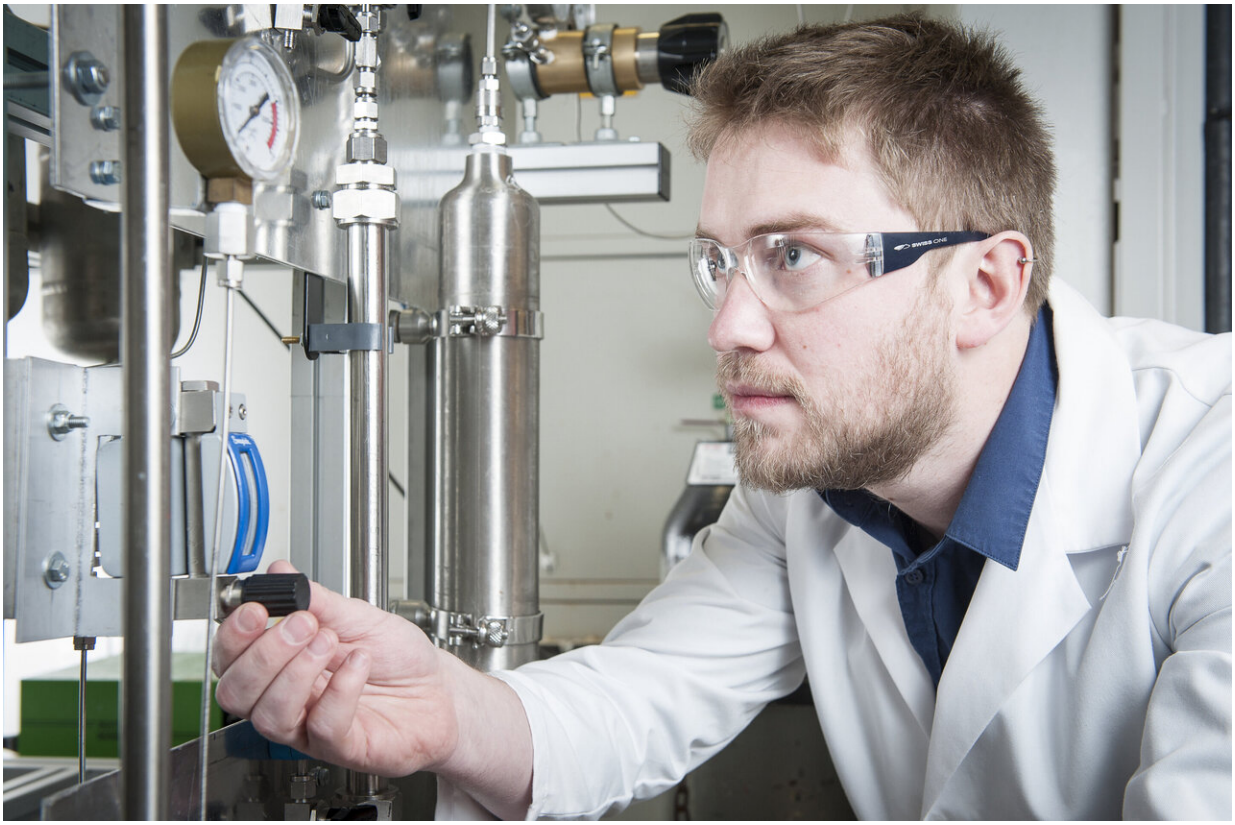
Solve invasive seaweed problem by turning it into biofuels and fertilisers

May 11 2020



Professor Chris Chuck Credit: University of Bath

UK researchers have developed a cheap and simple way of creating biofuel and fertiliser from seaweed, whilst removing plastic from the oceans and cleaning up tourist beaches in the Caribbean and Central

America.

Millions of tonnes of rotting seaweed washes up on beaches of Mexico, the Caribbean and elsewhere every year.

Partly fuelled by fertilisers washing into the sea from farming in the Americas, the foul-smelling Sargassum seaweed devastates the tourism industry and harms fisheries and ocean ecosystems.

A research team, led by the University of Exeter and the University of Bath, has developed a cheap and simple way to pre-process seaweed before making bulk chemicals and biofuels from it.

Making biofuels financially viable

"Ultimately, for this to work it has to make financial sense," said Professor Mike Allen, from the University of Exeter and Plymouth Marine Laboratory.

"Processing marine biomass like seaweed usually requires removing it from the salt water, washing it in fresh water and drying it.

"The costs of these processes can be prohibitively high.

"We needed to find a process that would pay for and sustain itself—something both economically and environmentally viable.

"This work provides a crucial missing step towards a true salt-based Marine Biorefinery by establishing the initial fractionation step."

Using acidic and basic catalysts, the team devised a process that releases sugars that can be used to feed a yeast that produces a palm oil substitute. The same method also prepares the residual seaweed for the

next stage of processing, called hydrothermal liquefaction.

This process subjects the organic material to high temperature and pressure, turning the seaweed into bio-oil that can be processed further into fuels, and high-quality, low-cost fertiliser.

Ed Jones, first author on the paper and Ph.D. student at the Centre for Sustainable Circular Technologies at the University of Bath said: "In contrast with existing pre-treatment strategies, we show that an entirely salt-based biochemical conversion route can work."

"For the first time this study demonstrates that, rather than a hindrance, the presence of saltwater can be helpful."

Professor Christopher Chuck, Director of the Centre for Integrated Bioprocessing Research at the University of Bath and the project lead said: "The variety of products created by this process is a major strength. The oil industry creates a variety of products including liquid fuel, plastics and fertilisers—and we can benefit from a similar flexibility.

"We can simply alter the process conditions to produce larger or smaller amounts of specific by-products, allowing us to have meet variable demand."

Removing ocean plastics

Not only is all the seaweed used in products, but any plastic collected alongside the seaweed will also be converted alongside the seaweed. Part of the inspiration for the project came from Professor Allen's children, Rosie (12) and Archie (9), who helped collect seaweed samples for trial studies from the Devon coast.

Professor Allen said: "It was Rosie who triggered a whole stream of

research following the painstaking removal of plastic litter from the children's seaweed samples by asking: 'Dad, can't you just convert the plastics alongside the seaweed?'"

Professor Allen's children, Rosie and Archie, help collect different seaweed samples from beaches in Devon to study in the lab. Credit: Professor Mike Allen

Removing an environmental nuisance

Another strength of the plan is its use of invasive seaweed such as Sargassum—an environmental nuisance which currently costs the tourist industry vast sums, both in clean-up costs and because it deters visitors.

Professor Allen said: "Many countries in the Caribbean and Central America rely heavily on tourism, so the coronavirus pandemic and the

ongoing Sargassum problem have put them on their knees. Last month more than 4 million tonnes of problematic seaweed washed up on their shores."

This is the latest in a string of developments around seaweed processing from the team which is supported by UKRI, Global Challenges Research Fund, Roddenberry Foundation, Innovate UK and Newton Fund. Exploiting their diverse expertise in phycology, chemistry, ecology, biotechnology and chemical engineering, they are now seeking to develop seaweed based biorefineries to provide local solutions and opportunities on the global stage.

Beginning with just an inquisitive family on their local Devon beach, the ideas and concepts they have inspired are now being applied on the international stage.

More information: Edward S Jones et al, Saltwater based fractionation and valorisation of macroalgae, *Journal of Chemical Technology & Biotechnology* (2020). DOI: 10.1002/jctb.6443

Provided by University of Bath