BIOPLASTIC, FIBRES, ROPES MADE FROM ALGAE

SPLASH converts algae sugars and hydrocarbons to polymers

The project: Re-combinant biomass cultivation, extraction and conversion

The four-year SPLASH project, which started in November 2012, aims to use microalgae as raw material for the sustainable production and recovery of hydrocarbons and exopolysaccharides and to further convert these to renewable polymers.

Initially two industrial bioproduction platforms will be explored: the green algae Botryococcus braunii and the green microalgae Chlamydomonas reinhardtii, to which the unique hydrocarbon- and polysaccharide-producing genes from Botryococcus will be transferred. These algae should then be cultivated as new biomass. The biomass cultivation is targeted to reach a pilot scale. Subsequent steps will develop procedures for the production, *in situ* extraction, and isolation of sugars and hydrocarbons, which will be further processed into polymers: polyesters from sugars and polyolefins from hydrocarbons.

The product: Biobased food packs, fibres and new technology

The end products will include biobased food-packaging, as well as fibres for yarns, ropes, and nets. The project will develop the product to a proof-of-principle stage. The biomass cultivation should reach pilot scale through the project. The pilot scale is also anticipated for the conversion process from algae sugars and hydrocarbons to the polyesters and the polyolefins. Industrial upscaling will be done after the SPLASH project.

SPLASH will result in

- An infrastructure for the exploitation of microalgae;
- The development of new products such as bioplastics and biobased production technologies;
- The substitution of conventional petrochemical products with renewables;
- Highly skilled personnel with expertise in algal biotechnology, micro-algal cultivation, and processing technology;
- Knowledge transfer into the several SMEs associated with the project.

As the project started less than a year ago, no proofs of principle are available yet. Demonstration of the concept on a small scale is expected in the fourth year.

The end users: Industry, aquaculture, manufacturing, recyclers

- Chemical industry bioplastics industry, for the application of bulk chemicals;
- Biomass cultivation, aquacultures, recycling industries;
- Manufacturing, consumer goods, food and packaging industries, private consumers.

The inventors: Academia, research and technology organisations, SMEs/ Industry

At this stage of the project no invention has been made.

It is envisioned that in the long term the developed bioplastic products will be obtained in high purity for application in 'drop in' or new processes.

20 partners are collaborating in the project with 45% of universities and research institutes and 55% SMEs and large industries. The project is managed by Wageningen University,

Research centre/ Food & Biobased Research.

Development stage: Preparation of proof of principle and piloting

We hope to demonstrate the concept of conversion of algae sugars and algae hydrocarburats into polymers/ polyolefins on a small scale in 2016.

The project carrying out performs a stakeholders analysis to identify parties who, in addition to project partners, can influence the economic, social and market success of the newly developed microalgae production platform. By involving all stakeholders at an early stage information will be gathered about their perception of the project's added value. The stakeholder analysis aims to establish a dialogue between the project and the market/other stakeholders to enable demand-driven research and development.

The Dissemination, Exploitation and Intellectual Property Advisory board (DEIPAB) will advise the programme management team on matters to do with project strategy and the exploitation of the scientific and technological results of the project, including intellectual property management. Industrial project partners are important advisors.

Algae ponds and bioreactors: 4 different production systems of 24 m2 each and 3 of 2.5 m2 each are established (see pictures).

Policy impacts: Addressing political action plans through renewable feedstock

Currently, the majority of organic chemicals and polymers are based on fossil raw materials. Global petrochemical production is estimated at around 330 million tonnes. The primary output is dominated by a small number of key building blocks, which are mainly converted to polymers and plastics. This production requires large amounts of fossil fuels as feedstock and generates huge quantities of CO2. It also contributes to the depletion of world resources.

A significantly increased use of renewable feedstock in chemical or energy-related industries would not only reduce the impact of global warming, it would also significantly reduce Europe's dependence on foreign crude oil imports.

SPLASH addresses several European action plans and political measures that have been put forward in the last few years concerned with socio-economic, geopolitical and environmental challenges such as: (1) actions to continue and stimulate research and development by building a European knowledge-based bioeconomy; (2) decrease of CO2 emission (Kyoto Protocol; Copenhagen Climate Summit); (3) actions to broaden the carbon-resource basis from fossil to natural resources. The development of policies on biobased chemicals by the EC, however, similar to what has been done for biofuels, would positively stimulate the development and introduction of bulk chemicals from microalgae and other renewable sources on the market.

Next steps: Data gathering, future funding, upscaling

Microalgae biotechnology research is still at an early stage, even though industry clearly recognises its longer term industrial potential. There are two main hurdles to clear in order to push production of biopolymers from microalgae to the next level:

Speeding up hydrocarbon and polysaccharide metabolism to a level at which it becomes possible to set up larger-scale demonstration facilities which can be used to test and establish the quantity and quality of the produced hydrocarbon.

Establishing and corroborating technical and economic data on the cultivation and processing of microalgae in an industrial setting. There is no doubt that the market demand for hydrocarbons is there, but it is unclear when microalgae can reach price parity with petroleum and natural gas. Studies will deliver credible data on which to base further research and investment in microalgae.

Once the principal obstacles are overcome, the industry will be in a position to work with the scientific community on further tailoring the hydrocarbons toward desired molecule lengths that reduce energy consumption during cracking. Increasing production to (semi) production level should be possible within the next ten to fifteen years.

The concept of biorefineries, needed to cultivate and harvest hydrocarbons from microalgae, requires a multidisciplinary and transnational approach. So far scientific knowledge is spread over small research communities across Europe and applications exist only on a small scale. The technological development is at too early a stage for the existing sector to produce significant breakthroughs in unaided research: current costs are too high and technical risks too many.

It is therefore important that the European Commission has set a clear innovation agenda which connects industry needs with national policies towards sustainable international competitiveness for Europe's biochemical businesses. Funding of future projects will be essential.

SPLASH

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