Abstract

Increasing emissions of greenhouse gases, particularly anthropogenic carbon dioxide, CO₂, arising mainly from fossil fuel combustion, are thought to be contributing to global warming. In order to avoid severe consequences to mankind, immediate action has to take place in developing new technologies and solutions.

Carbon Capture and Storage, CCS, has emerged as a suitable method in preventing CO₂ emissions to reach the atmosphere, essentially by capturing it from large sources and storing it. Options for long-term isolation of CO₂ include ocean storage, which may encompass adversities such as water acidification, or geological storage.

Biological fixation of CO₂ can be seen as a different approach to CCS, in which instead of storing the previously captured CO₂, it would be used as a reactant in the photosynthetic process, much as in the case of a natural sink. Since microalgae have extraordinary properties, such as high proliferation rates, tolerance to extreme environments, among others, they are preferred as the biological fixation medium.

Carbon dioxide emissions derived from large stationary sources, such as power stations, cement production and refineries, require large areas for the implementation of reactors. Such areas may not be available in the immediacy of the industrial complex and therefore require the transportation of the gas until its biofixation location.

Three distinct scenarios for CO₂ transportation in the specific case of microalga production were proposed.

Case A, supposes the transportation of a highly concentrated stream of CO₂, whereas in Case B the gas transported is the one directly collected from flue gas stacks. The separation process inherent to Case A for the treatment of the flue gas involves higher energy consumption and also higher costs, when compared to Case B, in which the gas is simply fed to the reactors without the separation. Despite that fact and since Case B involves a stream of around 12% of CO₂, a larger volume of gas has to be transported, and so, costs are increased for the same quantity of CO₂. Case C assumes the transportation of CO₂ dissolved in water, which would work as a part of the culture medium and therefore would not require the transportation of an extra stream of water. Therefore, an analysis is necessary for comparing the costs of transportation of these three scenarios, so as to decide which would represent the best option.
For the cases present previously a general optimization of design parameters was performed and a preliminary economic evaluation of the three different scenarios for the transportation of CO$_2$ from critical emission sources until the reactor's location was prepared.

The results of the evaluation show that the lowest cost transportation is attained by the transmission of a relatively pure stream of CO$_2$.

**Key words:** CO$_2$, pipeline, microalgae, economic analysis