Iowa Manure Matters

Odor and Nutrient Management

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The phosphorus index and manure management plans for confinements

by Jeremy Klatt, Iowa Department of Natural Resources

The Iowa Environmental Protection Commission (EPC) adopted rules that include using the phosphorus (P) index to determine application rates for manure management plans (MMPs) at their June 21 meeting. The P index was developed by scientists from Iowa State University, the National Soil Tilth Laboratory and the Natural Resources Conservation Service (NRCS) to determine the risk of P loss from a field. The index is based on erosion, soil test, location of the field, P applications and other factors.

The Department of Natural Resources (DNR) developed rules for using the P index to determine manure application rates as required by state law. The rules apply to confinement feeding operations that are required to use MMPs and will be phased in over the next four years.

Depending on the P index results, manure application rates can be based on phosphorus or nitrogen (N). The EPC adopted the following application rates based on results of the P index.

Very Low (0-1). Nitrogen-based manure management.

Low (>1-2). Nitrogen-based manure management.

Soil sampling to determine soil test phosphorus levels for use in P-index calculations.

This issue

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Medium (>2-5). Nitrogen-based manure management if practices will not raise the field to the "high" risk category. Manure applications must not result in application of P in excess of two times the P removal of the crop rotation.

High (>5-15). Until Dec. 31, 2008, fields with a P index rating between 5 and 10 may receive manure at a P-based rate if practices will be adopted to reduce the P index of the field to the "medium" risk category. After Dec. 31, 2008, no manure may be applied until practices are adopted that reduce the P index to the "medium" risk category.

Very High (>15). No manure application.

Here are some important points to consider about the P index and MMPs.

- **A very high soil test does not equal a very high P index.** The soil test classification is not the same as the P index risk category. Soil P is only one input to the P index; the erosion rate is typically more important than the soil test value.
- **Practices can be implemented to reduce the P index.** If a field is classified as "high" or "very high" risk, soil conservation practices can be implemented to reduce the P index. For instance, filter strips, grass waterways, increased residue cover, terraces, changing the crop rotation, contouring or any other practice that reduces erosion or sediment delivery from the field also reduces the P index. The P index spreadsheet, available on the Iowa NRCS Web site, is a good tool for determining the impact of specific practices.
- **Fields can be split to reduce the P index.** Relatively small areas are typically responsible for most P loss from a field. Therefore another option if a field is "high" or "very high" risk is to isolate the area that is causing the P index to be high and run the P index separately for that area. This should result in a higher P index for that high-risk area and a lower P index for the rest of the field. Manure could then be applied to these two areas based on their respective P index results.
- **The P index will be phased in.** If the rules are finalized as planned, original plans submitted on and after Oct. 25, 2004 will need the P index. Plans submitted before this date will be phased in (see table below).

For more information about the P index, including the P index calculator go to the Iowa NRCS Web site at http://www.ia.nrcs.usda.gov/.

Implementation Dates for P index-based Plans*

Original MMP Submitted. Due	P index-based MMP Update
Prior to April 1, 2002.	First update after Aug. 25, 2008
Between April 1, 2002 and Oct. 24, 2004.	First update after Aug. 25, 2006
On and after Oct. 25, 2004.	Upon Submittal

*Dates could change. Rules will be reviewed by the Administrative Rules Committee in August.

Additional changes to manure management plans that were adopted by the EPC:

- Changes to manure standard table values used for MMP calculations. These values were updated to reflect current Iowa State University publication values (Managing Manure Nutrients for Crop Production, PM 1811).
- The number of years records need to be kept has increased from three to five years. This change was made to be consistent with U.S. Environmental Protection Agency requirements.
- A copy of the manure management plan and records must be kept within thirty miles of the site.
- Records of commercial N and P applications must be kept for fields receiving manure.

Nutrient recovery options

by Wendy Powers, associate professor of animal science, Robert Burns, associate professor of agriculture and biosystems engineering

While the primary method of swine manure management in the United States is temporary storage followed by land application as crop fertilizer, there is increasing interest in recovering energy and nutrients from manure prior to land application. Insufficient nutrient assimilation capacity in nearby cropland, or interest in adding value to swine manure beyond the fertilizer value, are among the reasons that alternative management strategies may be sought. Producers who consider alternative manure uses will find many options available.

This is the first of a two-part series that discusses some of the options available to producers that facilitate nutrient recovery. Each process is explained and primary issues that a producer should consider with each process are discussed. Opportunities and approaches that enhance the ability to recover nutrients will continue to gain popularity as the need to move nutrients off-site, in order to avoid over-application of nutrients to cropland, heightens.

Separated manure solids at dairy farm.

Flocculation, Coagulation and Precipitation Methods (P recovery). Chemicals commonly used for the purpose of particulate flocculation and/or coagulation include aluminum sulfate ($Al_2(SO_4)_3$; alum), ferric sulfate ($Fe_2(SO_4)_3$), ferric chloride ($FeCl_3$), calcium carbonate ($CaCO_3$; agricultural lime), calcium oxide (CaO; chemical lime or talc), ferric sulfate ($FeSO_4$), and synthesized polyelectrolytes. Polyacrylamide polymers, another choice of flocculant, are used extensively as settling agents in wastewaters from food processing and packing, paper production, sugar extraction, mine and municipal wastewaters, potable water treatment, and as soil treatments to reduce leaching and erosion by irrigation waters. Flocculants are used to coagulate and precipitate nutrients and solids through chemical reactions. As a result, removals observed are typically greater than 80 percent of total solids (TS), 60 percent of nitrogen (N), 80 percent of phosphorous (P) and 60 percent of potassium (K). Because of the chemistry, using flocculants removes more P than either N or K while N is removed to a greater extent using separation or sedimentation techniques. Chemical precipitation has not been widely adopted for agricultural purposes in part because it requires a very dilute manure stream and require some sort of automated application. Cost of the chemicals is another inhibitor to their adoption. Solids and nutrients precipitated still need to be managed appropriately. However, as the need to move nutrients, particularly P, offsite implementation of flocculation using some of the cheaper flocculants (ie: ag lime) available may become more widespread.

The forced precipitation of struvite (the white crystalline scale on pump impellers and in pipe elbows and joints) from swine manure slurries prior to land application can reduce soluble phosphorus (SP) levels in the manure slurries, as well as offer the potential to concentrate and remove P from the system. The forced precipitation of struvite has been demonstrated to reduce the soluble phosphorus content in swine manure by as much as 90 percent in field-scale tests on commercial swine finish operations. Laboratory and field tests were conducted using magnesium to force the precipitation of struvite, which converts the soluble phosphorus in swine manure to a crystalline mineral. This mineral form of phosphorus could be less prone to move with runoff water and useful as a slow-release inorganic fertilizer. In Europe and Japan, large municipal sewage-handling facilities are recovering phosphorus as struvite using full-scale systems. While pilot scale struvite recovery systems using swine manure have

been developed, no full-scale systems are currently in use with animal manure.

Solids Separation by Screening or Sedimentation. Because most of the nitrogen and phosphorus in manure are associated with manure solids, the separation of these solids can be used as a nutrient recovery technique. When cropland is available nearby, often the liquid can be more readily applied to croplands through an irrigation system while the solids are spread on croplands or more easily exported off-farm than the wet product that precedes solid-liquid separation. Additionally the removal of manure solids prior to storage will reduce the organic loading rate of a lagoon or holding pond. Reduced loading improves organic matter digestion, maintains useful volume and designed retention times much longer before cleanout is necessary, and reduces odors in effluent.

Methods of separating or concentrating solids include evaporation, mechanical separation, and sedimentation (gravity settling) with or without flocculation. Sedimentation or settling basins and mechanical separation are both widely used. Mechanical separators are available that use static screens, vibrating screens, drag flight, drum roller and centrifugal and screw press devices to achieve solids separation in manures. It is also common to find separation units that incorporate a combination of these techniques.

The amount of solids recovered using mechanical separation is highly variable depending on the type and amount of solids in the manure to be separated. Testing with dairy manure has indicated that separation efficiencies on a dry-mass basis can range from 15 to 60 percent depending on the TS content of the influent manure using the same separator. Separation efficiency with swine manures will be considerably less than dairy manure because dairy manure contains large amounts of fiber that is easily separated. With diluted slurry (5 to 6 percent TS), approximately 60 percent of the solids will settle by gravity sedimentation with 10 minutes or greater of settling time. As solids content increases above 7 percent, removal decreases dramatically. Nutrient removals by sedimentation of a dilute stream (<2 percent TS) in a settling basin are less than that of TS removal; ranging from 15 to 45 percent of influent N and 1 to 20 percent of P with as much as 60 minutes of settling time. Sedimentation alone, is more effective than screening to remove both solids and nutrients.

Mechanical separators typically range from $12,000 to over $100,000 in cost depending on unit size and complexity. Beyond the capital investment is the maintenance and operating costs of the separators. While gravity settling requires fewer mechanical parts, periodic and frequent emptying of settling basins is needed. Costs must be weighed against the variability in removal between mechanical separators and sedimentation.

Summary. When selecting a nutrient recovery option, producers need to consider the extent of nutrient recovery needed and weigh that against not only the economics, but also the intensity of management needed to employ a strategy successfully.

In the second part of this series, we will address composting and aquaculture as options to recover manure nutrients.

Corrections

Correction to "Concrete solutions for confinement feeding operations" published in the Spring 2004 issue of ONM: The minimum concrete standards, adopted on March 24, 2004, are not required for the construction of a concrete pit or tank that is part of a small animal feeding operation (SAFO). These confinement feeding operations have an animal unit capacity of 500 animal units or less.

However, if a SAFO builds a concrete pit to replace an earthen basin or existing manure storage and handling facilities and the required separation distances from certain waters such as a wellhead, a water source or a sinkhole cannot be met, the SAFO must follow the minimum concrete standards unless secondary containment is provided. For a complete list of separated waters, see the Iowa Code Section 459.310 (http://www.legis.state.ia.us/cgi-bin/IACODE/Code2003SUPPLEMENT.pl).

The article "Implementing the phosphorus index for manure application" published in the Spring 2004 issue of ONM contained a table in which the column titles

and numbers were misaligned. The corrected table has been posted to the Web version of the article and may be found at: http://www.extension.iastate.edu/Pages/communications/EPC/Spring04/implementing.html.

DNR proposes airborne hydrogen sulfide level

by Bryan Bunton, Iowa Department of Natural Resources

The Iowa Department of Natural Resources (DNR) is proposing a rule to establish health standards for airborne levels of hydrogen sulfide gas. The proposed health effects standard for hydrogen sulfide gas is 30 parts per billion (ppb), daily maximum one-hour average, not to be exceeded more than seven times per year as measured at residences, churches, schools or other public use areas near animal feeding operations. The rule is scheduled for final adoption at the July 19 meeting of the Iowa Environmental Protection Commission. The meeting is open to the public.

The health standard is being proposed to compare against monitored levels of hydrogen sulfide gathered as part of a legislatively mandated field study that requires the DNR to measure levels of ammonia, hydrogen sulfide and odors near some of the largest animal feeding operations in Iowa. The health standard will be the "bar" used to compare against this monitoring data.

Because of the tremendous interest in this issue, the DNR recently conducted six public hearings around the state. As a result, almost 3,000 comments from livestock producers, those living in the vicinity of livestock operations, agricultural commodity groups, environmental organizations and concerned citizens were gathered. This is nearly twice the number of comments that the Environmental Protection Agency recently received on a proposed rule that applied nationwide.

Based on public comments and recommendations from the Iowa Department of Public Health, DNR staff will be proposing a level of 30 ppb over one-hour to the EPC, who then must make the final decision on the level of the standard. The DNR initially proposed a level of 15 ppb.

The Iowa Department of Public Health has identified several research articles that support the level of 30 ppb. These include a study completed in northeastern Nebraska where an association was made between visits to the hospital due to respiratory issues and exposure to ambient levels of hydrogen sulfide greater than 30 ppb measured on thirty-minute averages. In addition, a study of air pollution in Finland found an association between people reporting more incidences of headaches, depression, tiredness and nausea when exposed to levels of hydrogen sulfide greater than 28 ppb.

A proposed level of 30 ppb over one-hour is also supported by data from the state of California. The magnitude and duration of the standard are identical to the California ambient air quality standard (CAAS) for hydrogen sulfide. The CAAS standard for hydrogen sulfide has been in place since 1969. The March 1999 evaluation of the public health data by the California Office of Environmental Health Hazard Assessment underlying the standard is available at:

http://www.oehha.ca.gov/air/acute_rels/pdf/7783064A.pdf.

In addition to adjusting the proposed hydrogen sulfide level to 30 ppb, the department has proposed several other modifications to the rule that can be viewed by visiting the Air Quality Bureau's animal feeding operations Web page located at:

http://www.iowadnr.com/air/afo/afo.html.

The department also has developed a responsiveness summary that contains a written response to all public comments received. The summary explains the department's rationale and logic behind any modifications that were made to the proposed rule, or discusses why no such changes were made. The response to comments is available to the public and has been posted on the Air Quality Bureau's Web page.

Upcoming manure management field days

by Angela Rieck-Hinz, Department of Agronomy

Iowa State University (ISU) Extension is coordinating several manure management field days throughout Iowa in cooperation with local producers, watershed groups, equipment manufacturers and agency staff for summer and fall 2004.

The field days provide a good opportunity to meet with staff from ISU Extension, the Iowa Department of Natural Resources (IDNR), Natural Resources Conservation Service (NRCS), the Iowa Department of Agriculture and Land Stewardship (IDALS) and local equipment manufacturers and dealers in an informal setting to learn more about

Containment practices being simulated at a manure spill field day.

Date and Time	County	Objective	Contact	Sponsor
July 16, 2004, 9 a.m. to 12 p.m.	Plymouth and Sioux	Solids settling for feedlots (712) 546-7835	Plymouth County Extension Office Sioux County Extension Office (712) 737-4230 Registration required.	ISU Extension Iowa Beef Center NRCS IDNR
Aug. 4, 2004, 9:30 a.m. Strip Tillage Demo 1:00 p.m. Manure Application Demo	Hardin	Morning session will focus on strip tillage, afternoon session on manure application	Hardin County Extension Office (641) 648-4850	ISU Extension Zoske Farms Southfork Watershed Alliance
Aug.9, 2004, 1:30 to 3:30 p.m.	Worth	Integrated tillage and manure management demo	Mark Licht (515) 294-8039	
Aug. 24, 2004, 1to 3 p.m.	Monona	Solids settling for feedlots	Western Research and Demo Farm (712) 885-2802	ISU Extension and College of Agriculture
Aug. 26-28, 2004, 11 a.m. and 2 p.m. daily	Boone	Manure application demonstration to evaluate rate, residue and compaction	Kapil Arora (515) 382-6551	ISU Extension and Iowa Farm and Field Fest
Sept. 15, 2004, 10:30 a.m.	Washington	Manure application and nutrient management	Greg Brenneman (319) 337-2145	ISU Extension

manure application equipment, rates, regulatory compliance, compaction, residue management, water quality and solid settling for feedlots.

Some field days require registration for meals or refreshments. For more information regarding these events, including directions, please visit the Iowa Manure Management Action Group (IMMAG) Web page at http://extension.agron.iastate.edu/immag/ and click the Events button. The list on the IMMAG Web will be updated continuously throughout the year.

Manure application demonstration at field day.

Certification cards for manure applicators

by Karen Grimes, Iowa Department of Natural Resources

The Department of Natural Resources has not yet issued certificates to confinement site manure applicators, who have applied for certificates in 2004. However, if the application has been received by the DNR, the applicator is certified.

Except for a few recent applications, most commercial applicators should have received their certificates.

The remaining certificates will be issued as soon as a new database is completed. In the meantime, manure applicators are welcome to call Carol Arpy at (515) 281-6581 to check on the status of their certificates.

Changes in state law in 2003 required the DNR to create a new database to track two types of commercial applicators and educational fees that are required to cover costs of administering the program.

Has your address changed?

The ONM newsletter has been very successful in providing the most up-to-date information about manure management issues. With success comes growth, and our newsletter membership has grown to over 5,800 subscriptions.

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Congratulations, Dr. Lorimor!

Jeff Lorimor, associate professor in the Agricultural and Biosystems Department at ISU and original coordinator of this newsletter, bid farewell to ISU on June 30, 2004. The current newsletter coordinators, editors and support team would like to thank Jeff for his leadership, advice, editing and willingness to always come through with an article for the newsletter. We wish him the best of luck in his retirement.

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