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Cost effective biodiesel production from microalgae by oil extraction in a foam column

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Algae are referred to as third generation feedstock for biodiesel largely because they can grow on salt water and marginal lands. This benefit however, is not without a cost. If the drying steps of algae processing can be bypassed, a reduction of at least 80% in production cost can be achieved. Foam fractionation or flotation has the ability to combine harvesting with oil extraction if the cell lysing and cell separation capacity of a surfactant is combined with solvent extraction. This work investigated the feasibility of oil extraction and algae separation in a foam column by adding methanol to the top of the foam column or mixing it with the algae culture in the base of the foam column. The ratios of the volume of methanol: volume of algae culture was in the range 10:90=80:20 and cationic surfactant (CTAB) concentrations were in the range 30-350 mg/L. When methanol was added from the top of the column, a concentration of 200 mg/L CTAB was needed to achieve stable foam. Compared to this only 30 mg/L CTAB was enough to generate stable foam when methanol was mixed with the algae culture fed into the base of the column. Comparing the two scenarios in terms of the amounts of methanol and CTAB required, feeding methanol to the top of the foam column required 20 ml methanol for 500 ml of culture but higher CTAB (200 mg/L). Mixing 500 ml methanol with 500 ml of culture in the base of the foam column only required 30 mg/L of CTAB. Reducing the amount of methanol fed to the base of the foam column would allow for even less CTAB. By feeding methanol to the top of the foam column, an algae concentration factor of 5.6 was achieved. When methanol was fed to the base of the column, the algae concentration factor was 8.6. Results so far have shown that algae separation is possible with the foam column in the presence of methanol as long as methanol does not make up more than 50% by volume of the liquid in the base of the column. The material costs of the foam column were compared with another combined harvesting and extraction process for algae using nano-clay. The foam column achieved a concentration factor of 16.9 at cost of £2.10 per litre of culture whereas the nano-clay process achieved a concentration factor of 5.9 at cost of about £39.60 per litre of culture.

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