

Stoichiometry of Microbial Reactions

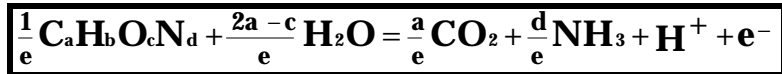
by Dr. Arturo Massol Deyá

for BIOL4734

Complete reaction (R) $R = R_d + f_e R_a + f_s R_c$

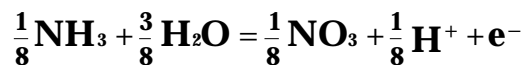
Electron donor half reaction (R_d)

Generic organic donors:



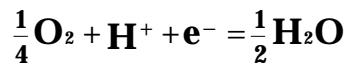
where $e = 4a + b - 2c - 3d$

Inorganic:

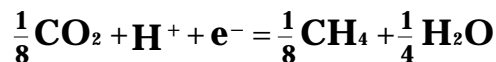
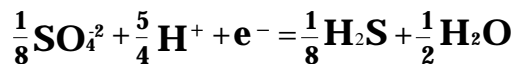
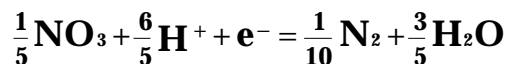


Electron acceptor half reactions (R_a)

Aerobic:

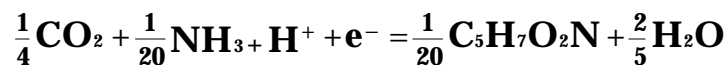


Anaerobic:

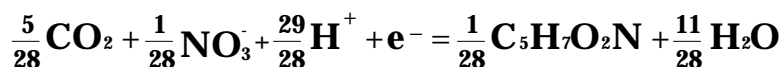


Cell synthesis half reactions (R_c)

Ammonia N source:



Nitrate N source:



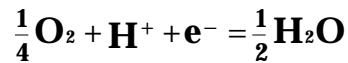
Stoichiometry example: aerobic hydrocarbon utilization

Hydrocarbon: octane
Nitrogen source: ammonia

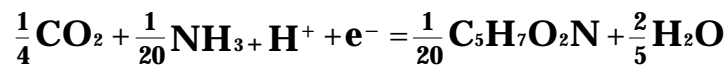
donor reaction:



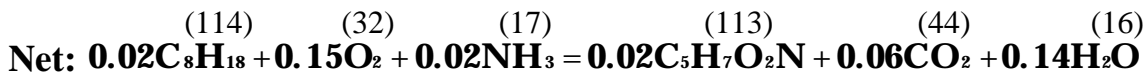
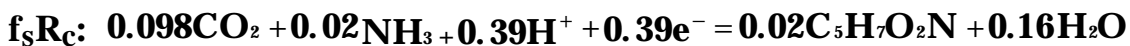
acceptor reaction:



synthesis reaction:



From f_s values, $f_s = 0.39$ so $f_e = 0.61$



Mass balance on the degradation of 1kg octane:

$$\mathbf{O_2 \text{ required} = \frac{(0.15)(32)}{(0.02)(114)} = 2.1 \text{ kg}}$$

$$\mathbf{NH_3 \text{ required} = \frac{(0.02)(17)}{(0.02)(114)} = 0.15 \text{ kg}}$$

$$\mathbf{Biomass \text{ produced} = \frac{(0.02)(113)}{(0.02)(114)} = 1.0 \text{ kg}}$$