Microalgal Biotecnology: designing light-limited photobioreactors.

1. Find the absorption coefficient, k_a (m2/g) from the following data of absorbance vs. biomass concentration obtained for a given microalgae at 517 nm in a 1 cm optical path cuvette.

Cb (g/L)	0.043	0.085	0.117	0.256	0.345	0.480	0.635	0.917	1.210	2.450
A (Log(Io/I))	0.0215	0.0425	0.0585	0.1280	0.1725	0.2400	0.3175	0.4410	0.5450	0.9330

2. Gather tha data of ka vs pigment content (X_p) Isochrisys galbana available in the paper "A mathematical model…" and find a second order polinomial to correlate ka con Xp (you can find a linear regression in the paper).

3. Find and annotate here the equation that allows calculating the average irradiance, I_{av}, in a flat system as a function of biomass concentration. Use the ka you calculated in question 1. Find the average irradiance in a flat system with a 10 cm light path when illuminated with an external irradiance of Io=1000 μE m^{-2} s^{-1} assuming a biomass concentration of1,2 g/L.

4. Write the equation (there may be more tan one) that gives I_{av} as a function Cb and ka in a cylindrical system (see paper "Evaluation of photosynthetic efficiency…). Use the same conditions given in question 3.

5. In the next table you are given the specific growth rate of a microalgae experimentally measured under an external irradiance of Io=1600 μE m-2 s-1. Data of ka are also given. Calculate I_{av} and fill in the corresponding row. Assume it is a flat system (so that you can use the simplest Iav equation) with L=12 cm.

μ (h^{-1})	0.0058	0.0123	0.0191	0.0236	0.0238	0.0240	0.0244	0.0306	0.0355	0.0405
Ka (m^2/g)	0.1169	0.1015	0.0795	0.0861	0.0822	0.0843	0.0902	0.0824	0.0547	0.0419
Cb (g/m^3)	2120	1430	1095	880	890	885	865	725	520	185
Iav										

6. Find the parameters of the kinectic model proposed by Aiba that better fit the μ vs Iav you just obtained in question 5. Congratulations, you just obtained your first microalgal growth model. Try to obtain also the parameters for the model of Camacho-Rubio et al. (2003)

7. Now that you have your kinetic model and assuming that you know how to calculate Iav, find out what growth rate can be expected in a flat photobioreactor with 10 cm light path, 1230 g/m^3 biomass concentration and an external irradiance of150 μE m^{-2} s^{-1}?

8. In the same conditions of question 7 ¿what Cb there will be if μ=0.025 h^{-1}?

Final note: In PBR analisys it is instrumental to know the relationshipp μ vs Cb, freom which Pb vs Cb (ó Pb vs μ) can be derived. Pb is a number referred to a "productivity" which can be calculated as Cb·μ (g m^{-3} h^{-1}). It is very important to decide if a PBR is working optimally. YOU will use this number to optimize a PBR in steady state contunuous culture (in which μ=D) and propose an optimal dilution rate.