

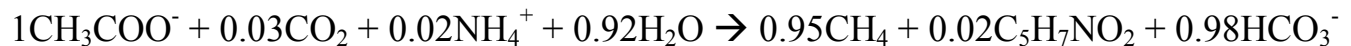
Assignment 2: Due Thursday, Feb. 7

1. Bacterial denitrification is carried out by heterotrophic bacteria using acetate (CH_3COO^-) as the electron donor and nitrate (NO_3^-) as the electron acceptor. The molar stoichiometry for the respiration (energy generating) part of the bacteria metabolism is:



- Write the mass-basis stoichiometry for denitrification and show that mass conservation is satisfied.
 - Write the COD-basis stoichiometry for denitrification and show that COD is conserved.
 - What is the oxygen equivalent of nitrate-nitrogen ($\text{g-O}_2/\text{g-NO}_3\text{-N}$)?
2. Given the stoichiometric relations you found in problem 1 and a denitrification rate of 20 $\text{mg-NO}_3\text{-N/L-hr}$:
- What is the acetate consumption rate, as $\text{mg-CH}_3\text{COO}^-/\text{L-hr}$ and as mg-COD/L-hr ?
 - What is the rate of alkalinity generated, as $\text{mg-CaCO}_3/\text{L-hr}$?

3. Methane production by a strain of *Archaea* growing on acetate follows this stoichiometry:



- Write the mass-basis stoichiometry for methane production and show that mass conservation is satisfied.
- Write the COD-basis stoichiometry for methane production and show that COD is conserved.
- If acetate is consumed in an anaerobic digester at a rate of 500 $\text{kg-CH}_3\text{COO}^-/\text{d}$, at a temperature of 35 °C and a pressure of 1 atm, what is the rate of methane (CH_4) production in m^3/day , assuming the stoichiometry given above?
- What is the rate of volatile suspended solids generation (kg-VSS/day), assuming 1 g $\text{C}_5\text{H}_7\text{NO}_2 = 1$ g VSS (volatile suspended solids)?