POWTS Treatment Tank Capacity Determinations

The amount of scum and sludge that accumulates in septic tanks is based on studies by Weibel, Bendixen and Coulter for the U.S. Public Health Service (1955), Winneberger (1977), Schmidt (1976), and Bounds (1988). Their research concluded the rate of scum accumulation equals 5.24 gallons per person per year plus 12.04 gallons per person. However, approx. 1/3 of the scum is above the liquid level, so we adjusted calculations for determining the amount of scum in three years for that portion below the liquid level. The research, also conclude the rate of sludge accumulation equals 8.15 gallons per person per year plus 38.82 gallons per person.

Using this information, the following formula can be developed to determine the minimum tank size required for tanks serving residential buildings. The formula is:

Minimum tank volume = the sum of the daily wastewater flow + variable scum and sludge accumulation per person + constant portion of scum and sludge volume/person

Or: Minimum tank volume = (# of people x 75 gallons/person) + (# of people x 11.61 gallons/year/person) + (# of people x 46.77 gallons)

This formula can be used to size any tank for a known or selected maintenance cycle by substituting the selected maintenance cycle in years or fraction of years into the formula. Regardless of the maintenance cycle the tank must be larger than the sum of the daily wastewater flow + constant portion of the scum and sludge accumulation.

Example:

Number of people = 6 (Remember 2 people per bedroom)
Maintenance cycle = 3 years (typical maintenance cycle based on Wisconsin Fund Program)

Tank Volume = (6 people x 75 gal/person) + (6 people x 11.61 gallons/year/person x 3 years) + (6 people x 46.77 gallons/person)
= 450 gallons + 208.98 gallons + 280.62 gallons
= 939.6 gallons

To determine the maintenance cycle for a given size tank serving a known number of people, you can use the following formula:

Maintenance cycle = {tank volume – [(# of people x 75 gallons/day/person) + (# of people x 46.77 gallons/person)]} ÷ (# of people x 11.61 gallons/person/year ÷ 365 days/year)

Example:

Tank volume = 1200 gallons
Number of people = 6

Maintenance cycle = {1200 gallons – [(6 people x 75 gal/person) + (6 people x 46.77 gal/person)]} ÷ (6 people x 11.61 gal/person/year ÷ 365 days/year)
= {1200 gallons – [450 gallons + 280.62 gallons]} ÷ 0.191 gal/day
= {1200 gallons – 730.62 gallons} ÷ 0.191 gal/day
= 469.38 gallons ÷ 0.191 gal/day
= 2457.5 days or 6 years, 8 months, 3 weeks and 1 day

Residential Tank Sizing based on 3 yr. maintenance cycle can be determined using the following formula.

Minimum tank volume = (number of bedrooms x 150 gallons/bedroom) + (variable portion of scum and sludge volume/person/year x 2 people/bedroom x number of bedrooms x 3 years) + (constant portion of scum and sludge volume/person x 2 people/bedroom x number of bedrooms)

The variable portion of scum and sludge volume/person/year = 11.61 gallons

The constant portion of scum and sludge volume/person/year = 46.77 gallons

Therefore the formula is:

Minimum tank volume = (# of bedroom x 150 gallons/bedroom) +
(11.61 gallons/person/year x 2 people/bedroomx # of bedrooms x 3 years) +
(46.77 gallons/person x 2 people/bedroom x # of bedrooms)

Example:

3 bedroom home

Tank volume = (3 x 150) + (11.61 x 2 x 3 x 3) + (46.77 x 2 x 3)

= 450 + 209.98 + 280.62

= 940.6 or 941 gallons

Commercial or Public Tank Sizing based on 3 yr maintenance cycle for commercial and public buildings having a wastewater contaminant load equal to individual residences can be determined using the following formula.

Minimum tank volume = DWF + (variable portion of scum and sludge volume/person/year x flow from the number of equivalent people x 3 years) + (constant portion of scum and sludge volume/person x number of equivalent people)

DWF = Design wastewater flow based on 150% of the estimated wastewater flow

The variable portion of scum and sludge volume/person/year = 11.61 gallons

The number of equivalent people = DWF gpd ÷ 150 gal/day/bedroom x 2 people/bedroom or

= DWF ÷ 75

Therefore the formula is:

Minimum tank volume = DWF + (11.61 gallons/person/year x DWF ÷ 75 gallons/day x 3 years) + (46.77 gallons x DWF ÷ 75 gallons/day)

Example: DWF = 400 gpd

Tank volume = 400 + [11.61 x 400 ÷ 75 x 3) + (46.77 x 400 ÷ 75)

= 400 + 185.76 + 249.44

= 835.2 or 835 gallons

Maintenance cycle based on Tank Size and DWF for Residential buildings can be determined using the following formula.

Maintenance cycle = {tank volume – [daily wastewater flow rate + (constant portion of scum and sludge x 2 people x number of bedrooms)]} ÷ (variable portion of scum and sludge x 2 people x number of bedrooms.)

Example:

Tank with a volume of 1200 gallons serving a 4 bedroom home

Maintenance cycle = {1200 – [600 DWF + (46.77 gallons x 2 people/bedroom x 4 bedrooms)]}
÷ (11.61 gallons/person/year x 2 people/bedroom x 4 bedrooms)

= {1200 – [600 + 374.16]} ÷ 92.88

= {1200 – 974.16} ÷ 92.88

= 225.84 ÷ 92.88

= 2.43 years or 29 months

Maintenance cycle based on Tank Size and DWF for Commercial or Public Buildings having a wastewater contaminant load equal to individual residences can be determined using the following formula.

Maintenance cycle = tank volume – (daily wastewater flow rate + constant portion of scum and sludge volume/person x number of equivalent people) ÷ (variable portion of scum and sludge/person x number of equivalent people x equivalent number of people)

Note: The number of equivalent people equals DWF ÷ 75 gallons/day/person

Example:

Tank with a volume of 1000 gallons serving a public building with a 400 DWF

Maintenance cycle = {1000 – [400 DWF + (46.77 gallons x DWF ÷ 75 gallons/day/person)]} ÷
[11.61 gallons/person/year x (DWF ÷ 75 gallons/day/person)]

= {1000 – [400 + (46.77 x 400 ÷ 75)]} ÷ [11.61 x (400 ÷ 75)]

= {1000 – [400 + 249.44]} ÷ [11.61 x 5.33]

= {1000 – 649.44} ÷ 61.88

= 350.56 ÷ 61.88

= 5.67 years or 68 months