Problem of the Day

**2015.May.25**

## Problem of the Day

If a wastewater treatment plant removes 35% of the influent BOD in primary treatment and 85% of the remaining BOD in the secondary system, what is the BOD of the raw wastewater if the BOD of the final effluent is 20 mg/L?

## Discussion

Happy Memorial Day and welcome back to Problem of the Day. Many folks have told us how often they come to Problem of the Day. I have seen instances where WWTT's Problems of the Day have made it into training materials in Ohio for example. Since I am now semi-retired from "my day job," I can be more diligent about keeping up-to-date with Problem of the Day.

Here goes . . .

Today's problem is nothing more than understanding how to properly manipulate percent removals and percent **non** removals. Obviously, the goal of a wastewater treatment plant is to remove BOD so if we're given the final effluent BOD concentration, we know that the primary effluent/secondary influent has to have a greater BOD concentration than the final effluent and that the BOD concentration of the raw wastewater influent to the wastewater treatment plant has to have a greater BOD concentration than the primary effluent/secondary influent.

In many problems dealing with percentages, WWTT likes to express a given percent in terms of "pounds per 100 pounds." Remember, in wastewater treatment math problems, percent is always on a mass (i.e., pound) basis except when dealing with the components of digester gas, then percents are given on a volumetric basis. But there are many problems dealing with percentages that WWTT will convert to the decimal equivalent by dropping the % sign and moving the decimal two places to the left.

But in this problem, there is a little trick. The final effluent BOD concentration is the BOD that was **not** removed in secondary and primary treatment. Since the percents given in the problem are for the amount of BOD that was removed first in primary and then in secondary treatment, these percents have to be subtracted from 100% to get the percent BOD that was **not** removed, after which they are converted to decimals:

- 100% −35% = 65% the BOD that was not removed in primary treatment, which becomes 0.65
- 100% −85% = 15% the BOD that was not removed in secondary treatment, which becomes 0.15

It is very important to emphasize, especially in light of WWTT's incessant focus on using units in math problems, that percents expressed as decimals are one of the few instances in wastewater math that **have no units associated with them**.

The arithmetic behind this problem is simply to divide the effluent BOD concentration, first, by 0.15 to get the primary effluent/secondary influent BOD concentration and, second, to divide that result by 0.65 to get the raw wastewater influent BOD concentration. If, instead, we multiplied by the decimal percents, the BOD concentration would get progressively smaller which, of course, we would know was incorrect.

## Solution

Remember, the 20 mg BOD/L in the final effluent is the BOD remaining after secondary treatment, which has to be 15%, 0.15 as a decimal, of the primary effluent/secondary influent BOD since 85% of it was removed (100% −85% = 15%). Similarly, the primary effluent/secondary influent BOD concentration is the BOD remaining after primary treatment, which has to be 65% since 35% of it was removed (100% −35% = 65%).

**Problem of the Day**: If a wastewater treatment plant removes 35% of the influent BOD in primary treatment and 85% of the remaining BOD in the secondary system, what is the BOD of the raw wastewater if the BOD of the final effluent is 20 mg/L?

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|---|---|---|---|---|---|
| mg BOD / L | = | 20 mg BOD / L | | 0.15 | 0.65 |

The arithmetic gives the answer:

20 ÷ 0.15 ÷ 0.65 = **<u>205 mg BOD/L</u>**.

***Again, happy Memorial Day and happy calculating! Let us know, by leaving a comment, if you want us to do a specific problem or if you see a mistake or if you have a question.***