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## **Biochemical Engineering**

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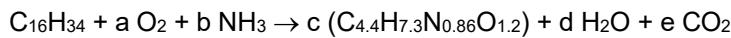
### **Exercise Session 4**

#### **1) Balancing**

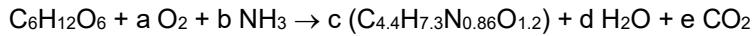
Assume that experimental measurements for a certain organism have shown that cells can convert 2/3 (w/w) of the substrate carbon (alkane or glucose) to biomass.

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

Hexadecane:



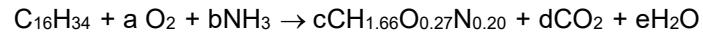
Glucose:



b) Calculate the yield coefficients  $Y_{X/S}$  (g dw cells /g substrate),  $Y_{X/O_2}$  (g dw cell /g  $\text{O}_2$ ) for both reactions. Comment on differences.

## 2) Stoichiometric coefficients for cell growth

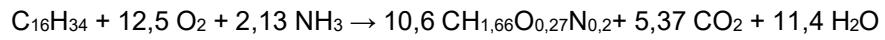
Production of single-cell proteins from hexadecane is described by the following reaction equation:



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

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

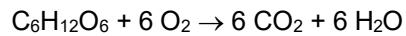
**3) Oxygen demand**



- 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<sub>2</sub> and H<sub>2</sub>O during growth. The cell composition is CH<sub>1.84</sub>O<sub>0.55</sub>N<sub>0.2</sub> plus 5% ash. Yield of biomass from substrate is 0.5 g g<sup>-1</sup>. 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?