Problem of the Day

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The flow-weighted composite influent sample yesterday had a COD concentration of 525 mg/L. The plant also collects a flow-weighted composite sample of the primary effluent. The COD concentration in yesterday's primary effluent sample was 316 mg/L. Calculate the percent removal of COD across the primary clarifiers.

Introduction

There are many reasons why the COD measurement is superior to BOD. It's faster, it's more precise, it allows very accurate mass balances to be performed. COD is somewhat complicated by the fact that some of it is unbiodegradable. Because all organics in a sample are oxidized in the COD test not just the organics microorganisms can oxidize in five days, the COD is always larger than the BOD. It turns out that the COD is almost always just about twice the BOD in municipal wastewater.

Like BOD, some of the COD in raw wastewater is soluble and will never be removed by gravity in a primary clarifier. Also, some of the COD in raw wastewater is associated with solids, or particles, that are not settleable. Both the soluble COD and particulate COD associated with non-settleable solids will pass through primary clarifiers. Same holds true for BOD which is why the BOD removal efficiency in primary clarifiers ranges from only 25 to 45%.

The calculation for determining the percent removal of COD is the same we use for TSS and BOD, anything for that matter:

$$\text{Removal efficiency (\%)} = \frac{(C_{in} - C_{out})}{C_{in}} \Big| 100$$

C_{in} = the concentration, mg/L, of BOD, TSS or other constituent, or mL/L of settleable solids in the influent to any process unit or treatment plant

C_{out} = the concentration, mg/L, of BOD, TSS, or other constituent, or mL/L settleable solids in the effluent from any process unit or treatment plant.

As can be seen, removal efficiency is always expressed as a percent. It is important to note that whenever calculating percent, all the units must cancel out.

Solution

The problem is done by directly inserting C_{in} and C_{out}—in this case, 525 mg/L and 316 mg/L, respectively—into the equation above.

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$$\text{Removal efficiency (\%)} = \frac{(525 - 316)\ \cancel{\text{mg/L}}}{525\ \cancel{\text{mg/L}}} \Big| 100$$

(525 − 316) x 100 ÷ 525 = **<u>39.8%</u>**.

Discussion

Rich Jones and Peter Dold of EnviroSim did a paper at Weftec 2013 that demonstrated anaerobic digester performance, measured in terms of VSR and gas production, is primarily a function of the fraction of unbiodegradable particulate COD in the influent and the efficiency of the primary clarifiers, which also is largely a function of the influent wastewater characteristics, neither of which is in the control of the operator. One of the things I love about wastewater treatment is that everything is interrelated!

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.