**MEC3040 Lab calculation exercises for Module 10: Factors affecting AD**

*Please show all work for calculations. You are welcome to use Excel.*

Table I: Tank data for Vermont Tech Community Anaerobic Digester (VTCAD)

|  |  |  |  |
| --- | --- | --- | --- |
| **VTCAD** | **Hydrolysis tank** | **AD Tank** | **Effluent tank** |
| Total volume (gallons) | 105,000 | 317,000 | 115,000 |
| Diameter (m) | 8 | 15 | 8 |
| Fill height (m) | 8 | 6.8 | 10 |
| Depth of cone (m) | NA | 1 | NA |

1. Calculate the HRT of the hydrolysis tank if the daily meal volume is 12,000 gallons, the feed rate (hydrolyzer to AD) is 1000 gallons every two hours, and the tank is initially 70% full.

*6.1 days*

1. Change a variable to produce a 5-day average HRT. What variable did you change and how did you change it?
2. Can we change the level of slurry in the AD tank? Explain your answer.
3. Calculate the HRT of the AD tank if the feed rate (hydrolysis tank to AD tank) is 1000 gallons every two hours.

*26.4 days*

1. What feed rate is required to produce a 20-day HRT in the AD tank?

*15,850 gallons/day*

1. Your feedstock mixture has 8% total solids and 89% volatile solids. You are feeding 1000 gallons from the hydrolysis to the AD tank every two hours.   
   Calculate the organic loading rate in lb VS/gallon/day.

*0.0221 lb VS/gallon/day*

1. We add sodium bicarbonate to increase the pH and buffering capacity of feedstock and slurry.

(a) How many grams of sodium are delivered by addition of one 50-pound bag of sodium bicarbonate. Begin with the chemical formula.

(b) If that sodium bicarbonate is the only source of sodium added to one day’s digester meal, what would the sodium concentration of the feedstock be (mg/L) in

(i) A total feed volume of 12,000 gallons

(ii) A total feed volume of 16,000 gallons

*(a) 6.21 E6 mg Na*

*(b) (i) 136 mg/L Na; (ii) 102 mg/L Na*

1. The 50:50 mixture of glycerol:crumb water that we receive from the biodiesel producer has a sodium concentration of 3755 mg/L. If this glycerol were the only source of sodium in AD feedstock, what would the concentration of sodium (mg/L) be if a 16,000 gallon meal contained:

(a) 200 gallons of glycerol:crumb

(b) 600 gallons of glycerol:crumb

(c) 1000 gallons of glycerol:crumb

*(a) 49.6 mg/L Na*

*(b) 140.6 mg/L Na*

*(c) 234.7 mg/L Na*

1. The 50:50 mixture of glycerol:crumb water that we receive from the biodiesel producer has a potassium concentration of 4000 mg/L. If this glycerol were the only source of sodium in AD feedstock, what would the concentration of potassium (mg/L) be if a 16,000 gallon meal contained:

(a) 200 gallons of glycerol:crumb

(b) 600 gallons of glycerol:crumb

(c) 1000 gallons of glycerol:crumb

*(a) 50.0 mg/L Na*

*(b) 149.8 mg/L Na*

*(c) 250.0 mg/L Na*