

White biotechnology:

The chemical “factories” behind eco-fuels

Chemicals are going green. Advances in white biotechnology are not only enabling the production of biofuels, but also base and specialty chemicals. This is achieved using natural organisms: special types of bacteria and fungi are able to transform renewable raw materials into useful intermediate products efficiently and at little cost to the environment. Algae, meanwhile, can feed on the harmful greenhouse gas CO₂ to produce both fuel and chemical building blocks for use in industry. Cultivating algae in bioreactors has the potential to open up an alternative source of raw materials for the future – and replace conventional processes based on the use of petrochemicals. Together with partners from industry and the world of research, Linde engineers are working on plant modules, biorefinery concepts and biotechnology processes that will make optimum use of renewable resources – with the aim of shaping a greener future.

Now that oil and natural gas resources are becoming scarcer and more costly, the time has come to look for alternative raw materials to meet our energy and industrial needs. White biotechnology is becoming increasingly popular not only as an enabler of eco-friendly fuels and base chemicals for industrial processes, but also across various applications in the food, animal feed, cosmetics, textile and paper industries. Biotechnology is based on the use of microorganisms and enzymes to economically transform renewable raw materials into a variety of intermediate and finished products. Biomass – when sustainably cultivated and used – can potentially provide a long-term and environmentally friendly source of energy and raw materials. Innovative technologies are now available to efficiently process all kinds of biogenic raw materials in plants known as biorefineries.

These technologies can even convert the greenhouse gas carbon dioxide (CO₂) into a useful commodity with the help of special microorganisms. Here, modified algae cells transform CO₂, often sourced as an industrial by-product, into green crude. Different algae strains are used to produce bioethanol. Large-scale algae farms would be able to mass-produce these valuable industrial commodities. Bioethanol, for example, can be used as an alternative fuel for cars.

Meanwhile, even rubbish is proving to be a valuable asset, as demonstrated at several landfill sites in the USA where, thanks to innovative Linde technologies, biogas is being put to good use. The methane-rich gas released by the waste is first purified and then liquefied to produce fuel for the refuse trucks. It’s a win-win for the environment – turning biogas into fuel eliminates waste and reduces dependency on fossil fuels.

In order to supply “green” hydrogen for fuel cells, Linde has set itself the long-term goal of producing hydrogen (H₂) from renewable sources and thereby creating a fully sustainable energy value chain. In 2010, Linde went on stream with a pilot plant that generates hydrogen from crude glycerine at its Leuna site in Saxony-Anhalt, Germany. The glycerine occurs as a by-product of biodiesel made from plant oils such as rapeseed. Since autumn 2011, the Leuna pilot plant has been producing 50 cubic metres of green hydrogen per hour to supply new hydrogen fuelling stations in Berlin and Hamburg.

Plant modules based on renewable feedstocks can replace entire petrochemical production chains. Biomass can be used, for instance, to create building blocks for the chemicals industry which, up until now, were based on crude oil. It is even possible to produce a wide range of base chemicals using plant materials containing starch, oil or sugar. At the Chemical-Biotechnological Process Centre (CBP) in Leuna, work is underway to develop and optimise



biomass processes and thus bring them to industrial maturity even faster. Linde engineers are cooperating with a number of partners on projects to modify production technologies – and in so doing are helping to make the chemicals industry more sustainable. At the same time, the use of renewable raw materials will reduce the industry's reliance on crude oil.