**Assessment for Module 3: Factors Affecting Anaerobic Digestion**

**3.1: Microbial populations**

1. Which type of bacteria do most of the work in the hydrolysis tank?
2. Describe the two populations of methane forming bacteria. What percent of methane production is performed by each? What is the essential difference between the way these bacteria make methane?
3. Anaerobic digestion is described as having three or four steps. Which stops occur in the hydrolysis tank, and which in the AD tank?
4. How would the three stages or steps of AD occur in a plug flow digester without? How are aerobic and anaerobic conditions separated?

**3.2: Feedstock basics**

1. Which feedstock fraction is higher or greater: total solids or volatile solids? Why?
2. What is retention time and how is it calculated?
3. What is a ‘sour’ digester & how is it treated?
4. What is the value of manure as AD feedstock?
5. Which is a greater problem in AD feedstock: recalcitrant or inert material?
6. What Vermont agencies regulate AD feedstock materials?
7. In AD, the C:N ratios of feedstock are important. What is the optimal ratio? What does C supply? What does N allow?
8. Why would food scraps be a more balanced AD feedstock than FOG?

**3.3: Loading rate & retention times**

1. What is a good loading rate for most AD systems?
2. Hydraulic retention time (HRT) affects process stability and the efficiency of anaerobic digestion. If a digester’s tanks have fixed volumes, how can the operator change the system’s HRT, either intentionally or unintentionally? What would she have to change?

**3.4: Temperature & mixing**

1. Compare and contrast the added costs and benefits of psychrophilic vs. thermophilic AD.
2. What are two methods of mixing AD slurry?
3. Mixing can increase the efficiency of AD, but it can also lower biogas production. Why? Give two reasons that mixing increases efficiency, and one way that it can decrease biogas production.

**3.5: Environmental factors**

1. What are the optimal pH ranges for hydrolysis and AD?
2. What is the ‘Ripley ratio’? What are its optimal values? What does a very high Ripley ratio indicate?
3. Alkaline metals are necessary micronutrients but can also inhibit AD. What is the stimulatory concentration of sodium? At what concentration does it inhibit AD?
4. What is feedback inhibition and how does it apply to AD? What three products of AD can act as feedback inhibitors?

**3.6: Symptoms & seven causes of unstable AD**

1. Rank the seven causes of unstable AD in order of the operator’s ability to control them. Justify (explain) each answer with a few sentences.