Chemicals industry could cut CO₂ emissions using biotechnology

Industrial scale biotechnology could be used by the chemicals industry to produce bulk chemicals like ethylene, butanol or acrylic acid, which are the basic raw materials used in the production of many materials, such as plastics and electronic components. Currently, these chemicals are made from starting materials that are derived from crude oil and natural gas, using processes which release significant amounts of CO₂. New research suggests that industrial biotechnology processes, such as fermentation, that use biomass as a starting material could significantly reduce CO₂ emissions from the chemicals industry.

Researchers at Utrecht University in The Netherlands analysed current and future technologies that could be used to produce 15 bulk chemicals using industrial biotechnology processes. The researchers calculated the carbon emissions used to produce these chemicals using biotechnologies and compared these with current production using oil and gas-based technologies. They concluded that existing industrial biotechnologies could be used to substantially reduce CO₂ emissions from the chemicals industry.

Waste biomass from industrial biotechnology processes can also be used to generate power. Using biomass for electricity co-production means less power is required from fossil fuel-based sources. When the researchers subtracted this ‘carbon credit’ from the total CO₂ emissions produced to make the bulk chemicals, they showed that some biotechnology processes were capable of reducing CO₂ emissions by 100%.

The greatest emissions savings could be achieved using biotechnology to produce ethanol, butanol, ethylene, PDO, PHA and acrylic acid. In terms of raw materials, sugar cane offers the greatest benefit, because it provides the opportunity for electricity co-production. In temperate climates like Europe and North America where sugar cane is not grown, the preference would be for lignocellulosic raw materials, such as corn stover or other woody grasses.

Industrial biotechnology already has much to offer. Recent advances in fermentation technology have lead to increased productivity and yields and the industry expects further substantial progress by using genetically modified microorganisms. With biotechnology advances in the future, the researchers suggest that worldwide CO₂ savings in the range of 500-1000 million tons per year are possible.

The research, undertaken as part of the project BREW¹ (Medium and long-term opportunities and risks of the biotechnological production of bulk chemicals from renewable resources), was funded by the European Commission 5th Framework programme under the Competitive and Sustainable Growth (GROWTH²) Programme.

¹ The BREW project dealt with major aspects of biotechnological production of bulk chemicals and chemical intermediates from renewable raw materials in the medium and long term (until 2050). http://www.chem.uu.nl/brew/


Contact: b.g.hermann@uu.nl

Themes: Biotechnology, Chemicals, Climate change & energy