

Using natural resources to reduce emissions

The improved method of producing a liquid fuel developed during this project will help to reduce carbon emissions from transport.

The need

Using fuels that are made from plant material, vegetable oils and treated waste (known as biofuels) are considered to be carbon neutral when derived from sustainable sources. However, greater uptake will depend on more efficient and cheaper production. Biobutanol is an excellent liquid biofuel that can be used in transport and can be readily integrated into the existing fuel infrastructure. It also outperforms other biofuels based on bioethanol and biodiesel. Uptake of biofuels will help contribute to the Government's target of reducing carbon emissions by at least 26% by 2020.

The results

This project, led by Green Biologics Ltd, used the latest advances in science and process development to improve the efficiency of the fermentation process that converts sugars found in energy crops and agricultural wastes to biobutanol. The process was first commercialised during World War I, but its use declined in the 1940s when it could no longer compete on price with cheaper, oil-derived equivalents.

Work focused on two aspects of the fermentation process:

- Using genetic engineering to develop superior strains of microbes that improve biobutanol yield and concentration
- Using a new system, based on an electro dialysis membrane bioreactor, to improve production efficiency.

Adding the electro dialysis bioreactor to the fermentation process allows the removal of acid by-products that restrict microbial growth, thus limiting biobutanol production. In addition, the microbes developed by Green Biologics Ltd produce less acid and reduce fermentation times. The process conditions to improve biobutanol levels and productivity were optimised in a laboratory-scale fermenter. The work has also resulted in two patent applications detailing strain and process improvements.

Integrating the microbes with the new system significantly improves fermentation efficiency and process economics. This will reduce the cost of biobutanol production and make recommercialisation of the process much more likely.

Market potential

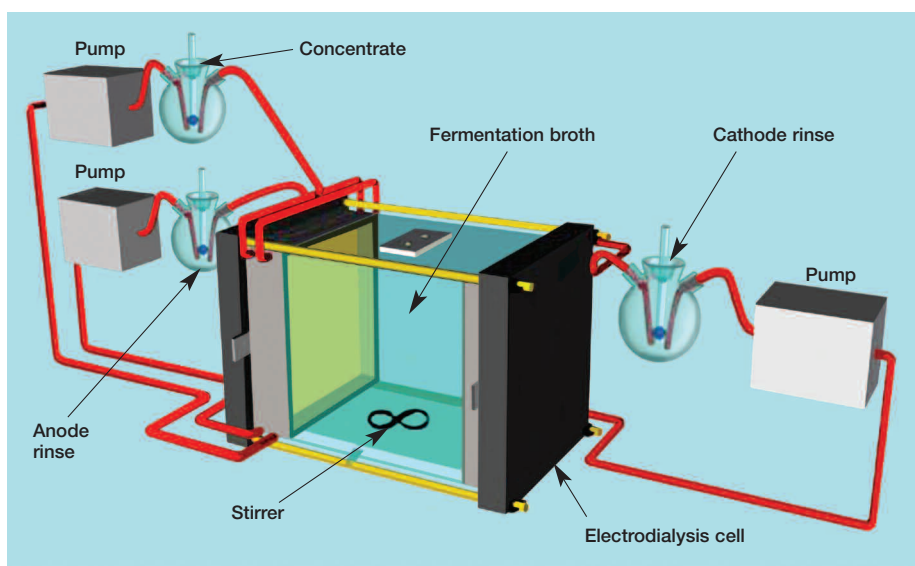
Biobutanol is superior to bioethanol as a liquid fuel for transportation because it is more tolerant of water contamination, is easier to blend with diesel or petrol, and can be readily stored, handled and transported via existing petrol pipelines. The annual global market for this new biofuel for transport is worth about £25 billion.

Process improvements coupled with relatively high oil prices mean that, even today, biobutanol competes with oil-derived butanol on price. Biobutanol fermentation is already being recommercialised in China to address the global chemical market for butanol worth £3 billion/year. Penetration into a new biofuel market will elevate the biobutanol fermentation into one of the world's largest industrial biotechnology processes once again.

Future activities

Green Biologics Ltd plans to offer its improved microbes to existing biobutanol producers in China and Brazil, together with biobutanol technology and support to producers of sugar and molasses that might otherwise produce lower margin bioethanol.

Longer term, improved microbes (and process improvements such as integration of the electrodiagnosis unit) will form part of a technology package that offers a process solution for new builds or retrofits. However, further work is still required to optimise the electrodiagnosis system.



A schematic diagram of the electrodiagnosis membrane bioreactor



Process optimisation in laboratory scale fermentors

HOW THE TECHNOLOGY STRATEGY BOARD MADE A DIFFERENCE:

‘This project has accelerated our strain development programme, resulting in improved microbes for the production of biobutanol.’

Technology Strategy Board Driving Innovation

Collaborative research and development projects are one of the tools that the Technology Strategy Board uses to drive innovation in the UK. The Technology Strategy Board is a business-led executive non-departmental public

body, established by the Government. Its role is to promote and support research into, and development and exploitation of, technology and innovation for the benefit of UK business, in order to increase economic growth and improve the quality of life. It is sponsored by the Department for Business, Innovation and Skills (BIS).

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Project # 200047

Project partners

Green Biologics Ltd
C-Tech Innovation Ltd

Technology Strategy Board investment

£250,000

Total project investment

£500,000

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