Institut "Jožef Stefan" Ljubljana, Slovenija

TECHNOLOGY OFFER

NOVEL HYDROPHOBIC POROUS ALGINATE CARRIERS WITH INCORPORATED MICROORGANISMS FOR CLEANING OIL SPILLS

Fields of use

Soil and water pollution; Soil and water treatment; Remediation of contaminated sites; Environment; Environmental Biotechnology; Maritime Industry and Services; Molecular biology; Biotechnology

Current state of technology

TRL4. Technology validated in the lab.

Type of cooperation

Technical cooperation agreement, Joint venture agreement

Intellectual property

A patent application was filed at the European Patent Office in 2023.

Developed by

Jožef Stefan Institute

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Summary

The Jožef Stefan Institute has developed a method for the synthesis of novel alginate hydrogel for use as a bacterial carrier for the removal of hydrophobic pollutants such as oil, polycyclic aromatic hydrocarbons (PAH), total petrolium Hydrocarbons (TPH), pesticides, etc. The institute is looking for partners that specialise in the remediation of contaminated soils and water, especially following oil spills.

Description of the invention

A release of oil to the environment (e.g., tanker incidents, engine oil spills, improper disposal, etc.), whether by accident or otherwise, threatens contamination of soil, ground and surface waters, thereby endangering drinking water supply, and terrestrial and aquatic fauna and flora. In humans, exposure to oil spills can lead to severe health problems such as respiratory damage, eye and skin irritation, heart and liver damage, decreased immunity, and increased cancer risk. Therefore, quick and efficient clean-up of oil spills, without damaging the local ecosystem, is essential to minimise their negative impact.

While traditional clean-up methods such as chemical or manual containment and removal often result in rapid results, bioremediation is less labour-intensive and prevents chemical or mechanical damage. The biodegradable carriers used in bioremediation processes with microbial bioaugmentation harbour cells and enable prolonged use of cell biomass, protection of cells from harsh environmental conditions, decrease microbial competition with autochthonous microbiota as well as prevent protozoan grazing of introduced microbial biomass and provide a stable local environment (pH, ionic strength, nutrients).

The preparation of hydrophobic porous alginate as a carrier for bacterial immobilisation for the purpose of oil remediation has never been sufficiently optimized due to the technical limitations, limited biodegradability, and procedures deleterious to the microorganisms (low pH, freeze-thawing or high temperatures).

The Jožef Stefan Institute has developed a method for the preparation of novel hydrophobic porous alginate carriers with incorporated microorganisms that due to its properties can be used in soil and water bioremediation hydrophobic pollutants.

Main Advantages

The main advantages of the proposed solution:

- Sufficient carrier porosity for successful binding of the microorganisms and suitable conditions for the survival of microorganisms which in turn increases their soil or water bioremediation efficiency following oil spills
- The synthesis of novel carriers is performed in standard conditions and requires less energy compared to the traditional methods
- Sufficient surface hydrophobic properties for increased efficiency

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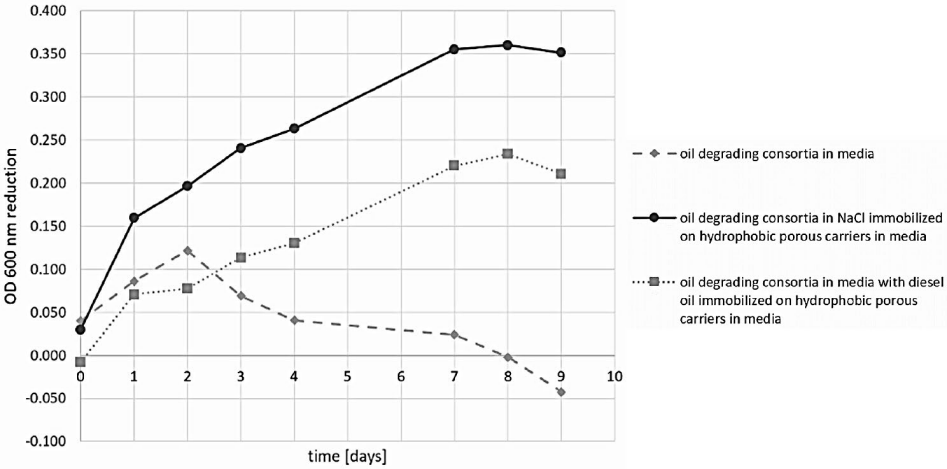

Figure 1: Oil degradation efficiencies of immobilized and free-living oil degrading bacterial consortia. The oil degradation is monitored by the reduction of 2,6-dichlorophenolindophenol (DCPIP), which is equivalent to enzymatic degradation of oil by bacteria. Three different scenarios were tested: (i) oil degrading consortia inoculated in liquid media, (ii) oil degrading consortium immobilised on carriers in 0.9 % NaCl, and (iii) oil degrading consortium immobilised on carriers in minimal media with diesel oi. Higher light absorption values tested supernatants at OD600nm represent higher removal efficiencies.

About us

The technology has been developed at the Department of Environmental Sciences (O2), Jožef Stefan Institute, whose researchers have several decades of experience in colloid biology, including different molecular microbiology techniques, development of advanced isolation and characterization techniques of bacteria and their consortia, cell surface modifications, immobilisation of bacteria, bacterial aggregations, artificial biofilm construction and microfluidics. The Jožef Stefan Institute is the leading Slovenian institute with over 1150 employees, covering a broad spectrum of basic and applied research.

Partner Sought

Partners are sought among the companies that specialise in the remediation of contaminated soils and water, especially following oil spills. The role of the partner sought is to apply the novel hydrophobic porous alginate carriers with incorporated microorganisms in the remediation of oil spills. If the partner is able to implement the method successfully, they will be invited for the commercialization of its results.