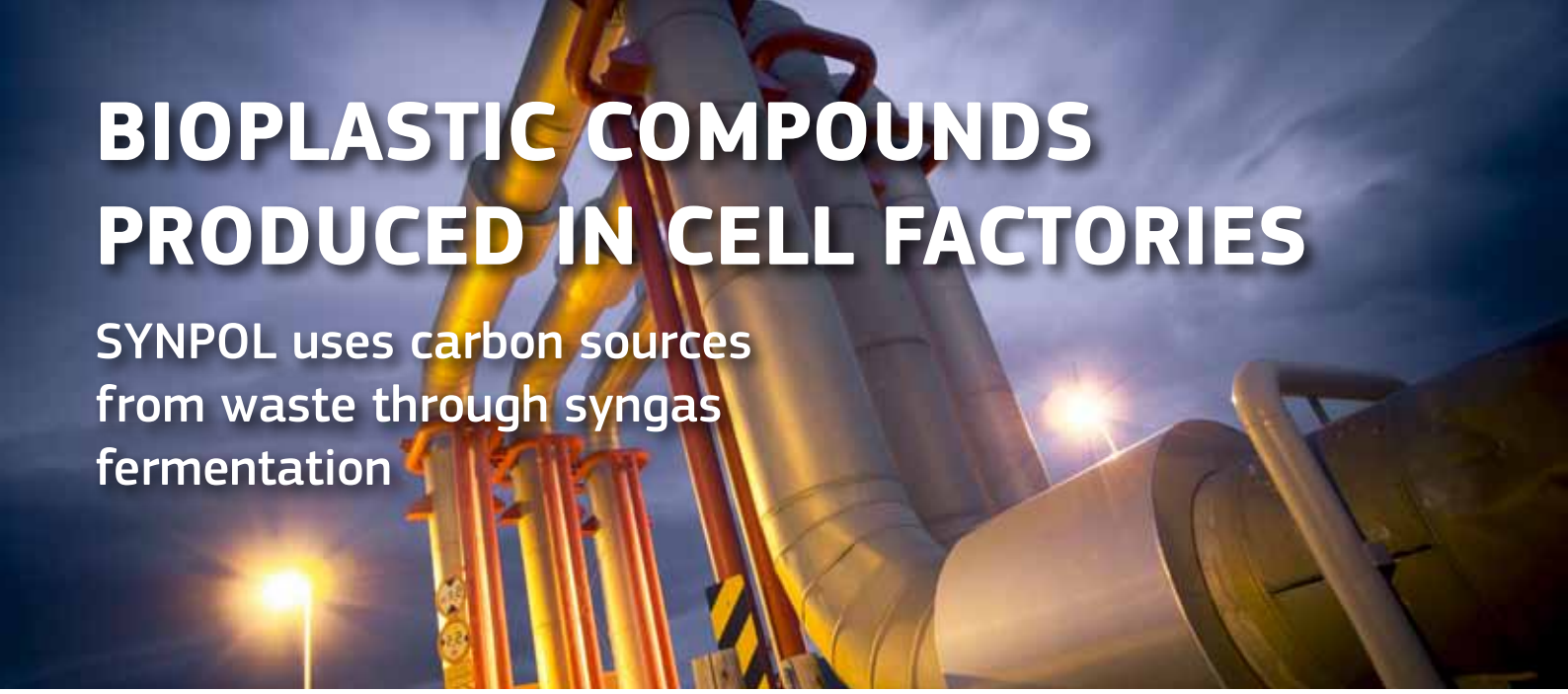

BIOPLASTIC COMPOUNDS PRODUCED IN CELL FACTORIES

SYNPOL uses carbon sources from waste through syngas fermentation

The project: Introduction of novel technology and biotech approach in Europe

Complex waste raw materials - such as municipal and chemical waste - which are pyrolyzed, gasified and then fermented by microorganisms, are the starting point of the SYNPOL project, which aims at producing 100% biodegradable bioplastic compounds.

Pyrolysis and gasification are widely regarded as the main viable large-scale options for biowaste disposal. Gasification, combined with biosynthesis processing systems, has become a promising industrial procedure. Research related to fermentative production of chemicals from CO/CO2 has

greatly increased in recent years since the potential for using biological means of converting CO/CO2 to chemicals has been recognised. Now the fermentation of synthetic gas (syngas) is an attractive technology for the production of biofuels and several industrial processes for ethanol production from syngas are already available from companies in the USA, New Zealand and Canada (e.g., Coskata, INEOS Bio, LanzaTech, Syngas Biofuels Energy, BRI Energy).

Unfortunately, these promising industrial processes have not yet been implemented in Europe. This is the point where SYNPOL starts. SYNPOL´s syngas fermentation technology opens a new window for the rational design of an innovative process to convert complex wastes into new biopolymers.

The product: Green plastics compounds, high added value chemicals, new processes

Bacteria will fermentatively produce bioplastics' basic compounds, the so-called PHAs (polyhydroxyalkanoates), out of the carbon fractions of the gas.

Different prototypes of biopolymers and their blends will be prepared from SYNPOL. Finally, the PHA, plasticizers and nano-clays will be further assessed for their physical and mechanical properties, for their appropriate end use in different sectors of the bioplastics industry as bulk chemicals, and as fine chemicals.

SYNPOL aims to convert complex waste into new cost-efficient biopolymers in three major steps:

- Gasification of different waste streams (urban and industrial waste) to produce synthesis gas (syngas);
- Fermentation of the carbon fractions of the syngas (CO and CO2) by using different natural and recombinant acetogenic bacteria to produce bioplastic building blocks and PHAs;
- Synthesis of biobased plastic prototypes with well-defined structures and improved properties for wide commercial use, through chemical and enzymatic catalysis by utilising the monomers and polymers produced during syngas fermentation.

Novel processing technologies are another end product: in particular the combination of new microwave-supported waste pyrolysis with syngas fermentation microbiology. To this end, SYNPOL will establish an integrated platform for biopolymers production. Reduced energy input and optimised purification of waste streams will contribute to the economic viability of end products.

The end users: Chemical industry, manufacturers of consumer goods

- Chemical and biotech industry (bulk chemicals, fine chemicals), bioplastic producers;
- Recycling industry and related services;
- Manufacturers, pharmaceutical industry, food producers, consumers.

SYNPOL links the notion of adding value to waste to representative members of European bioindustries, distinguished by an interest in the development of biotechnological processes, to produce biopolymers using wastes. The ultimate scope of SYNPOL is to establish a win-win situation between these bioindustries and the polymer industry, as a branch of the chemical industry.

The inventors: Research and technology organisations, academia and industry/SME

SYNPOL is coordinated by the Biological Research Centre (CIB), Madrid. The CIB is a publicly funded national research institute that belongs to the National Spanish Research Council (CSIC, Consejo Superior de Investigaciones Científicas).

Partners are: the Spanish National Institute of Carbon (INCAR-CSIC); UNIMAN (The University of Manchester); UULM (Universität Ulm); UCD (University College Dublin); HES-SO (Haute Ecole Spécialisée de Suisse Occidentale); KTH (Kungliga Tekniska Högskolan); WWUM (Westfälische Wilhelms-Universität Münster); UNISTRA (Université de Strasbourg); Biopolis (Biopolis S.L., Spain); Bioplastech (Bioplastech Ltd., Ireland); OWS (Organic Waste Systems NV, Belgium); BIONET (Bionet Servicios Tecnicos S.L., Spain); INFORS (Infors AG, Switzerland); BEFESA (Befesa Gestión de Residuos Industriales S.L., Spain).

Development stage: Proof of principle, upscaling

The ultimate goal of the project is the up-scaling to pilot stage and the design of technology for bioreactor plants and industrial fermentation, including lifecycle and cost assessments of future developments.

Strain design. Studies will be aimed at discovering the most efficient strains for syngas conversion into biobased chemical building blocks and biopolymers.

Process optimisation. The main steps of the process - syngas production, syngas fermentation, downstream process and biopolymer synthesis - will be optimised to increase the yield, reduce costs, and decrease environmental impact.

Exploitation Studies. Studies concerning degradation, lifecycle and production plant design will be undertaken in order to demonstrate the commercial viability and sustainability of the SYNPOL technology. These studies will also include activities for dissemination of results, training, and management.

Policy impact: Environment and economies

Over recent years, new environmental policies and social concerns have triggered intensive research into the production of specialised high added value chemicals from biochemical technologies, that are cost effective and benign to the environment. The knowledge generated through the innovative biotechnological approach of the SYNPOL project will not only benefit the environmental management of terrestrial waste, but also reduce the harmful environmental impact of petrochemical plastics. The strategy will enable a switch from the current state of negative development to an alternative development independent of fossil resources, which is an unquestionable environmental need.

Additionally, the SYNPOL project can provide the core knowledge for potential exploitation of different industrial biowastes, further promoting the integration of heterogeneous industrial sectors and expanding their business and service opportunities. Moreover, it will have an important impact on social, economic, ethical, legislative and educational aspects of everyday life, since its support of research in the production of biobased materials may lead to potential breakthroughs in the industrial sector, and to benefits for derived sectors such as food production, pharmaceuticals, packaging industries, recycling.

Next steps: Platforms, dialogue with industry

2013 is the first of SYNPOL's four years. In the next three years, SYNPOL will:

- Build durable partnerships between the project partners and the European biotech industry;
- Actively engage in mobilising private and public funds through competitive participation in research projects;
- Make use of research results by entering into dialogue with the European industry, so that novel products may find their way to the market;
- Provide the grounds for integrating research, training, and education within the bioeconomy;
- Stimulate public dialogue to attract young researchers to biotechnology research.

SYNPOL

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