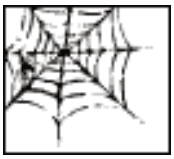
Archived Publication

This information provided in this document is for reference. Please be aware that the information in this document may be outdated or superseded by additional information.



EPA promulgated regulations for Concentrated Animal Feeding Operations (CAFOs) in February 12, 2003 that expanded the number of operations covered by the CAFO regulations and included requirements to address the land application of manure from CAFOs. The rule became effective on April 14, 2003. NPDES-authorized states were required to modify their programs by February 2005 and develop state technical standards for nutrient management. On February 28, 2005, in response to litigation brought by various organizations, the Second Circuit court issued its decision in *Waterkeeper Alliance et al. v. EPA*, 399 F.3d 486 (2d Cir. 2005). EPA has updated the CAFO rule to reflect the changes requested by the Court. Visit www.epa.gov/npdes/caforule to view the 2008 CAFO Final Rule and supporting documents.

APPENDIX D - MEASURING THE AMOUNT OF ANIMAL WASTE

Determining the amount of animal waste produced and collected at your farm is essential to successful nutrient management. You can estimate the amount of animal waste that is available for land application based on the quantity of animal waste collected at cleaning time or by calculating your volume in storage. Include animal waste from all sources (e.g., scraped barns, drylots, lagoons, animal waste pits, solid separators, calf huts) in your calculation.

Description

Estimating the total amount of animal waste in storage is a primary element to determine the amount of nutrients you have available, and by extension, the total number of acres that can be fertilized at your calibration rate (see Appendix J). To determine your total amount of animal waste, you will need to estimate the volume of animal waste in each pile or container. This procedure is described below.

Instructions for Calculating Animal Waste in Above-Ground Piles

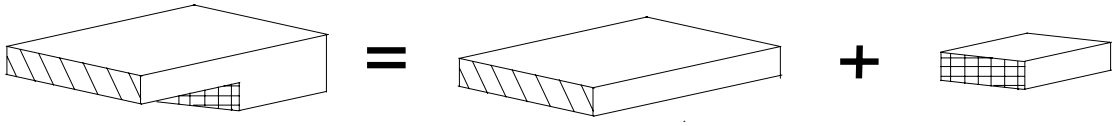
The volume of your animal waste pile can be calculated by transforming the pile's shape into a common geometric shape, such as a cube or a pyramid. To calculate volume, all you will need to know is the formula for the simple shape (see the common volume equations at the end of this appendix) and the dimensions of your pile. For example, if you store your animal waste in a rectangular box, then the formula to use is:

Volume = Length * Width * Height

Next, you will need to measure the box's length, width, and height (also called depth) and plug these numbers into the volume equation. Make sure your measurement units for all dimensions (i.e., sides) are consistent. For example, when measuring sides of your container, make sure you consistently measure in feet, yards, meters, etc.

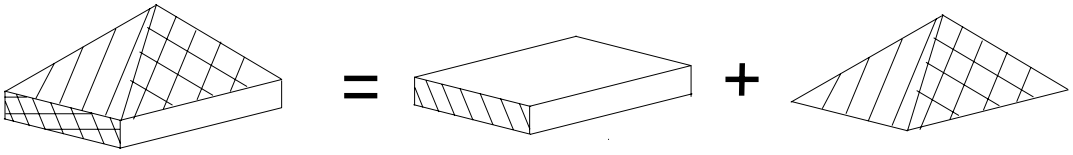
Your animal waste pile will most likely be a complex shape for which a volume formula is not readily available; therefore, you cannot use a simple formula to calculate your amount of animal waste. Instead, contour and break down the complex pile shape into an imaginary group of simple shapes (e.g., cones, rectangular boxes). The volume of each simple shape can then be computed by adding the volumes of all of the simple shapes (see the common volume equations at the end of this appendix). Make sure your measurement units for all simple shapes are consistent. Two examples of how to simplify a complex shape are provided below.

In Example 1, an animal waste container with an annex becomes two rectangular prisms, each with different heights, lengths, and widths. Each volume is calculated separately (length * width * height), and then added together to get a total volume.



Example 1

In Example 2, a heaped load on a wagon becomes a rectangular prism and a rectangular pyramid, with the top of the rectangular prism in common with the bottom of the pyramid. Each volume is calculated separately (see volume equations at the end of this appendix), and then added together to get a total volume.



Example 2

When prism ends do not form a perfect shape, or where the dimension is not uniform along the end, take an average for the dimension when calculating volumes. Sometimes it is necessary to imagine moving animal waste around to form a measurable shape. Although this decreases the accuracy of the volume calculation, it makes it easier to compute the volume.

You will probably need to convert your estimated volume of animal waste (in cubic feet or gallons) to units that match your animal waste application rates (in gallons or tons per acre). Converting animal waste volume to weight requires you to know the bulk density of the animal waste, which you can determine by weighing a unit volume of animal waste and dividing the weight by the volume (see Appendix J for more details on determining the bulk density of your animal waste).

Using Example 1 above, you measure your container and find one section of its inside dimensions to be 12 feet long, 5 feet wide, and 1 feet deep, while the other section is 3 feet long, 5 feet wide, and 0.5 feet deep. The total volume is:

$$\text{Volume (ft}^3\text{)} = [(12\text{ ft}) \times (5\text{ ft}) \times (1\text{ ft})] + [(3\text{ ft}) \times (5\text{ ft}) \times (0.5\text{ ft})] = 67.5\text{ ft}^3$$

Next, determine the bulk density of your animal waste. If your 5-gallon bucket (which has a volume of 2/3 cubic foot) weighs 5 pounds empty and 37 pounds filled, your density is:

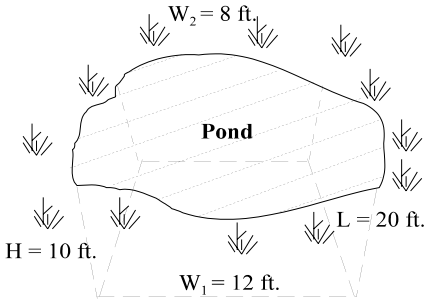
$$\text{Density} = (37\text{ lb} - 5\text{ lb}) / (2/3\text{ ft}^3) = 48\text{ lb/ft}^3$$

Therefore, your total animal waste in tons is:

$$\text{Total Animal Waste (tons)} = (67.5\text{ ft}^3 \times 48\text{ lb/ft}^3)/(2{,}000\text{ lbs/ton}) = 1.62\text{ tons}$$

Instructions for Calculating Liquid Animal Waste

Ponds, basins, and pits can be considered inverted piles, and you can therefore use the same techniques to estimate volume in above-ground piles. You can also compute the volume using the dimensions of your basin or by estimating the amount of animal waste removed after emptying your basin. The following example shows how to calculate volume in a basin, assuming the basin is a trapezoidal prism:



Volume = (H x [W_1 + W_2]/2) x L

Volume = (10 x 20/2) x 20 = 100 x 20 = 2,000 ft^3

If you store your animal waste in a constructed tank, use the dimensions of the tank to calculate volume. If the tank is not full, you will need to estimate your "new" height for the tank, that is, how high waste comes to in the tank. Use this new height in your volume calculation.

References

Cooperative Extension Service, University of Maryland System, Agricultural Engineering Department.

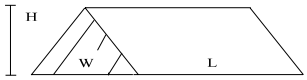
Manure Management. Outreach & Extension, University of Missouri/Lincoln University.

Who To Contact For More Information

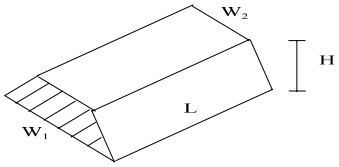
Your Local Cooperative Cooperative Extension Office
Your Local Land Grant University
National Water Management Center/Natural Resources Conservation Service (USDA)

Common Equations for Calculating Volume

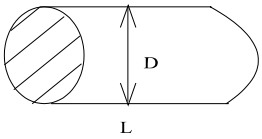
W = Width H = Height L = Length D = Diameter



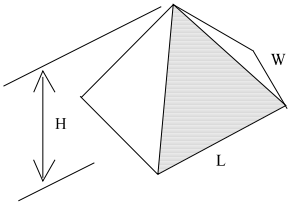
Triangular Prism = (W * H) ÷ 2 * L



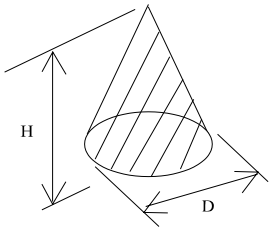
Trapezoid Prism = (H * [W_1 + W_2] ÷ 2) * L



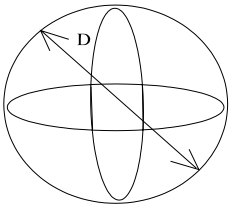
Circular Prism = 0.785 * D^2 * L



Pyramid = W * L * H ÷ 3



Cone = 0.785 x D^2 * H ÷ 3



Sphere = 0.524 * D^3