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CTI Success Story

Voracious Bacteria as Ecological Remediation Agents

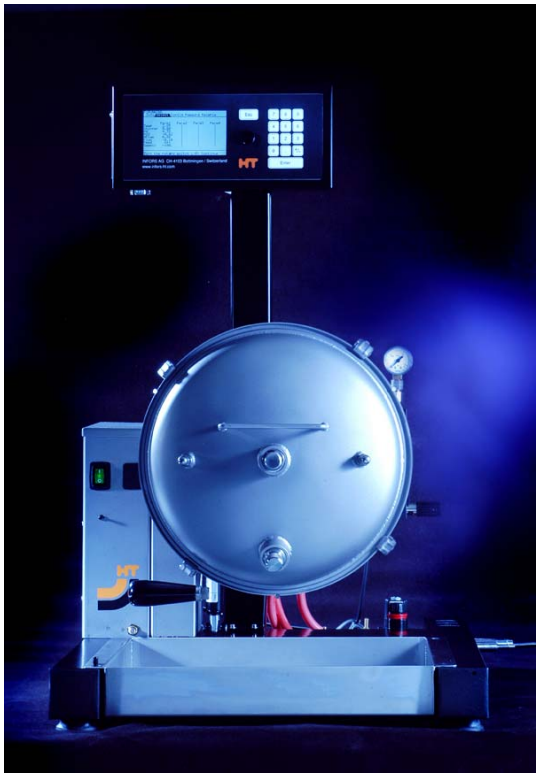
Biologist Trello Beffa mobilises selected microorganisms to treat contaminated soil and groundwater. The fermenter specialist Infors is his know-how partner of choice for the development of a bioreactor that is suitable for the speedy, cost-efficient implementation of biodegradation processes.

For a number of years, microorganisms have been used for environmental bioremediation, e.g. in the event of oil spills. The microorganisms utilise most mineral oil components as carbon and energy sources. Most of the contaminants are decomposed, but only where the soil is porous and the ground fauna and flora are intact. Microorganisms fail where the oil slick is loosened from the ground with the help of hot steam, as this method sterilises the soil.

In fact, microorganisms boast a substantial potential for bioremediation procedures. The conventional approach is to excavate the contaminated soil and send it to special incineration plants or waste sites. Instead of solving the problem, this cost-intensive procedure postpones it until a later date, as the hazard is not eliminated.

Speeding Up of Natural Degradation Processes

In contrast, microorganisms can often decompose contaminants to non-toxic compounds directly in the soil or in the groundwater. With the support of the Swiss National Science Foundation (SNSF) and CTI, Trello Beffa, head of the biodegradation group at Neuchâtel university, has developed procedures for isolating bacteria and fungi for biotechnological applications.



The TERRAFORS bioreactor. Photo: MADEP/Infors

"Unlike traditional treatment techniques based on chemical and mechanical methods, bioremediation procedures based on microbacterial technologies represent a speedy, cost-efficient way to accelerate natural degradation processes", explains Trello Beffa. "Most common contaminants, such as hydrocarbons, mineral oils, chlorinated solvents, phenol, and soon dioxin, as well, can be decomposed by bacteria and fungi."

Laboratory Procedures for the Market

With his team, Beffa discovered that certain bacteria that are suitable for recycling urban and industrial organic wastes rapidly proliferate at high temperatures during composting. Thus, he came up with the idea of establishing a bioreactor and using suitable microorganisms under specific, controlled ambient conditions for the development of organic waste treatment procedures. Within the scope of its priority programme SPP BioTech, SNSF financed a rotating 110-litre pilot bioreactor, the first to enable continuous stirring and homogeneous mixing of the material. Beffa planned to transform the experience gained with this unit into a compact, robust mini-reactor. Alexander Hawrylenko and his company Infors AG in Bottmingen, one of the world's first manufacturers of innovative fermenters for research, process development and small-scale production, proved to be a suitable know-how partner, with whom he could materialise this vision. CTI supported Beffa in financing the research expenditures. In 2002, Beffa established MADEP SA as a spin-off of Neuchâtel university. After several years of intensive research and development, the TERRAFORS bioreactor was presented in summer 2005.

The 15-litre stainless-steel tank is a rotating drum that mixes ground samples, organic wastes, and natural and contaminated solids. Special microbe communities can be selected and cultivated in a precisely controllable environment. This includes bacteria (including actinomycetes) and fungi (including mould and yeast) with aerobic, microaerophile, and anaerobic needs over a wide temperature range. Combined with the IRIS data collection and control software, TERRAFORS facilitates the evaluation of aspects of biodegradation, bioremediation, and the fermentation of solids, as well as the speedy optimisation of the required processing parameters.

Large Deployment Field: Omnipresent Contamination Sources

The technology can be deployed for process development and screening under laboratory conditions, wastewater treatment, soil bioremediation, recycling of solid and semi-solid wastes, composting, and process development in the field of solids fermentation.

However, the bioreactor and the voracious bacteria from Trello Beffa's laboratory can also be used for other decontamination processes, as potential contaminants like heavy metals, hydrocarbons from gas factories, or chlorinated solvents from the industry are ubiquitous. Switzerland obtains almost 80% of its water supply from underground watercourses. The shooting ranges, for example, where hundreds of pounds of lead, antimony, and arsenic infiltrate the soil every year, represent a serious problem. At the same time, soil contamination has an impact on other ecological components, such as the atmosphere, hydrosphere, biosphere, and lithosphere. According to the Federal Office for the Environment (FOEN), Switzerland has approximately 60,000 contaminated sites, 4,000 of which are in need of remediation. Thus, there is still a lot to do for the bioreactors and their voracious bacteria and fungi.

Further Information

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