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Worksheet to Calculate Manure Spreader Capacities

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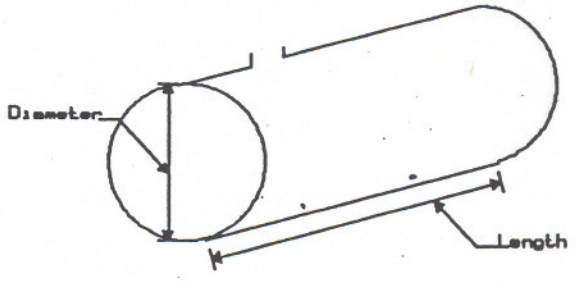
I. For Liquid Tank Type Manure Spreaders

The capacity of liquid manure tanks (in gallons) provided by the manufacturer in the Operator's Manual can be used. If this information is not available, the volume can be calculated by using either of the following methods. First, if you have access to a scale, simply weigh the liquid tank wagon and tractor when the tank is full and when it is empty. Subtract the empty weight from the full weight to get the weight of the liquid manure in the tank. Make sure the fuel level in the tractor is not significantly different. Then divide the weight of the manure in pounds by 8.3 lb/gallon to get the volume in gallons.

You can also determine the size of your tank by measuring it and calculating its volume. Assuming the tank is round, this can be done by measuring the "diameter" and "length" of the tank (in feet), as shown in the diagram. Then divide the diameter by 2, square the result, multiply by π ($\pi = 3.14$), multiply by the length, and finally, multiply by 7.5 gal/ft^3 to convert from cubic feet to gallons, i.e.,



$$\left[\frac{Diameter}{2}\right]^2 \times 3.14 \times Length \times (7.5\ gal/ft^3) = volume\ in\ gallons$$

$$\left[\frac{\_\_\_\_\ ft}{2}\right]^2 \times 3.14 \times \_\_\_\_\ ft \times (7.5\ gal/ft^3) = \_\_\_\_\_\ gallons$$

For Example:

$$\left[\frac{6\ ft}{2}\right]^2 \times 3.14 \times 16\ ft \times (7.5\ gal/ft^3) = 3{,}400\ gallons$$

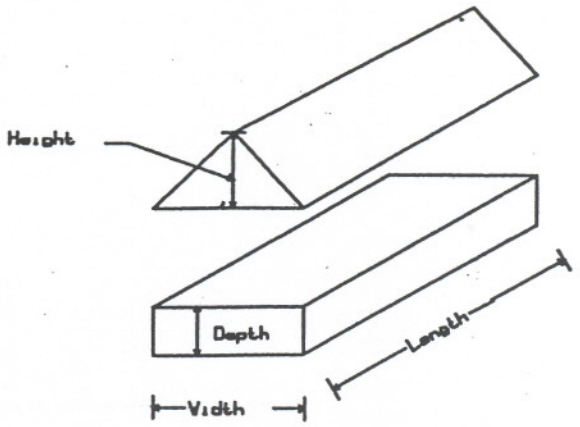
II. For Box Type Manure Spreaders

As with tank wagons, the easiest way to determine the weight of manure in a box spreader is by weighing the spreader full and empty. If you have access to a scale, simply weigh the tractor and spreader when the spreader is full and when it is empty. Subtract the empty weight from the full weight to get the weight of the manure in the spreader. Make sure the fuel level in the tractor is not significantly different. Then divide the weight of manure in pounds by 2,000 lb/ton to get the weight of manure in tons per spreader load.

The weight of manure in one spreader load can also be estimated by determining the volume of the box spreader and measuring the manure density. Spreader volume information is often provided by the manufacturer in the Operator's Manual, and is usually listed as either an ASAE Heaped Capacity volume or as an ASAE Struck Level volume. If your spreader loads are filled above the level of the box, you should use the heaped capacity value. Heaped capacity values are generally reported for various beater and extension configurations. Therefore, choose the heaped capacity value for the spreader model and beater configuration you have.

If the capacity information from the manufacturer is not available, the following procedure can be used to estimate the "heaped capacity volume" for your box spreader.

1) Measure the "depth," "width," and "length" of the box, as shown in the diagram. Record these measurements in the chart below.



2) Load the spreader with manure to the level you normally fill it. Measure the average "height" of the manure from the top of the box to the top of the manure, as shown in the diagram. Record this height in the chart. Add the depth and height together to get the total "manure height", i.e.,

Depth + Height = Manure Height

		For Example:
Width:	_____ feet	5 feet
Length:	_____ feet	16 feet
Depth:	_____ feet	2 feet
Height:	_____ feet	2.6 feet
Manure Height:	_____ feet	4.6 feet

3) The "heaped capacity volume" of the spreader can now be calculated by multiplying the manure height times the width and length of the spreader box times 0.8, using the following equation:

Manure Height (ft) x Width (ft) x Length (ft) x 0.8 = volume (ft^3)

_____ ft x _____ ft x _____ ft x 0.8 = _____ ft^3

For Example:

4.6 ft x 5 ft x 16 ft x 0.8 = 290 ft^3

(4) Next, the volume of the manure spreader must be converted to the number of wet tons of manure per spreader load. To do this, the density of the manure in the spreader is needed. Knowing the density of your manure is critical to estimating the weight of manure in one spreader load. Usually, the density can be assumed to be about 60 lb/ft^3 unless it contains significant quantities of bedding, which can reduce the density to as low as 35-40 lb/ft^3.

Therefore, if your manure has a lot of bedding in it, we recommend you measure your manure density. To estimate the manure density, you need a container of known volume, such as a 5 gallon bucket, and then do the following:

a) Weigh the empty 5 gallon bucket and record the weight in the equation below.

b) Fill the bucket level full with manure, packing the manure to the same density as the manure loaded into the spreader. To get the density of manure in the bucket to be the same as in the spreader will be more difficult as the amount of bedding in the manure increases, but do the best you can to make them the same.

c) Weigh the full bucket and record the weight in the equation below. Then subtract the empty weight from the full weight, as shown.

wt. of full bucket (lb) - wt. of empty bucket (lb) = wt. of 5 gal. of manure

wt. full _____ lb - wt. empty _____ lb = _____ lb

For Example:
wt. full 35 lb - wt. empty 2 lb = 33 lb

(5) Repeat step (4) until you have at least six manure weights and record these weights in the following chart. Add the six weights to get the total weight.

		For Example:	
weight 1	_____ lb	weight 1	33 lb
weight 2	_____ lb	weight 2	36 lb
weight 3	_____ lb	weight 3	32 lb
weight 4	_____ lb	weight 4	34 lb
weight 5	_____ lb	weight 5	36 lb
weight 6	_____ lb	weight 6	33 lb
Total	_____ lb	Total	204 lb

Calculate the average weight for the 5 gallons of manure by dividing the total weight of the six weighings by six:

Total _____ *lb* ÷ 6 = *average wt.* _____ *lb of 5 gal. of manure*

For Example:
Total 204 lb ÷ 6 = average wt. 34 lb of 5 gal. of manure

(6) Calculate the density of the manure by dividing the average weight of manure from step (5) by 5 gal and multiply the result by 7.5 gal/ft^3 to convert from gal to ft^3.

$$\frac{\text{avg. wt. of manure (lb)}}{\text{5 gal}} \times 7.5\ \text{gal/ft}^3 = \text{density (lb/ft}^3\text{) of manure}$$

_____ lb/5 gal x 7.5 gal/ft^3 = _____ lb/ft^3

For Example:
34 lb/5 gal x 7.5 gal/ft^3 = 51 lb/ft^3

(7) Calculate the weight of one spreader load of manure by multiplying the "heaped capacity volume" from the Operator's Manual or from step (3) times the default density of manure (i.e., 60 lb/ft^3) or the density calculated in step (6), and divide the result by 2000 to convert from pounds to tons.

heaped capacity volume (ft^3) x *density of manure (lb/ft^3)* ÷ *2000 lb/ton* = *tons of manure in one spreader load*

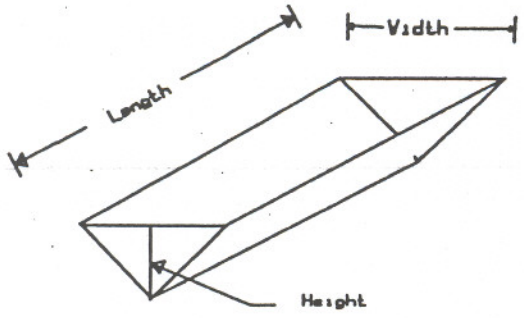
_____ ft^3 x _____ lb/ft^3 ÷ 2000 lb/ton = _____ tons of manure in one spreader load

For Example:
290 ft^3 x 51 lb/ft^3 ÷ 2000 lb/ton = 7.4 tons of manure in one spreader load

III. For Side Slinger Type Manure Spreaders

As with box spreaders, if you have access to a scale, simply weigh the tractor and spreader when the spreader is full and when it is empty. Subtract the empty weight from the full weight to get the weight of the manure in the spreader. Make sure the fuel level in the tractor is not significantly different. Then divide the weight in pounds by 2,000 lb/ton to get the weight of manure in tons per spreader load.

The weight of manure in one spreader load can also be determined by estimating the volume of the side slinger spreader and measuring the manure density. If the capacity in cubic feet (ft^3) is provided by the manufacturer in the Operator's Manual, use that value . If capacity information is not available, the following procedure can be used (assuming the spreader is roughly triangular in shape) to estimate the volume of the spreader.



(1) Measure the length, width, and depth of the spreader, as shown in the diagram. Record the measurements in the chart below.

		For Example:
Depth:	_____ feet	6 feet
Width:	_____ feet	7 feet
Length:	_____ feet	16 feet

(2) Calculate the volume of the manure spreader by multiplying ½ times the depth times the width times the length of the spreader box, using the following equation:

½ x Depth (ft) x Width (ft) x Length (ft) = Spreader Volume (ft^3)

½ x _____ ft x _____ ft x _____ ft = _____ ft^3

For Example:
½ x 6 ft x 7 ft x 16 ft = 340 ft^3

(3) Next, the volume of the manure spreader must be converted to the number of wet tons of manure per spreader load. To do this, the density of the manure in the spreader is needed for this conversion. As with box type spreaders, the default manure density (i.e., 60 lb/ft^3) can be used, but if your manure has a lot of bedding in it, then you should measure its density as was shown in Section II, steps 4-6 above.

(4) Calculate the weight of one spreader load of manure by multiplying the total spreader volume from the Operator's Manual or from step (2) times the density of manure, and divide the result by 2000 to convert from pounds to tons, as shown in the following equation.

total spreader volume (ft^3) x density of manure (lb/ft^3) ÷ 2000 lb/ton = tons of manure in one spreader load

_____ ft^3 x _____ lb/ft^3 ÷ 2000 lb/ton = _____ tons of manure in one spreader load

For Example:

340 ft^3 x 51 lb/ft^3 ÷ 2000 lb/ton = 8.7 tons of manure in one spreader load

Once you have determined the gallons of manure delivered by each liquid tank spreader, or the wet tons of manure contained by each load of a box type or side slinger type spreader, refer to Bulletin MM-5 for additional guidance on determining rates of manure application. By recording the number of loads of manure applied to a known area of land, the total quantity of manure applied can be calculated using the gallons or wet tons per load. If the manure has been applied uniformly, the rate per acre can then be calculated by dividing the total amount of manure applied by the number of acres covered by the manure.

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