Reseachers developing a technique combining the use of nanoparticles and bioremediation to decontaminate polluted soils

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Polluted soils. Credit: Elhuyar Fundazioa

The Basque Institute of Agricultural Research and Development Neiker-Tecnalia is currently exploring a strategy to remedy soils contaminated

by organic compounds containing chlorine (organochlorine compounds). The innovative process consists of combining the application of zero-iron nanoparticles with bioremediation techniques. The companies Ekotek and Dinam, the UPV/EHU-University of the Basque Country and Gaiker-IK4 are also participating in this project known as NANOBIOR.

Soils affected by organochlorine compounds are very difficult to decontaminate. Among these organochlorine compounds feature some insecticides mainly used to control insect pests, such as DDT, aldrin, dieldrin, endosulfan, hexachlorocyclohexane, toxaphene, chlordecone, mirex, etc. It is a well-known fact that the use of many of these insecticides is currently banned owing to their environmental impact and the risk they pose for human health.

To degrade organochlorine compounds (organic compounds whose molecules contain chlorine atoms) present in the soil, the organisations participating in the project are proposing a strategy based on the application, initially, of zero-iron nanoparticles that help to eliminate the chlorine atoms in these compounds. Once these atoms have been eliminated, the bioremediation is carried out (a process in which microorganisms, fungi, plants or enzymes derived from them are used to restore an environment altered by contaminants to its natural state).

The bioremediation process being developed by Neiker-Tecnalia comprises two main strategies: biostimulation and bioaugmentation. The first consists of stimulating the bacteria already present in the soil by adding nutrients, humidity, oxygen, etc. Bioaugmentation is based on applying bacteria with the desired degrading capability to the soil. As part of this process, Neiker-Tecnalia collects samples of soils contaminated by organochlorine compounds and in the laboratory isolates the species of bacteria that display a greater capacity for degrading these contaminants. Once the most interesting strains have

been isolated, the quantity of these bacteria are then augmented in the laboratory and the soil needing to be decontaminated is then inoculated with them.


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Credit: Elhuyar Fundazioa

Bank of effective strains to combat organochlorines

The first step for Neiker-Tecnalia is to identify bacterial species capable of degrading organochlorine compounds in order to have available a bank of species of interest for use in bioremediation. This bank will be gathering strains collected in the Basque Country and will allow bacteria that can be used as a decontaminating element of soils to be made available.

The combining of the application of zero-iron nanoparticles and bioremediation constitutes a significant step forward in the matter of soil decontamination; it offers the added advantage of potentially being able to apply them in situ. So this methodology, which is currently in the exploratory phase, could replace other processes such as the excavation of contaminated soils so that they can be contained and/or treated. What is more, the combination of the two techniques makes it possible to reduce the decontamination times, which would take much longer if bioremediation is used on its own.

Provided by Elhuyar Fundazioa

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