USES OF A WATER-ALGAE-PHOTO-BIO-SCRUBBER FOR SYNGAS UPGRADING AND PURIFICATION

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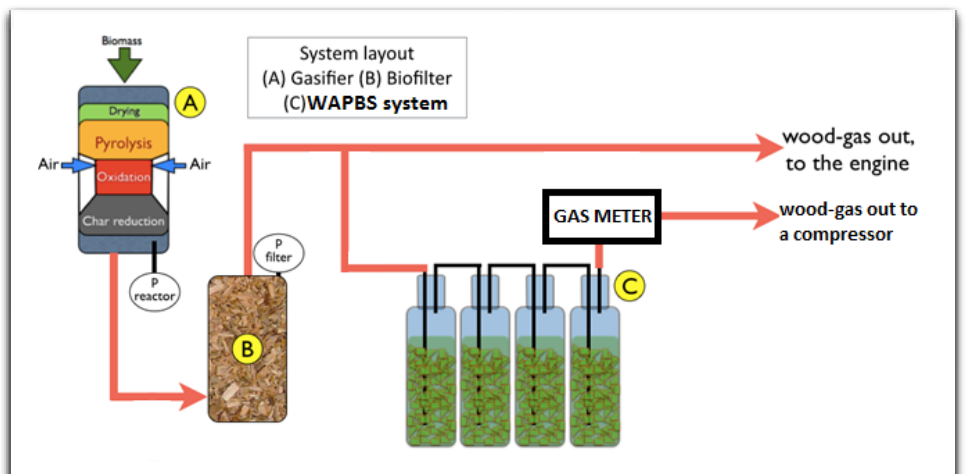
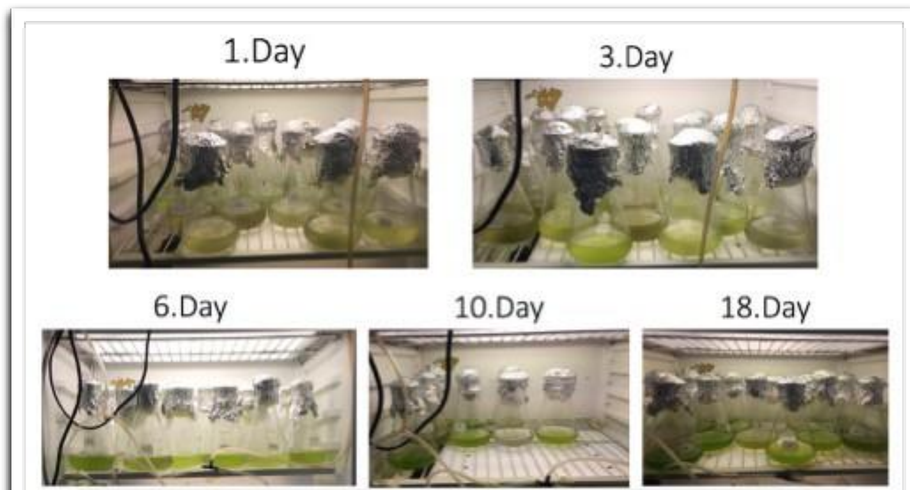
Aim of this work is to try to put together the two worlds of syngas filtering and syngas upgrading trough the use of a water-algae water photo-bio-scrubber. The system studied consists of a 10 kWel downdraft gasifier provided with a water scrubber where the syngas is bubbled in a solution of water, nutrients, algae and artificial light (. The heat provided by the syngas keeps the scrubber to the proper temperature where tars are condensed and algae can grow at proper rate. At the same time the CO_2 content in the gas can be, in part, converted into biomass by the algae. From the scrubber it is disposed a multi-phase liquid composed of water, biomass, tars and char. The first analysis carried out in this work consisted in a two phases process of the gas. First, in the gasification system, part of the gas was derived into a simple water scrubber where all the flows where measured and the temperature was kept constant at 30 °C. Then the water obtained in such a way was used as basis for algae grown in lab conditions. Results shown the capability of such a system to be used in existing gasification facilities.

A 10 kW gasifier power plant was used in this work [6]. It is an imbert type downdraft gasifier fueled with wood chips. The syngas generated by the reactor is roughly filtered in a drum filter where wood chips are used by filter media. As depicted, part of the wood-gas is derived after the biofilter and it is sent the Water Algae Photo Bio Scrubber system (WAPBS): a series of 4 Drechsel bottles filled with about 0.4 l of syngas cleansing water (SCW). The syngas volume that pass through the bottles is measured by a gas meter. Into the bottles the syngas is cooled down from 50 °C to 30 °C, tar and particulate are trapped into the water while part of the CO_2 is available for the micro algae to be converted into biomass. The syngas flow through the bottles is very low (about 0,5 Nm^3/h), in such a way all the pollutants of the syngas are trapped into the bottles. Three tests was done increasing the volume of the syngas filtered in the bottles. Table III resumes the results in terms of condensate water, particulate and tar in each sample of scrubbing water.



Experiment design

Tests



Results

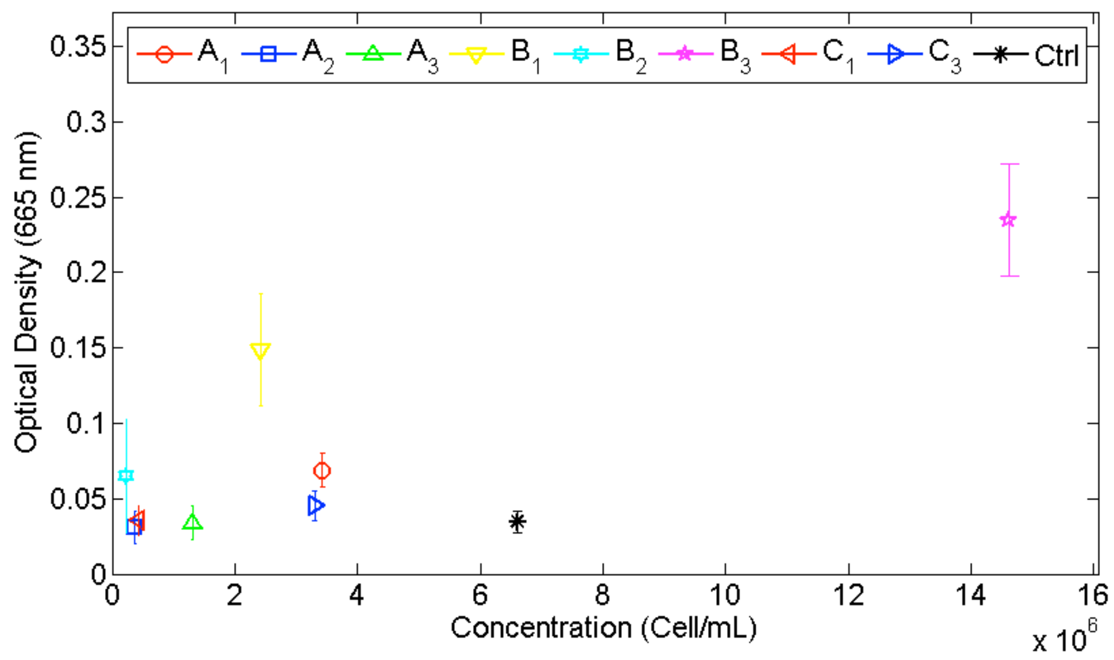
SCW pollutants concentrations

SCW sample	Syngas vol.[l]	Water vol.[l]	Tar conc. [mg/l]	Particulate conc. [mg/l]	Water conc. [g/l]
A	263	0.3	306	123	32
B	500	0.4	436	175	45
C	750	0.4	611	262	63

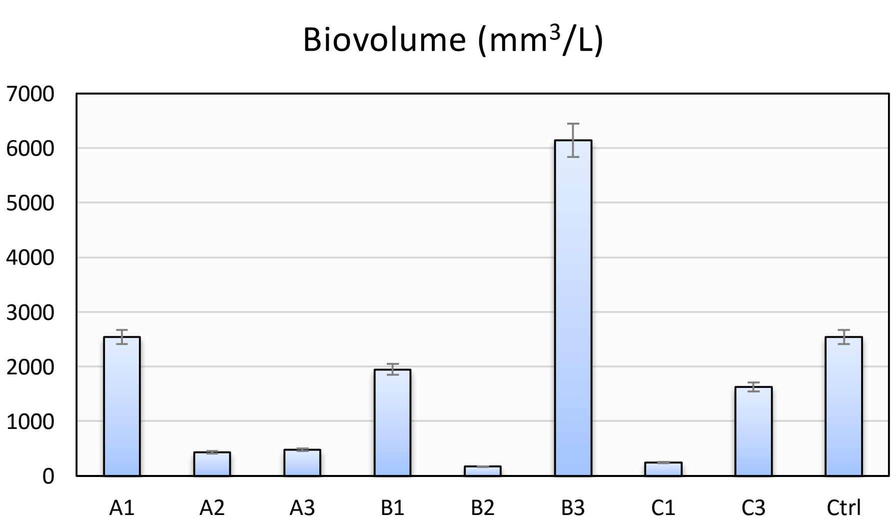
SCW dilution with BG11

	Sample name	Syngas Cleansing Water (SCW) (%)	BG11 [8] (%)
A Bottle	A1	50	50
	A2	70	30
	A3	30	70
B Bottle	B1	50	50
	B2	70	30
	B3	30	70
C Bottle	C1	50	50
	C2	70	30
	C3	30	70
BG 11	Ctrl	100	

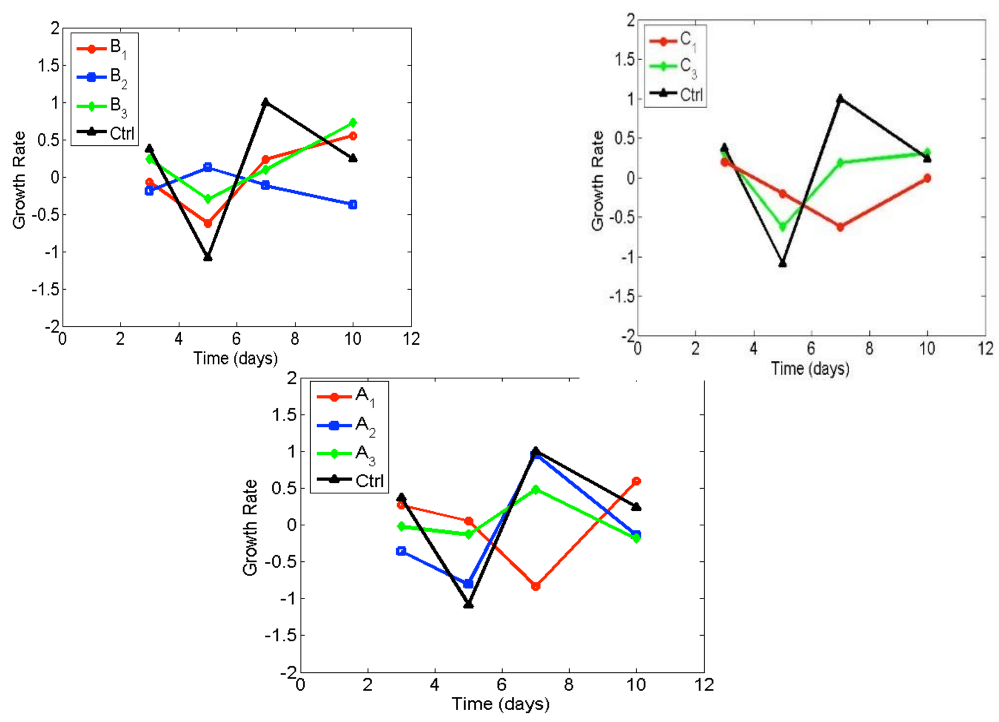
(1) The algae grown in B3 showed the highest values of OD and cell concentration, close followed by the ones grown in B1.



(2) According to the cell volume, after 10 days growth, microalgae in B3 sample have clearly the largest biovolume.



(3) Microalgae grown in A1, B1, B3 samples returned the highest growth rate values



(4) The microalgae grown into the B3 and B1 SCWs have the highest amount of pigments content.