



text: Dr. Małgorzata Kłoskowicz

# PLANTS AND BACTERIA AS RESCUE FOR CONTAMINATED SOIL



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Let us imagine there had been a spill of heating oil in a single-family home. As a result of this incident, the area located under the building became contaminated. A ditch was dug around the building, appropriately selected bacteria were introduced into the soil by means of a drainage system, and then for several months the gradual cleansing of the soil was monitored. This is a Finnish example of using biological methods to clean up contaminated sites. At the University of Silesia, these methods are being developed by Dr. Magdalena Pacwa-Płociniczak and Assoc. Prof. Tomasz Płociniczak.



## BIOLOGICAL CLEANING METHODS

It is no secret that both bacteria and some plant species are able to survive in the most unfavorable, even extreme conditions. Such places certainly include areas contaminated with various compounds, both organic and inorganic, including hydrocarbons and heavy metals. According to research, some organisms thrive in such an environment and even... cleanse it naturally of contaminants.

Scientists try to learn as much as possible about these extraordinary abilities of certain bacterial strains and selected plant species in order to create a unique “arsenal” which would provide support in the remediation of contaminated areas.

In one of her projects, Dr. Magdalena Pacwa-Płociniczak analyzed the possibility of using different strains of bacteria for the purification of soil from organic compounds. The biologist isolated the bacteria and subsequently checked in the laboratory which of them have the greatest potential with regard to bioremediation and how they are able to survive even in very difficult conditions.

“My husband’s interests are very similar. I knew that for a while he had been researching plants that could also support processes interesting for me. We joined forces and started working together to improve natural, biological methods to clean up areas contaminated with organic and inorganic compounds by using microorganisms and carefully selected plant species,” the researcher says.

Scientists from the University of Silesia, on the one hand, conduct research to improve known methods, and on the other – intensively cooperate with companies, private owners, or local government units to use the acquired knowledge in practice and, on this basis, propose the best solutions tailored to clients’ needs. The most important thing is to look for the most environmentally-friendly way to clean up the contaminated area in a non-invasive manner.



Left: ability to produce hydrocyanic acid (orange colored blotting paper).  
Middle: dissolution of tricalcium phosphate (zones of translucency around the colony)  
Right: ability to produce iron-binding siderophores (orange coloration around the colony)  
/ Photo: Tomasz Płociniczak

## A “SET” OF MICROORGANISMS AVAILABLE ON REQUEST

There are no two areas which would be the same in terms of the type and concentration of pollutants. Each environment also has a unique “set” of microorganisms that adapt to the given conditions. This is an important hint from nature. Moreover, various plant species which accelerate and support the remediation process may also grow in such an area. An additional necessary element is a little ingenuity to propose effective, environmentally-safe solutions.

“When an owner of an area to be cleansed contacts us and is interested in using biological treatment methods, we first have to carefully examine the area and consider what “kit” to offer,” Dr. Magdalena Pacwa-Płociniczak says.

One of the people the scientists collaborated with asked for a solution designed for a contaminated area located in the Opole Voivodeship (province).

“An interesting fact is that this person was familiar with the potential of bioremediation methods. Maybe that is why we did not have to convince them about the benefits of using natural techniques,” Dr. Tomasz Płociniczak adds.

Firstly, soil samples were collected and analyzed. The scientists had to identify the types of pollutants and their concentrations, and check what microorganisms were present in the area.

“This is one of the most important questions. In the method which is

being developed, we try to use those microorganisms that already inhabit a given area. The introduction of other ones could lead to local “fights”, and thus contribute to a decrease in the effectiveness of the method,” Dr. Magdalena Pacwa-Płociniczak explains.

Moreover, the case in question required consultation with a geologist. It turned out that a nearby installation had lost its tightness and contamination was constantly flowing in, causing the concentration of soil contaminants to increase. Thus, a one-time cleanup of the area would not produce the expected and lasting results.

After learning the answers to the most important questions, Dr. Tomasz Płociniczak proposed to build six special wells.

“Contaminated water from the designated area was accumulated in them. There, we also applied useful microorganisms isolated from this area, which we knew could break down organic pollutants. The water was also aerated and heated so that conditions were conducive to the multiplication of the organisms selected by us,” the scientist explains.

The water purified in this manner was then poured over the contaminated area. It infiltrated the soil and, along with the subsequent contamination, was returned to the well. Then, the entire process started all over again.

“Therefore, we proposed a closed system to biologically cleanse soil contaminated with organic substances, using water as a carrier of pollutants and beneficial bacteria at the same time,” Dr. Tomasz Płociniczak adds.

## MASTERING NATURE

In our country, biological methods of treating sites contaminated with organic and inorganic compounds are still not very popular. Biologists from the University of Silesia do not hesitate to point out four factors that may be relevant in this respect.

Firstly, it is not a universal solution. Scientists do not use ready-made biological “vaccines”, although there are some on the market. They treat each case individually and must first examine the contaminated area with regard to the type and concentration of contaminants and the microorganisms present in it. Sometimes the specificity of the area requires additional consultations, as in the case of the Opole Voivodeship, which may generate additional costs. They are tailor-made solutions, so the price goes hand in hand with quality.

Secondly, the activity of microorganisms and plants takes time. Sometimes it is the case that the client can wait for the biological method to become effective. A mining waste to be used as

a recreational area for residents does not have to be made available in one month; its preparation can take several years if environmental concerns are the priority. The situation is different for the owners who want to start putting their plans into practice as soon as possible.

“How do they proceed? They rent trucks and drive several hundred times with the contaminated soil in order to transport it elsewhere. Subsequently, uncontaminated soil is brought to the site. Such action certainly takes less time, but is more expensive and, above all, it disrupts the natural biological balance. What is the gain? The removed soil does not disappear, it has to find a new place, and moreover, it is rarely the case that only the land intended for the construction of buildings is contaminated. As time passes, harmful organic or inorganic compounds make their way back to the site via various natural routes, and the landowner is back at the point where the problem started,” Dr. Tomasz Płociniczak comments.

Thirdly, efficacy. Scientists are aware of the challenges connected with the

use of biological methods for cleaning up contaminated sites.

“We are not fully able to master nature. We “employ” plants and/or microorganisms to help us. Research is being conducted, and we continue to learn more about the mechanisms which allow organisms to survive in contaminated soil. Therefore, the bioremediation process must be monitored and may require various improvements or modifications. We are prepared for this,” Dr. Magdalena Pacwa-Płociniczak says.

And above all: awareness. Scientists regretfully admit that, in many parts of the world, including Poland, care for the environment is unfortunately still in the fledgling stage. “We would like to believe that in the future there will be no need to convince anybody of the superiority of biological over chemical and physical methods. The natural ways of remediating contaminated areas, chosen according to the specifics of the area, do not change its character and ultimately contribute to the preservation of valuable biodiversity,” the biologists from the University of Silesia conclude.

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