Tut 3

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0.0.1 Tutorial 3

The production of 1,3 propanediol (PDO) by the company DuPont is one of the success stories of bioproduction of polymer intermediates on a bulk scale. Read on the polymer SORONA for some background on the process and final product.

PDO is a natural metabolic product when *Klebsiella pneumonica* grows on glycerol as substrate. DuPont opted for glucose as feedstock and engineered *Escherichia coli* to aerobically convert glucose into PDO.

Write out the overall stoichiometry of the reaction using glucose, ammonia and oxygen as feed. Assume that apart from PDO and biomass, no by-products are formed except water and CO_2. It is further given that biomass can be described by $CH_{1.91}O_{0.48}N_{0.22}$. The following yields are specified:

Y_{SX} = 0.0822 g/g

Y_{SO} = 0.00267 mol O_2/g [reagent]

a) Determine the mass based yield of PDO on glucose(YSP). [0.51 g/g]

b) PDO synthesis is a two step reaction from Dihydroxyacetone Phosphate (DHAP) in glycolysis. In order to calculate the amount of **NADH** required/generated in the pathway from glucose to PDO, we can consider the following reaction within the cell:

$$Gluc \rightarrow PDO + xNADH$$

Determine the NADH amount with a DOR balance and confirm your answer by googling the metabolic pathway map.

c) What is the ATP requirements in the pathway from glucose to PDO?

d) Why is oxygen used in the overall stoichiometry?

e) Will all the DHAP that form proceed to produce PDO?

f) Determine the moles of ATP formed in oxidative phosphorylation. Express the answer using a cmol of boimass as basis. Assume a $(P/O)_{NADH}$ and $(P/O)_{FADH}$ of 1.5. [2.9 $\frac{mol\ ATP}{cmol\ X}$]

g) What is the ATP in (f) used for. Identify 3 separate targets.

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