Press release, 2025

Aiming for zero-pollution future

Is bioremediation a solution?

Due to human activity, the environment is heavily polluted by different contaminants. Microplastic, oils, heavy metals and a wide range of pharmaceuticals, from ibuprofen to antibiotics, are broadly distributed in our soils and water bodies and have a negative impact on environment, human health and wellbeing. Are you aware that in Europe there is sits which need to be cleans? An estimated 2.8 million sites across the EU may be contaimanted. Fortunately there is effective solution to tackle this problem – it is called BIOREMEDIATION.

Throughout millennia nature has been using its self-healing abilities. In a completely natural process organic matter is decomposed into its constituent parts, recycling the nutrients contained therein while emitting by-products. For example, large number of bacteria that is present in every gram of soil, provide it with the ability for self-cleaning. This may take e.g. the form of enzymes that degrade pollutants or bacteria that modulate heavy metal uptake in plants.

However, the human activities have had a devastating impact on the natural world, that our environment cannot handle by itself. Our activity has polluted the environment with myriad chemicals, hydrocarbons and other contaminants, compromising the quality of soil and groundwater. In results it affects climate change, food security and our well-being. Of course we can try to help the environment by using standard remediation options like burying polluted soils in landfills or applying chemical remediation. But these measures are often disruptive, intrusive, expensive and can damage delicate ecosystems and human health.

Fortunately, there is an alternative. We can help optimise and accelerate healing actions by using nature-based method like bioremediation. A process that uses living organisms like bacteria, fungi, animals, green plants or their enzymes to either eliminate toxic environmental contaminants by their complete conversion to inorganic products or by their transformation to nontoxic compounds. Pre-cultivated, multiple biologics consortia, which are designed and engineered in a laboratory setting, can target specific contaminants and more efficiently remove them from the contaminated area.

Bioremediation benefits in comparison with standard cleaning measures are well established. The Exxon Valdez oil spill polluted nearly 2,000 km of Alaska's coastline with heavy crude oil. To support recovery, oleophilic fertilizers were

applied to stimulate native oil-degrading microorganisms and accelerate biodegradation.

Long-term monitoring shows that this approach was largely successful – most contaminants were broken down, and today only small traces of the most persistent oil components remain. This case is a landmark example of effective large-scale bioremediation.

Other example concerns sensitive microbial ecosystems such as marshes and wetlands where standard measures could disrupt and cause long term damage to the environment. Arcata Marsh and Wildlife Sanctuary in USA used the collaborative effort of microbes and plants in wastewater treatment, providing a sustainable and natural filtration system for urban runoff. While in Southeast Asia native plants such as Pteris vittata, act as hyperaccumulators, absorbing and accumulating heavy metals like arsenic from contaminated soil, providing a natural and effective remediation process.

Bioremediation methods can be far more effective in tackling environmental pollution than other, more traditional methods of site cleaning where pollutants are not destroyed and the problem is merely moved from one matrix to another. They are less intrusive and can facilitate the remediation of environmental impacts without damaging delicate ecosystems. Bioremediation does not increase the health risk for workers. It can be a much cheaper method compared to standard options such as incineration or landfill. Bioremediation can be applied in many different contexts, including soil, water and even air, acting on many different types of pollutants, including petroleum substances, heavy metals, pesticides, making it a very flexible method. Furthermore, it is a permanent method of removing contaminants. Organisms are able to continue the process of removing contaminants for a long time and even after the end of the bioremediation application.

The benefits of bioremediation are vast and significant. However, to attain them an optimisation and acceleration of bioremediation applications is indispensable, also in the perspective of tackling situations generated by very recalcitrant contaminants or mixed pollutants. The EU-funded environmental biotechnology **Nymphe** project (New system-driven bioremediation of polluted habitats and environment) aims to do just that. It explores innovative nature-based, low-energy and low-chemical bioremediation solutions to revitalize land and waters affected by deep environmental contamination. The ambition is to remove multiple pollutants (such as microplastics and pesticides in the agricultural soil, and chlorinated solvents and petroleum hydrocarbon in groundwater and sediments in the industrial area) from different contaminated sites in Europe. **Nymphe's** actions will improve the ecological quality and health of soils and waters.

We aim to select the most promising biologics (species of bacteria, fungi, algae, plants, worms, bivalves... or even just enzymes extracted from living organisms), improve the best candidates, combine them in bioremediation systems with

optimal decontamination properties. We will use consortia of different microbes that are characterised by a higher stability and greater efficiency than single strains and possibly combine them with other organisms to obtain assemblies of living organisms with high fitness for the contaminated environment as high efficiency in biodegrading the contaminants.

More information: www.nympheproject.eu
Karolina Niedziółka, k.niedziolka@innowo.org