

Contacts: eveline.mayner@epfl.ch
manfred.zinn@epfl.ch



Biochemical Engineering

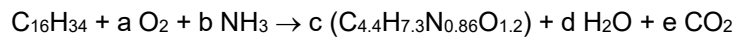
Exercise Session 4

1) Balancing

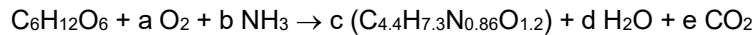
Assume that experimental measurements for a certain organism have shown that cells can convert 2/3 (w/w) of the substrate carbon (alkane or glucose) to biomass.

a) Calculate the stoichiometric coefficients for the following biological reactions:

Hexadecane:



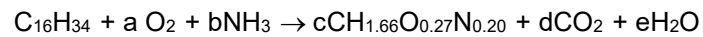
Glucose:



b) Calculate the yield coefficients $Y_{X/S}$ (g dw cells /g substrate), Y_{X/O_2} (g dw cell /g O_2) for both reactions. Comment on differences.

2) Stoichiometric coefficients for cell growth

Production of single-cell proteins from hexadecane is described by the following reaction equation:

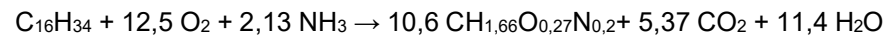


Where $\text{CH}_{1.66}\text{O}_{0.27}\text{N}_{0.20}$ represents the biomass. If $\text{RQ} = 0.43$, determine the stoichiometric coefficients.

RQ: respiratory coefficient

$$\text{RQ} = \frac{\text{moles CO}_2\text{produced}}{\text{moles O}_2\text{consumed}} = \frac{d}{a}$$

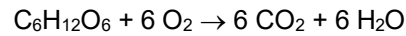
3) Oxygen demand



- a) Calculate the oxygen requirement from the above given chemical equation.
- b) Calculate the oxygen requirement based on the reduction grade.

4) Product yield and oxygen demand

The chemical reaction equation for respiration of glucose is:



Candida utilis converts glucose to CO_2 and H_2O during growth. The cell composition is $\text{CH}_{1.84}\text{O}_{0.55}\text{N}_{0.2}$ plus 5% ash. Yield of biomass from substrate is 0.5 g g^{-1} . Ammonia is used as nitrogen source.

- a) What is the oxygen demand with growth compared to that without?
- b) *C. utilis* is able to grow with ethanol as substrate, producing cells of the same composition as above. On a mass basis, how does the maximum possible biomass yield from ethanol compare with the maximum possible yield from glucose?