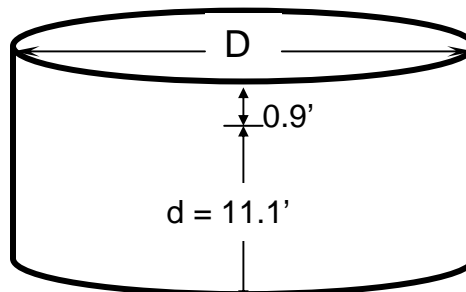


Supplement 8 Manure Storage Volume Calculations

1. To determine the volume in a circular storage facility, use the equation for the volume of a cylinder:

$$V = d \cdot (3.14 \cdot D^2 / 4)$$

Where d = useable depth of tank
D = tank diameter



Example:

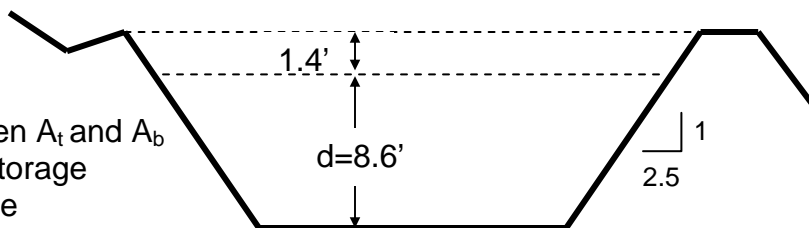
A storage tank is 92 feet in diameter and 12 feet deep. It is located in a county where the 25-year, 24-hour rainfall is 5 inches. The freeboard requirement is another 6 inches. The useable depth is therefore 11.1 feet to provide for the 5 inch storm and the freeboard. What is its useable volume at the 11.1 foot depth?

$$V = 11.1' \cdot (3.14 \cdot 92^2 / 4) = 73,751 \text{ ft}^3$$

2. To determine the volume in a storage facility with sloping sides, use the equation for prismatic volume:

$$V = (d/3) \cdot (A_t + A_b + (A_t \cdot A_b)^{0.5})$$

Where d = useable depth between A_t and A_b
 A_t = Useable area at top of storage
 A_b = Area at bottom of storage



Example with known bottom dimensions:

A storage pond is 10 feet deep. The bottom dimensions are 60' x 80'. The side slopes are 2.5:1. The top foot of storage is reserved for freeboard, and another 5 inches for the 25-year, 24-hour rainfall in that county. How much useable storage volume is available?

You first need to find the useable top dimensions:

$$d = 10 - (1 + (5/12)) = 8.6' \text{ useable depth below freeboard \& 25-yr, 24-hr storm}$$

$$A_t = (60 + (2 \times 2.5 \times 8.6)) \times (80 + (2 \times 2.5 \times 8.6)) = 103 \times 123 = 12,669 \text{ ft}^2$$

$$A_b = 60 \times 80 = 4800 \text{ ft}^2$$

$$V = (8.6 / 3) \cdot (12669 + 4800 + (12669 \cdot 4800)^{0.5})$$

$$V = 2.9 \cdot (12669 + 4800 + 7798)$$

$$V = 73,274 \text{ ft}^3$$

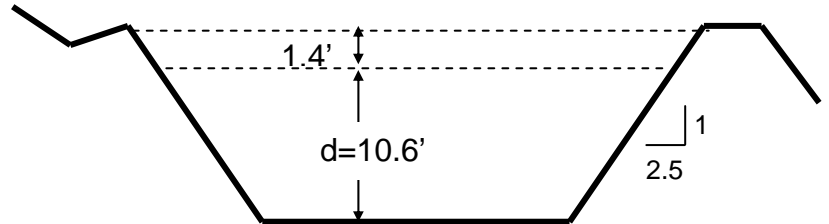
Example with known top dimensions:

A storage pond is 12 feet deep. The top dimensions are 120' x 130'. The side slopes are 2.5:1. The top foot of storage is reserved for freeboard, and another 5 inches for the 25-year, 24-hour rainfall in that county. How much useable storage volume is available?

Use the same equation for prismatic volume:

$$V = (d/3) \cdot (A_t + A_b + (A_t \cdot A_b)^{0.5})$$

You need to find the useable depth, the useable top dimensions, and the bottom dimensions:



$$d = 12 - (1 + (5/12)) = 10.6' \text{ useable depth below freeboard \& 25-yr, 24-hr storm}$$

The useable top dimensions are found $12 - 10.6 = 1.4'$ below the measured top:
 $A_t = (120 - (2 \times 2.5 \times 1.4)) \times (130 - (2 \times 2.5 \times 1.4)) = 13,899 \text{ ft}^2$ useable top

$$A_b = (120 - (2 \times 2.5 \times 12)) \times (130 - (2 \times 2.5 \times 12)) = 60 \times 70 = 4200 \text{ ft}^2$$

$$V = (10.6 / 3) \cdot (13899 + 4200 + (13899 \cdot 4200)^{0.5})$$

$$V = 3.5 \cdot (13899 + 4200 + 7640)$$

$$V = 90,087 \text{ ft}^3$$

T. Murphy & W.H. Latshaw
 Revised September 2008