DSM Background information

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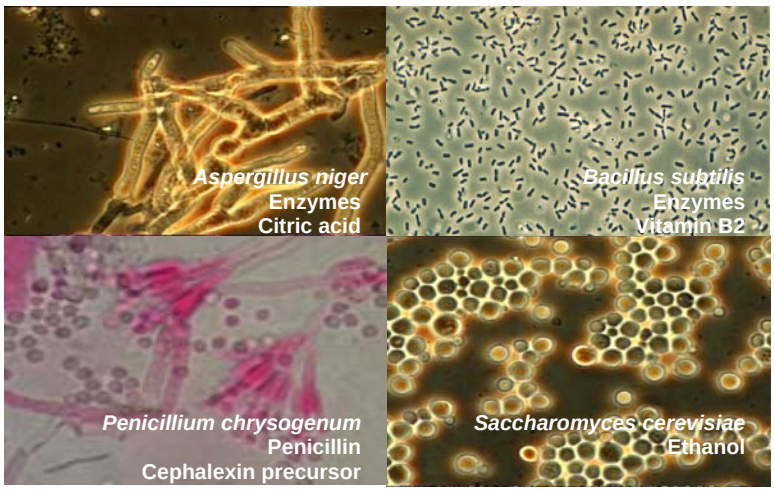
'White Biotechnology'

What is White Biotechnology?
White biotechnology, or industrial biotechnology as it is also known, refers to the use of living cells and/or their enzymes to create industrial products that are more easily degradable, require less energy, create less waste during production and sometimes perform better than products created using traditional chemical processes.

Not to be confused with red biotech (health-related applications of biological technology), blue (marine) biotech or green (agricultural) biotech, white biotechnology is widely regarded as representing the next evolutionary step towards a sustainable and environmentally-friendly chemical manufacturing industry, which itself creates the building blocks that comprise every man-made object and applications range from biofuels to pharmaceuticals, food nutrients, chemicals and other materials.

White biotechnology is not new. Indeed, biotechnology has been used in industrial applications for the creation of food nutrient, washing powders and other products for many years. However recent scientific advances in the fields of genomics, molecular genetics, metabolic engineering and catalysis, coupled with advances in enzyme and fermentation technology as well as external factors such as soaring energy prices, renewed environmental concerns and energy security fears, have combined to make white biotechnology more important than ever.

Human knowledge of white biotech has evolved to the point where today, products derived from white biotechnology often display better performance, higher sustainability and more commercially-viable characteristics to products created from traditional chemical procedures.



White Biotechnology today
White biotechnology works by marshalling living cells into micro-factories that, by using biomass as a feedstock rather than traditional petrochemicals, create a variety of materials with energy efficiency, increased productivity and better safety and environmental characteristics than could have been otherwise achieved by traditional means.

Today, DSM is the global leader in white biotechnology, with a fermentation network comprising 13 plants worldwide and a total fermentation capacity of over 30 million cubic metres per year. The technology has already brought DSM measurable success in reducing raw materials consumption and greenhouse gas emissions for itself and its customers.

DSM's white biotech activities now account for over €1.5bn in annual revenues, mainly through its application in the food nutrition and antibiotics businesses, but also from other business areas.

To give an example of the benefits of white biotechnology over traditional production means, the introduction of white biotech-based advanced fermentation technology at one of its antibiotics plants in Delft, the Netherlands, enabled the firm to replace a

complex 13-step chemical process with a one-step fermentation, two-step enzyme process, with the result of energy savings of 65% and a halving of raw material costs.

As well as utilising white biotechnology in existing business streams, DSM is also at the forefront of new applications for white biotechnology. For one initiative, the DSM is collaborating with the French company Roquette to produce for the first time succinic acid – a chemical building block used in the manufacture of resins, films, food and clothing among products – using biological means.

This collaboration with Roquette in the production of bio-succinic acid is significant as, by using a biological route rather than a chemical route, the partners expect to achieve a 40% reduction in energy requirements and an actual positive impact on CO2 levels, as carbon dioxide is actually used in the production process.

DSM and Roquette will open a demonstration plant for Bio-succinic acid in France in late 2009. The purpose of the demonstration plant is to refine the production process in preparation for full, industrial-scale commercial production, which could happen as soon as 2011/2012.

Successful production of bio-succinic acid at the industrial level will help provide the knowledge, economies of scale and new markets for bio solutions in other fields including pharmaceuticals, fuel, chemicals, food and feed and materials.

In the materials space, DSM already has a head start, with a strong position across the whole biomaterials value chain from feedstock processing to primary conversion, secondary conversion, bio-compounds and formulation.

Bio-succinic acid can be applied for the production of agricultural films (e.g. PBS) that after usage can be 'shreddered' and ploughed back into the soil. These bio-based

PBS films are thus biodegradable and consequently will be degraded within two months in the soil.

2nd generation: The Future of White biotechnology
White biotechnology is already delivering considerable savings, both financially and environmentally, by reducing or eliminating our reliance on scarce resources and reducing greenhouse gas emissions from production. However, application of white biotechnology on an industrial scale nowadays relies on scarce resources: sugar and starch. With reliance traded from one set of commodities to another, the resulting scenario is one where unsustainable demand from industry for sugar and starch would have catastrophic knock-on effects on food and other crop prices.

Today, as an outcome of wide ranging research by industry, governments and research institutes, progress is beginning to be made in the formulation of next generation technology which enables the recovery of sugar from biowaste rather than food crops or the production of high yield crops such as switchgrass from non-agricultural land. This technology goes a long way to ensuring that demand for biofuel will be able to be met – with the correct regulatory and governmental assistance – without any meaningful impact being made on food prices or food production.

DSM has already invested hundreds of millions of euros in white biotechnology and has placed its ambition to be at the forefront of a technology which it believes will transform the nature of manufacturing at the very heart of its business strategy. Working with key international partners including the US Department of Energy and Roquette, DSM's holistic approach to solving the complex business, societal, scientific and logistical challenges surrounding applications for white biotechnology will see it continue to partner with those organisations which, using DSM's world-leading technology, it believes offers the strongest chance to provide a better, more cost effective solution for meeting the planet's fuel, drugs, food and other needs than those offered by traditional chemistry.

DSM – the Life Sciences and Materials Sciences Company
Royal DSM N.V. creates solutions that nourish, protect and improve performance. Its end markets include human and animal nutrition and health, personal care, pharmaceuticals, automotive, coatings and paint, electrical and electronics, life protection and housing. DSM manages its business with a focus on the triple bottom line of economic prosperity, environmental quality and social equity, which it pursues simultaneously and in parallel. DSM has annual net sales of about € 8 billion and employs some 22,700 people worldwide. The company is headquartered in the Netherlands, with locations on five continents. DSM is listed on Euronext Amsterdam. More information: www.dsm.com