Problem of the Day

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The combined primary and waste activated sludge pumped to an anaerobic digester has a volatile solids content of 73.8%. The digested sludge in the sludge holding tank upstream of the belt filter press has a volatile content of 52.9%. Calculate the volatile solids reduction in the digester.

Introduction

The VSR is a very important calculation whether you're operating anaerobic or aerobic digesters. For example, the "503 Regs," which regulate biosolids disposal, require a VSR in the plant's digesters of at least 38% for biosolids that are land applied, Class A or Class B. I worked with one operator who ran such a high SRT in his oxidation ditch (greater than 60 days!) that he was unable to meet this 38%-VSR requirement through his aerobic digester: The WAS was substantially digested before even getting to the digester! Also, for any certification exam problem that has anything to do with anaerobic digester gas, the VSR will have to be calculated.

The VSR calculation is simple enough when looking at the equation:

$$\text{VSR, \%} = \frac{(.VS_{in} - .VS_{out}) \times 100}{.VS_{in} - (.VS_{in} \times .VS_{out})}$$

where $.VS_{in}$ is the **decimal** percent of the incoming sludge and $.VS_{out}$ is the **decimal** percent of the digested sludge. VSR is always reported as a percent.

At least in California, the calculators allowed into certification exams don't like this equation very much. As a result, examinees tend to do the calculation in the numerator and write down the number, then do the calculation in the denominator and write down the number, and then divide the numerator by the denominator. This is an okay strategy, but not one that WWTT recommends. The reason: every time you write a number down from the display of your calculator and every time you punch in a number from the page into your calculator, you risk transposing numbers, especially under the pressure of a certification exam. Be careful. WWTT always emphasizes the following when calculating the VSR with this equation:

1. The volatile solids percentages must be expressed as decimals
2. Do not round any numbers as you work through this calculation until the end; the calculation is sensitive to rounding
3. Practice, practice, practice doing the VSR calculation before the exam (practice means getting the correct answer every time)

Solution

The VSR calculation doesn't work very well using the solution bridge; it's one of those calculations operators do that they just have to plug the numbers into the equation and turn the crank. These are the numbers we need:

1. $.VS_{in} = 0.738$
2. $.VS_{out} = 0.529$

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$$\text{VSR, \%} = \frac{(0.738 - 0.529) \times 100}{0.738 - (0.738 \times 0.529)}$$

VSR = **<u>60.1%</u>**.

Discussion

What does the VSR mean? A VSR of 60.1%, for example, means that for every 100 pounds of VS applied or fed to the digester, 60.1 pounds are destroyed. Well, not really "destroyed" because the carbon in the VS is converted to methane (CH_4) and carbon dioxide (CO_2) in the digester gas. The reason we use the word "destroyed" is because digester gas production is often expressed as cubic feet of gas produced per pound of volatile solids destroyed. The way WWTT expresses the VSR when doing digester gas

problems is, for example, 60.1 lb $VS_{destroyed}$/100 lb $VS_{applied}$. This labeling is very, very useful when doing digester gas problems.

Happy calculating! Let us know, by leaving a comment, if you want us to do a specific problem, if you see a mistake, or if you have a question on any of the Problems of the Day you are looking at.