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Updated ASABE Standard Manure Excretion Standard

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NEWSLETTER

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Introduction

This newsletter introduces the new ASABE (American Society of Agricultural and Biological Engineers) Standard D384.2, Manure Production and Characteristics. This new standard provides an equation-based approach that integrates animal feeding program and performance into the final estimate of total solids, nitrogen, and phosphorus excretion for seven livestock and poultry species. This article reviews the opportunity this standard provides for improving accuracy of farm-specific nutrient management planning and introduces an educational opportunity for users to be introduced to new software for using the standard.

I propose to conduct one or more workshops on the standard and supporting software tool in June. Attendance will be from your own desk via your connection to a prearranged web site and conference call. If you are interested in learning more about this training opportunity, email 1) your name, 2) email address, and 3) organization to Monte Shomaker < mshomaker2@unl.edu>.

Overview of ASAE Standard

The ASABE standard contains 8 sections. Section 1 is a tabular summary of "typical" manure excretion based upon feeding programs and performance levels characteristic for early 2000's(see table 1). As time passes, these typical values will also become dated due to industry changes. Thus, caution should be used with the typical values table in section 1 as time passes.

Sections 2 through 7 summarize the equations for estimating excretion characteristics of beef cattle, dairy cattle, horses, poultry (separate sections for meat birds and layers), and swine. At a minimum, all species groups provide equations for estimating dry matter, N and P excretion. Some species groups defined equations for estimating additional characteristics.

Section 8 of the new standard summarizes As-Removed manure characteristics. Reporting of the as-removed characteristics proved to be the most controversial component of this standard due to the wide variation that can exist in these values.

Comparing Estimates of Excretion

Tables 2 and 3 compares the new standard with average values published by USDA Natural Resources Conservation Service (NRCS) and American Society of Agricultural Engineers (ASAE) old standard. In addition, "typical" excretion values are compared with a likely range of excretions for common feeding strategies and performance levels. The following observations can be made from the comparisons made in for beef and swine:

- Previous ASAE and NRCS estimates for beef compare favorably with the new ASABE typical N excretion estimate but are less accurate in their estimates of P and TS excretion. The new ASABE typical excretion for swine are higher for N, lower level of P, and significantly different for TS excretion as compared to the old ASAE and NRCS estimates.

Table 1. Sample of tabular summary of "typical" manure characteristics for meat producing animals (Part A) and all other animals (Part B)

Part A. Characteristics are typically reported in unit mass (or volume) per finished animal.

Animal Type and Production Grouping	Total solids	Volatile solids	COD	BOD	Nitrogen	P	K	Ca	Total Manure		Moisture	Assumed Finishing Time Period (days)
	lb/ finished animal (f.a.)								lb/ f.a.	ft^3/ f.a..	% w.b.	
Beef - Finishing cattle	**780**	**640**	670	150	**55**	**7.3**	38	**17**	9,800	160	92	153
Poultry - Broiler	**2.8**	2.1	2.3	0.66	**0.12**	**0.035**	**0.068**		11	0.17	74	48
Poultry - Turkey (male)	**20**	16	19	5.2	**1.2**	**0.36**	0.57		78	1.3	74	133

Part B. Characteristics are typically reported in unit mass (or volume) per animal per day.

Animal Type and Production Grouping	Total solids	Volatile solids	COD	BOD	Nitrogen	P	K	Ca	Mg	Total Manure		Moisture
	lb/ day-animal (d-a)									lb/ d-a.	ft^3/ d-a.	% w.b.
Beef - Cow (confinement)	**15**	**13**	14	3.0	**0.42**	**0.097**	0.30	**0.20**		-	-	88
Dairy - Lactating cow	**20**	17	18	2.9	**0.99**	**0.17**	**0.23**			150	2.4	87
Dairy - Dry cow	**11**	9.2	9.7	1.4	**0.50**	**0.066**	0.33			83	1.3	87

Bold values are based on species-specific equations.

VS, COD, and BOD were calculated from TS using relationships from past ASAE and SCS (1992) standards

Non-bold K and moisture content values are based upon past ASAE standard, SCS (1992), and other relevant literature.

Total manure is based upon equation estimate of total solids divided by 1 minus moisture content.

- Using the new ASABE "typical" excretion estimates can produce significant error for individual farms (Rows D - I) where feed ration and performance will vary. The new ASABE "typical" estimate for beef can be from 10% high to 50% low for N excretion, 33% high to 80% low for P, 20% high to 40% low for TS excretion. Similarly, a typical value for swine may be from 45% high to 17% low for N excretion, 40% high to 17% low for P, 160% high to 10% low for TS excretion.
- Table 3 illustrates the importance of a standard that responds to emerging environmentally friendly feeding strategies (Rows E – J). Diets based on use of crystalline amino acids and phytase (or low-phytate corn) have the potential for lower dietary CP and P levels and N and P excretion. A low CP diet would produce N excretion levels up to 40% less than new standard typical value (Row E). Low P diets would reduce P excretions levels by 33 to 40% from new typical values (Row E). Higher digestibility diets such as diets based upon degermed and dehulled corn from a dry milling process will produce less manure.

These summaries presented in Table 2 and 3 suggest that some adjustments in average or typical estimates of excretion resulted from the new standard. However, the biggest potential errors result from assuming that all animal feeding operations are the same. *In many situations, using a typical or average estimate of excretion (old or new values) has the potential to include significant error when applied to individual farm nutrient management plans.*

Table 2. Comparison of beef cattle excretion (kg/finished animal) based upon New ASAE standard for typical industry feed nutrient concentrations and feed efficiencies. Table also illustrates estimated excretion for other current and past excretion estimating standards.

Source	Dry Matter Intake (lb)	Feed Crude Protein	Feed P	Dry Matter Digestibility	Feed Efficiency (feed/gain) and Days to Finish	Excretion (lb/finished animal)		
						N	P	TS
Typical or Average Excretion								
A. New ASABE	20	13.3%	0.31%	80%	6.3 / 153	55	7.1	770
B. Old ASAE	--	--	--	--	--	51	13.7	1280
C. NRCS	--	--	--	--	--	44	14.1	880
Changes in feed characteristics while all other assumptions remain constant								
D. New ASABE	20	12.5%	0.25%	80%	6.3 / 153	51	5.3	770
E. New ASABE	20	18.7%	0.50%	80%	6.3 / 153	82	12.8	770
F. New ASABE	20	--	--	85%	6.3 / 153	--	--	640
G. New ASABE	20	--	--	70%	6.3 / 153	--	--	1080
Changes in feed efficiency while all other assumptions remain constant[1]								
H. New ASABE	20	13.3%	0.31%	80%	5.69 / 138	51	6.4	730
I. New ASABE	20	13.3%	0.31%	80%	6.95 / 168	60	7.9	840

1. All assumptions are held constant with exception of days to finish. High and low feed efficiency scenarios assume feeding period of 138 and 168 days to market weight, respectively.

Caution – In practice, a change in one feed characteristic may impact performance or other diet characteristics. This table may not always reflect those impacts.

Table 3. Comparison of grow-finish swine excretion (kg/finished animal) based upon New ASAE standard for typical industry feed nutrient concentrations and feed efficiencies. Table also illustrates estimated excretion for other current and past excretion estimating standards.

Source	Dry Matter Intake (lb)	Feed Crude Protein	Feed P	Dry Matter Digestibility	Feed Efficiency (feed/ gain) and Days to Finish	Excretion (lb/finished animal)		
						N	P	TS
Typical or Average Excretion								
A. New ASABE	5.25	15.6%	0.43%	82%	2.86 / 120	10.4	1.7	137
B. Old ASAE	--	--	--	--	--	9.7	3.3	203
C. NRCS	--	--	--	--	--	7.7	3.0	117
Low CP and P diets while all other assumptions remain constant								
D. New ASABE	5.25	11.5%	0.33%	82%	2.86 / 120	6.4	1.0	137
Changes in feed efficiency while all other assumptions remain constant								
E. New ASABE	5.25	15.6%	0.43%	82%	2.57 / 108	8.8	1.4	123
F. New ASABE	5.25	15.6%	0.43%	82%	3.14 / 132	12.1	2.0	150
Changes in feed dry matter digestibility while all other assumptions remain constant								
G. New ASABE	5.25	--	--	80% (high fiber diet)	2.86 / 120	--	--	150
H. New ASABE	5.25	--	--	84% (low fiber diet)	2.86 / 120	--	--	123
I. New ASABE	5.25	--	--	95% (dry milled corn[1])	2.86 / 120 [1]	--	--	53

1. Degermed, dehulled corn from corn dry milling processes. Increasing digestibility should reduce number of days to finish further reducing total solids excretion estimated on a finished animal basis.

Caution – In practice, a change in one feed characteristic may impact performance or other diet characteristics. This table may not always reflect those impacts.

Applications of New ASAE Standard

The most immediate application of the ASAE equations for nutrient and solids excretion is for long-term or strategic planning procedures that use estimates of total manure volume and mass of manure nutrients. Such estimates that are commonly made by livestock and poultry farms during a permit process, when a facility is new or expanding or when a farm is assembling a proposal for cost share funding. For shorter-term annual or tactical planning procedures such as land application rates, on-farm data such as manure samples will likely be of greater value.

Improvements in nutrient and total solids excretion estimates offered by the new equations should improve the accuracy of farm-specific planning in the following areas:

- *Land requirements for managing N and P*.
- *Cost of manure application*.
- *Ammonia emissions*.
- *Solids and volume estimates.*

Accessing This Standard

Using the proposed ASAE equations will complicate the process of estimating nutrient and solid excretion. Software tools based upon these equations provides one option for improving the utility of equations. A spreadsheet tool with instructions for these estimates can be found at http://cnmp.unl.edu/cnmpsoftware2.html.