Problem of the Day
2014.Sept.28

Discussion

Anaerobic digestion has been around for a long time. It kind of fell out of favor, approximately, in the 70s and 80s primarily because we didn't fully understand all that was going on inside them. Today, anaerobic digesters are becoming widely used because, as the cost of energy goes up, the value of the methane produced during anaerobic digestion goes up and up and up.

The volatile solids reduction through digesters is an important calculation. It is calculated as follows:

$$\textbf{V}\text{olatile }\textbf{S}\text{olids }\textbf{R}\text{eduction (\%)} = \frac{(.VS_{in} - .VS_{out})}{.VS_{in} - (.VS_{in} \times .VS_{out})} \Big| 100$$

$.VS_{in}$ = the decimal percent of the influent volatile solids concentration
$.VS_{out}$ = the decimal percent of the effluent volatile solids concentration

As can be seen, the VS must be expressed as a **decimal** for this equation "to work." There are other equations to calculate the VSR, but this is the equation used on State of California Operator Certification Exams.

The VSR calculation is extremely important. The primary process objective of digestion—anaerobic or aerobic—is volatile solids destruction (same as "reduction"). Not only is it a key operational performance metric (VSR typically ranges from 50 - 60%), but it is imperative that the VSR be calculated whenever doing any calculations about gas and/or energy production.

Problem of the Day: Seventy-six thousand pounds of total solids are fed to the digesters at the Cedar Bend WWTP per day. These solids average 75.6% volatile. The digested sludge, prior to dewatering, averages 56.3% volatile solids. What is the percent volatile solids reduction?

Solution

The VSR calculation is very straightforward, but WWTT stresses three important points about making this calculation:

1. The volatile solids percent in the influent and effluent (in and out) of the digester must be expressed as a decimal (for this problem, 0.756 and 0.563, respectively).
2. Practice doing this calculation, **correctly**, on the calculator you will take to any State of California Certification Exam.
3. This equation is sensitive to rounding during the calculation so no rounding until the final answer is calculated.

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$$\left|\text{Volatile Solids Reduction (\%)}\right| = \left|\frac{(0.756 - 0.563)}{0.756 - (0.756 \times 0.563)}\right| \left|100\right|$$

= 58.4%.

What does the VSR mean?

To appreciate the physical meaning of the VSR and to facilitate problem solving when using the VSR, it is very helpful to express it as:

$$58.4\%\ \text{VSR} = \frac{58.4\ \text{lb VS}_{\text{destroyed}}}{100\ \text{lb VS}_{\text{applied}}}$$

We will visit the VSR again in a future Problems of the Day.