lbs. Of PLT® Binds 14 lbs. NH3

$2NaHSO_4$	+	$2NH_4OH$	→	$(NH_4)2SO_4$	+	Na_2SO_4	+	$2H_2O$
(Sodium bisulfate)		(ammonium hydroxide)		(ammonium sulfate)		(sodium sulfate)		(water)
100 lbs.		29 lbs.		55 lbs.		59 lbs.		15 lbs.

Figure 1. Binding of ammonia by PLT to produce ammonium sulfate

In an unpublished study (Johnson 2003) of broiler litter from Northeast Georgia, sodium bisulfate usage for ten consecutive flocks increased the Ammonium-N to an average of 6,809 PPM compared to an average of 2,969 PPM of the untreated control litter. This greatly reduced the amount of supplemental nitrogen needed for fertilization. In a study conducted by Fairchild, et al. at the University of Georgia (Johnson et al, 2006), consecutive use of PLT® for three flocks showed a linear increase in both N and NH_4-N retained in the litter as the amount of PLT® applied increased (Fig. 2 and 3). The higher amounts of retained nitrogen in the litter of the 150 pound treatment group indicates a reduction in ammonia emissions in this house over the lower treatment rates based on a mass-balance model. Interestingly, total phosphorus levels were 20% lower in the 100 pound and 150 pound houses when compared to the 50 pound house. The decrease in total phosphorus is mostly likely caused by dilution due to the level of amendment added when the amendment becomes a greater proportion of the total litter volume.

Amount of retained Total Nitrogen and NH_4-N in broiler litter after three flocks of PLT® usage on re -used litter

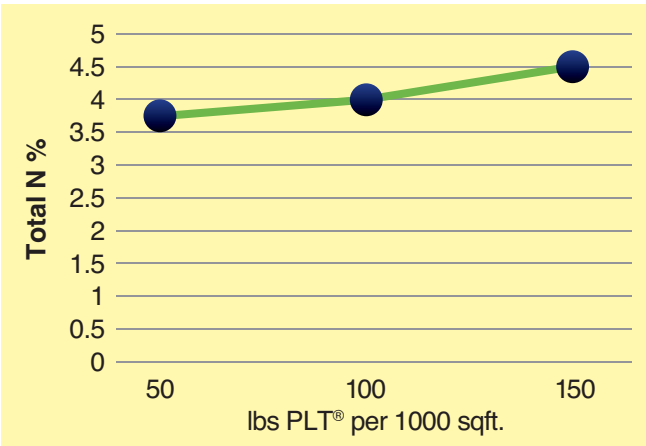

Figure 2.

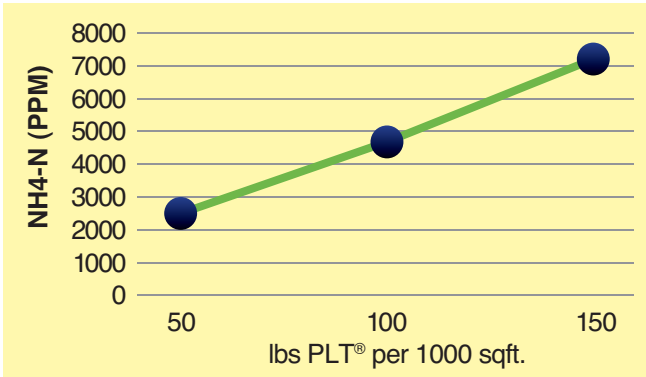

Figure 3.

Patterson, et al. (2006) completed a study in a high-rise commercial egg-layer facility to evaluate the use of PLT® litter amendment for the reduction of ammonia and flies. PLT® was applied at the rate of either 200 pounds per 1,000 square feet or 400 pounds per 1,000 square feet on eight separate occasions during two 45-day experimental periods on a central row in the pit area of the house. A third row was left untreated as a control. Because layer manure does not contain a plant substrate, as does broiler litter, the moisture and ammonia content tend to be greater. Repeated applications of a litter amendment at higher rates are often necessary before significant changes in manure characteristics are observed.

The same observations were made in this study where the higher rate of PLT® showed the most consistent decrease in ammonia emissions (ppm/sec) with emission rates significantly lower than the control on three out of the five sampling periods (0.2178, 0.8394, and 0.6435 for the high-treated vs. 0.6140, 0.9883, and 1.1863 for the controls respectively). Similar results were seen for the rate of Ammonia Linear Flux (mg/cm^2/min). As in the UGA study, manure ammonium (NH_4+) nitrogen and P_2O_5 were positively altered by treatment group with the high-rate treatment group having the highest level of retained nitrogen and the lowest level of P_2O_5 (figure 4).

Treatment (lbs/ton)	Total N (lbs/ton)	NH_4-N (lbs/ton)	Total Phosphate (P_2O_5) (lbs/ton)
Control	38.37b	11.08c	71.63a
PLT-150	40.50ab	13.75b	62.38b
PLT-300	46.08a	17.06a	55.48c
P-value	0.0551	<0.0001	0.0004

Figure 4. Commercial Layer Manure Analysis after 8 PLT® treatments over a 45-day period

The Economic Impact of PLT® on Fertilizer Value

All of these studies confirm that PLT® greatly increases the fertilizer value of poultry litter and helps to bring the N: P ratio back into proper alignment. Greater amounts of ammonium sulfate are generated as higher levels of PLT® are used or when the whole house is treated. These higher amounts maintain a lower in-house ammonia concentration for an extended period of time resulting in less fuel usage, and improved weights and feed conversions in addition to the increase in fertilizer value. With ammonium sulfate prices averaging $420 per ton at the beginning of 2012, the value of the ammonium sulfate generated through PLT® use in the brooder chamber each flock is about $115 per house. Therefore, a 4-house farm that cleans out every two years and uses PLT® with each flock would generate approximately $4,600 in free ammonium sulfate.

Because the usage of PLT® dramatically increases the nitrogen content of poultry litter, it is recommended that a nutrient analysis be done on all litter removed from the house to determine proper agronomic application rate. In addition, a complete quantitative N analysis should be done instead of the more common estimated NH_3 value. This is because the estimated NH_3 calculation assumes that a large percentage of ammonia will be lost to volatilization during land application and does not account for the nitrogen retention that occurs with the use of an ammonia-binding litter amendment. In addition, in areas where P-based nutrient management plans must be used, farmers will find that they are able to spread a higher volume of litter per acre with the use of PLT® due to the lower P content of PLT®-treated litter. In areas where N-based nutrient management plans are followed, farmers will need far less supplemental nitrogen (if any) on both pastureland and cropland.

When combined, these components allow farmers to greater utilize all the resources their farms produce without having to make outside purchases in difficult economic times. For growers that sell their litter, they are able to charge a premium for their product based on its greater fertilizer value. This allows litter to be hauled greater distances profitably, thus expanding the universe of potential buyers. For litter destined to alternative uses such as pelleting or composting operations, the increase in nitrogen content and a more preferable N:P ratio coupled with the absence of heavy metals and possibly a lower pathogen load makes PLT®-treated litter a highly desirable substrate for those uses.

When added to the increase in bird performance and fuel savings generated from PLT® usage during each flock, the additional $4,600 of free ammonium sulfate available at the end of a two-year clean-out cycle is one more reason to treat your litter each and every flock with PLT® regardless of the season.

Patterson, P., T. Cravener, C. Myers, G. Martin, and A. Adrizal. 2006. The impact of sodium bisulfate (PLT) on hen manure, ammonia emissions, and flies. Proc. 2006 SPSS/SCAD Annual Mtg. Atlanta, GA. 33.

Johnson, TM, B. Murphy, R. Chick, B. Fairchild, and CW. Ritz. 2006. The Use of Sodium Bisulfate as a Best Management Practice for Reducing Ammonia and VOC Emissions from Poultry and Dairy Manures. Proc. International Workshop on Ag. Air Quality. Potomac, MD. 786-794.

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