PROCESS MODELLING AND LIFE CYCLE ASSESSMENT OF ALGAL BIOCHAR-BIOENERGY SYSTEM

Jiacheng Sun, UK Biochar Research Centre, School of GeoSciences, University of Edinburgh, UK
jiacheng.sun@hotmail.com
Ondřej Mašek, UK Biochar Research Centre, School of GeoSciences, University of Edinburgh, UK

Key Words: Biochar, Pyrolysis, Biodiesel, Microalgae, LCA

The algae biochar-bioenergy system (ABBS) is a sustainable and innovative approach to producing biofuels from algae while using pyrolysis for biochar production using algae residues. Biofuels, particularly algal biofuel, as a replacement for fossil fuels and to achieve net-zero emissions goals. However, current markets for algal biofuel are not mature due to high production costs and greenhouse gas emissions. To address these issues, the study proposes a system which incorporates biochar to store atmospheric carbon and bring biochar market into the system to reduce the cost of biofuel. The ABBS is analysed using various methods to obtain data on algal biomass, biodiesel, biochar, and by-products, and is modelled in Aspen Plus to assess its power and heat feasibility. This study conducts a life cycle assessment (LCA) of the ABBS to evaluate its environmental impact. The ABBS is a sustainable system that produces biofuels especially from wastewater cultivated microalgae and incorporates biochar to store atmospheric carbon. The LCA uses SimaPro software to analyse the environmental impact of the ABBS, including its carbon footprint, water usage, and potential for eutrophication. The results show that the ABBS has a lower carbon footprint (with net GHG emission of -0.16676 kg CO_2eq- per MJ biodiesel production, Fig. 1) compared to conventional production and can effectively store atmospheric carbon. The ABBS also has a low potential for eutrophication and water usage compared to conventional biofuel production systems. The findings suggest that the ABBS has potential as a sustainable alternative to traditional fossil fuel production.

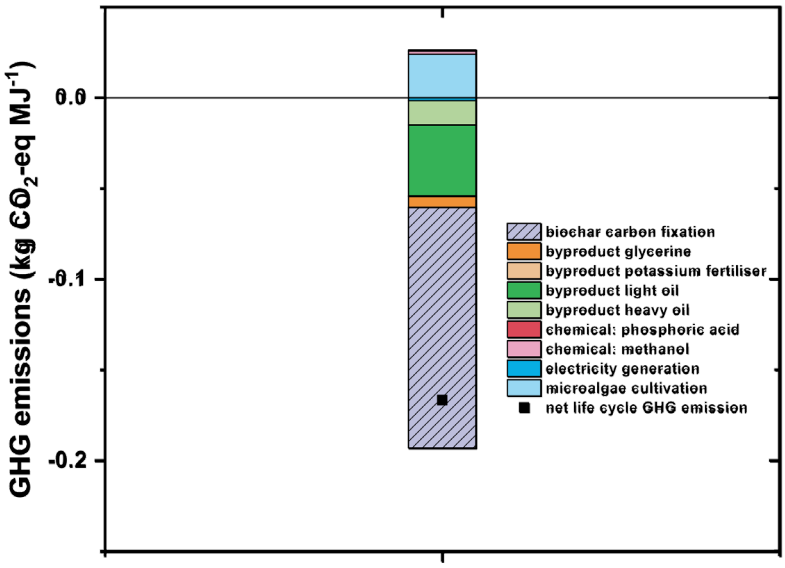

Figure 1 – GHG emission potential of algae biochar-bioenergy system.