DESIGN OF A BIODIESEL PRODUCTION FROM ALGAE PLANT
PART 1: PRELIMINARY

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GENERAL ANALYSIS AND PROJECT OBJECTIVE

OVERVIEW

•Biofuel production represents a solution to future problems of energy deficiency.
•Oil usage is one of the most investigated areas for producing biofuels.

ADVANTATGES

•Oil production is made using algae as producer organism, mainly due to its high efficiency in biodiesel or bioethanol production.
•Using algae prevents food and environmental problems that are caused by using other carbon sources for producing fuels such as corn or oil. **(1)**

DISADVANTATGES

•On the other hand, the process is not competitive nor on short term neither in the context of current biodiesel prices.
•Algae lipid storage capacity is too low for an efficient oil production (without applying genetic engineering techniques) **(1)**, which would enhance our project price.

OBJECTIVE: To design a biodiesel production plant which covers 15% of biodiesel consumed in Catalonia, corresponding to 74.1 KTN amount of biodiesel per year.

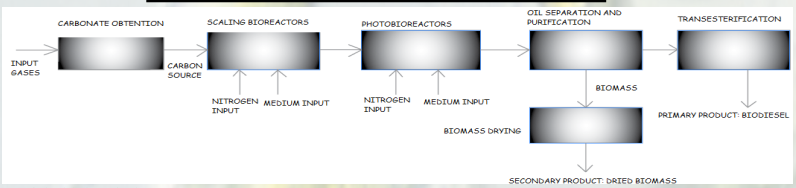
ALTERNATIVE SELECTION

The process can be performed using various types of systems:
• Open systems.
• Closed systems.
• Artificial light.
• Natural Light.
The chosen system is a closed system (photobioreactor) with natural light due to the low cost of the bags used as reactors, the ease it represents for waste treatment and products in front of open systems and the reduction of price and unlimited provided accounts which represents sunlight in front of artificial light. **(5)**

PLANT LOCATION

Plant oil production to make biodiesel from algae would be located in the coastal zone close to Vallcarca cement factory (Garraf) (UTM coordinates x = 404.805 y = 4566.810).
Why has this situation been chosen? **(2)**
•Cement factory produces a waste current which contains CO^2. With the appropriate treatment it can be used as a carbon source for our algae. Using their waste as input material for our process, we not only help the cement factory (buying him CO^2 at negative balance) but it can also avoid the pollution caused to the environment.
•The cement factory itself is a potential fuel customer, so they will have interest in obtaining fuel from a cleaner source.
•Closely located to Barcelona, but outside the capital, in a non touristic area (minimizing the environmental impact) and ensuring good communications by road and by air (local airport) or sea (local port).

GENERAL PROCESS BLOCK DIAGRAM

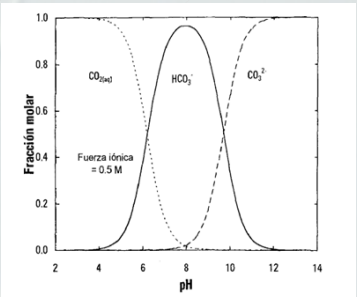


PROCESS STAGES

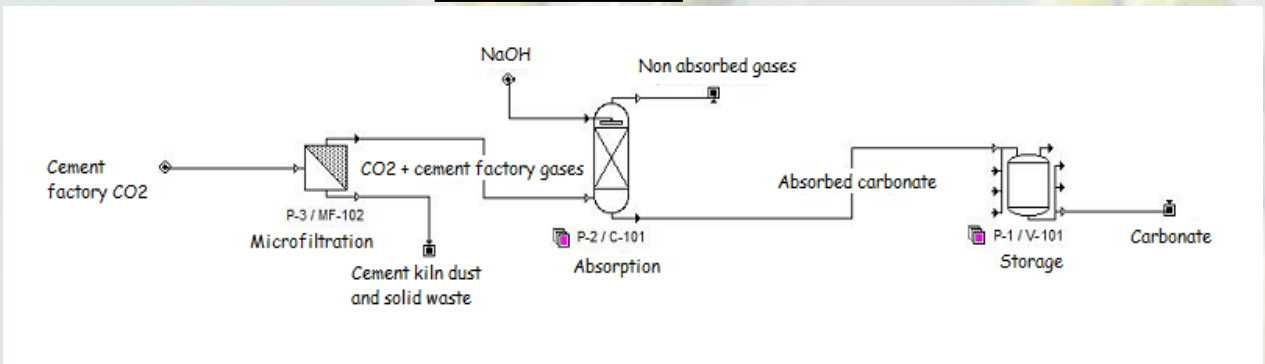
UPSTREAM:	BIOREACTOR:	DOWNSTREAM:	
Getting the carbon source	Photobioreactors	Oil separation and purification	Biomass drying
Biomass production: scaling		Transesterification	

ABSORPTION PROCESS

Cement factory waste stream is passed through an absorption column, in which it makes contact with NaOH. As shown in the image, pH decrease caused by NaOH current allows CO^2 to majorly become carbonate ion, which will be used as carbon source for algae.
This allows carbonate ion to be absorbed and separated from other gases, which come out from the absorber's waste current, which will be properly used in later process steps. **(6)**



CO^2 ABSORPTION



STAGE'S CARBONTE YIELD

10257173.21667 / 10800000.042 X 100 =

94.97

OVERVIEW

•The waste current providing from the cement factory contains 6% CO^2, various gases, cement kiln dust and solid remains **(3).** Once filtered to remove solid remains and cement kiln dust, it is passed through an absorption column, which uses NaOH to achieve the CO^2 separation from the rest of the gases. Once absorbed, carbonate is stored, previously to its use as carbon source for both growth and production algae reactors. **(4)**

EQUIPMENT COST ($)

1 microfiltre
28.000 $

27 Absorption columns
3.402.000 $

BENEFITS.

•Contribution in reducing greenhouse effect, more environmentally – friendly process.

•Very high carbonate amounts achieved, exactly 133343251.7 kg/year, which is equal to 7426.52 times the CO^2 consumption of a truck (assuming that a truck consumes 17955 Kg/year of CO^2. **(7) (8)**

•Use of the waste gaseous current generated at the absorption column in the downstream biomass drying step, which contributes in reducing downstream costs.

•Economically better than another carbon source obtaining processes due to the low NaOH cost price and the received financial aids.

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