Exploring a range of UK seaweed species for the production of fuels and fertiliser

S. Raikova\textsuperscript{a}, C. Chuck\textsuperscript{a}, M. McManus\textsuperscript{a}, M. Allen\textsuperscript{b}, S. Baena\textsuperscript{c}, M. Yallop\textsuperscript{d}

\textsuperscript{a}Centre for Doctoral Training, Centre for Sustainable Chemical Technologies, University of Bath, BA2 7AY, UK.
\textsuperscript{b}Plymouth Marine Laboratory, Prospect Place, Plymouth, PL1 3DH, UK. \textsuperscript{c}Airbus Group Innovations, Pegasus House, Aerospace Avenue, Filton, Bristol, BS34 7PA, UK. \textsuperscript{d}University of Bristol, 24 Tyndall Avenue, Bristol, BS8 1TQ, UK.

e-mail: s.raikova@bath.ac.uk URL: http://www.bath.ac.uk/csc

1. Macroalgae
- Marine biomass has a higher photosynthetic efficiency (ca. 6–8 %) than terrestrial crops (ca. 1–2 %)\textsuperscript{1}
- Macroalgae are an abundant natural resource, and a promising feedstock for third-generation biofuels
- Promising source of novel fuel crops—no competition with agriculture and less areal constraint
- Numerous methods of processing to fuels: chemical, biological, thermochemical

2. Hydrothermal liquefaction
- Hydrothermal liquefaction (HTL) is an inexpensive and energy-efficient thermochemical route to whole biomass conversion
- HTL is carried out using subcritical water (310–360°C, 100–180 bar) as both a solvent and a reactant for the conversion of biomass to a range of products

3. Biorefinery concept
All products generated via HTL can be used within a biorefinery to create value

4. System optimisation
- HTL was used to process the macroalga Ascophyllum nodosum in a batch system
- A range of temperatures between 300–350 °C was used, as well as a range of heating rates 5–60 °C min\textsuperscripts{-1}
- The composition and properties of each product phase were examined

5. Optimisation of HTL conditions
- Higher heating rates give higher bio-crude oil yields (literature precedent)\textsuperscript{2}
- Higher processing temperatures give higher bio-crude yields
- No notable correlation between temperature and elemental composition or energy recovery in bio-crude oil
- Increasing temperatures improves ammonia recovery in aqueous product, but depletes phosphate

6. Species screening—early findings
- Optimised HTL conditions were used to process a range of South West UK seaweeds
- Trends relating initial biomass composition to product distribution and properties were analysed

7. Further work
- Further investigation of the complex relationship between biomass and product composition to rationalise reactivity
- Based on this, a set of specifications for an ideal biomass for the proposed biorefinery model will be laid out
- A theoretical biorefinery model will be built up, and a Life Cycle Assessment (LCA) carried out

References