Environmental biotechnology

Heavy metals in soil and drinking water, landfill leachate, dirty laundry – why not get nature to help us in our efforts to clean soil, laundry and water? Biotechnologists are increasingly learning how to apply the knowledge about biological metabolic processes in the field of environmental protection, including waste management and environmental rehabilitation. Environmental biotechnology is a field with great potential. In future, bacteria and other microorganisms will most likely also contribute to sustainability and cost efficiency in other areas, including the cosmetics and detergent industry as well as in the production of fine and bulk chemicals.

Wastewater treatment systems of Wehrle Umwelt GmbH rely on biomembrane systems

Wastewater treatment plants are nothing without bacteria. These invisible single-celled organisms put their metabolism to good use in the purification of polluted wastewater. Environmental biotechnology is something that was applied with no expert knowledge hundreds of years ago but is now subject to in-depth investigation and has led to the emergence of an entire branch of industry and science. For example, environmental biotechnologists aim to make bacterial biochemical degradation pathways even more efficient by analysing the composition of bacterial communities in wastewater treatment plants or in landfill leachate and by elucidating the biochemical pathways used by the bacteria. This includes analysis on the process level designed to optimise the efficiency of wastewater treatment plants and to develop new waste disposal procedures.

Protecting the environment and achieving cost savings

There are many examples of areas where environmental biotechnology can be applied. By focusing on selected examples, the current dossier shows Baden-Württemberg at the forefront of exploitation and investigation of the potential of environmental biotechnology. Scientists from Tübingen have developed a method involving mineral-forming bacteria that degrade arsenic in water. Biotechnology has also proven useful for the remediation of contaminated soils. The company IBL Umwelt- und Biotechnik GmbH in Heidelberg has developed an in situ technology where naturally occurring soil microrganisms can be activated in several steps, leading to the degradation of mixtures of toxic substances such as benzene, toluene and aliphatic and chlorinated hydrocarbons.

Biosensors used for the detection of harmful substances in water, air and soil are the key tools of environmental biotechnology. Researchers are developing systems based on microorganisms of enzymes that can help indicate environmental toxins. Since 1996, the European Union has required that their member states continually monitor air pollution.

Mosses that grow on trees are excellent indicators for airborne pollution.

This requirement was tightened in 2008 with an EU directive to monitor not only nitrogen oxides and sulphur oxides but also airborne heavy metals like cadmium, lead and nickel. This is hard to achieve with existing technologies as they are either imprecise or very expensive. A group of researchers led by Prof. Dr. Ralf Reski is part of the MOSSCLONE consortium, which receives funding of 3.5 million euros for three years from the EU under its Eco-innovation initiative, whose objective is to develop a novel, precise and inexpensive method to monitor air contamination, especially by heavy metals. The innovative method is based on the use of mosses, which are well suited as bio-indicators for airborne pollution.

Saving raw materials and resources is another form of environmental protection. Growing interest in and use of renewable fuels suggests that it is likely that the importance of biotechnology in this area will increase significantly over the next few years, for example with regard to the production of bulk chemicals, which up until now have been produced using petrochemical manufacturing methods.

The production of biosurfactants used in washing agents and soap is another classic area where biotechnological methods are used. The application of enzymes isolated from extremophilic microorganisms, which are active at extreme temperatures, might also lead to a reduction in energy consumed. Washing agents containing such enzymes can be used at lower temperatures and help save electricity. Modifying production processes also helps companies to save money as biotechnological methods, once established, are in many cases cheaper than methods involving inorganic catalysts.

Considerable economic potential, in particular in emerging countries

The use of biotechnological methods in environmental protection therefore has considerable potential in many respects, including on the global level. Wehrle Umwelt GmbH, a company headquartered in the city of Emmendingen close to Freiburg, is very active in the Asian market where it builds plants for the treatment and purification of landfill leachate. The company has even become a market leader in this field in the Far East. ET&T (Environmental Training and Transfer GmbH), a subsidiary of IBL Umwelt- and Biotechnik GmbH Heidelberg, makes its money in countries such as Brazil, China and Iran where it offers education and training programmes related to the remediation of environmental damage.

The potential of environmental biotechnology has also been recognised on the political level. For example, the Baden-Württemberg government supports the establishment of a network focused on environmental technology. The network brings together companies and research institutions with skills in the field of biotechnology. According to the German Federal Environment Agency estimates an annual growth of 5.4 percent between 2005 and 2020 and believes that environmental biotechnology therefore has the potential to create and secure jobs. However, in order to be able to tap into new markets, invent innovative methods and further develop environmental protection in Germany and elsewhere, companies and research institutions need qualified staff. A cooperation model involving four universities in the STERN Bioregion shows where such skilled staff can be found – the four universities have come together to offer a joint master's programme on environmental protection.

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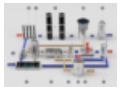

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