



Bioremediation and Waste Treatment

Process and Technology



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Pollution

- Sources and causes
- Effects
 - Human health
 - Environment
 - Environment health information
 - Pollution control
 - Practices
 - Devices
- Marine pollution
- Types of pollution
 - Acidification
 - Euthropication
 - Plastic debris
 - Toxins
- Nutrient pollution
 - Nutrient remediation



Environmental Remediation

- Remediation standards
- Site assessment
- Funding remediation
- Mapping remediation
- Remediation technologies
 - Thermal desorption
 - Excavation or dredging
 - SEAR - surfactant enhanced aquifer remediation
 - Pump and treat
 - Solidification and stabilization
 - In situ oxidation
 - Soil vapor extraction
 - Nano remediation
 - Bioremediation
- Community consultation and information
- Incremental health risk
- Emissions standards
- Transport and emergency safety assessment
- Impacts of funding remediation

"I couldn't compare and contrast which one (dispersants) was more toxic than the other based on that."

Maryland's Chesapeake Biological Laboratory, who helped write a 2005 National Research Council (NRC) [report on dispersants](#)



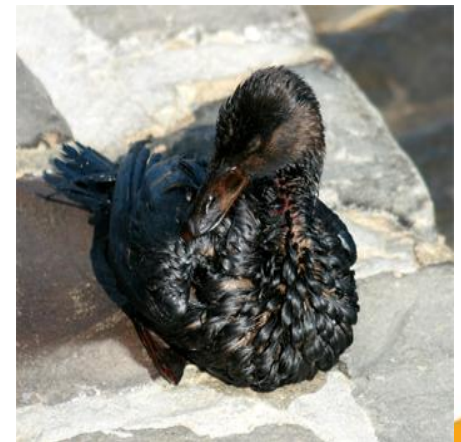
Bioremediation

- **Bioremediation** is a waste management technique that involves the use of organisms to remove or neutralize pollutants from a contaminated site.
- Genetic engineering approaches
- Myco-remediation
- Advantages
- Monitoring bioremediation



Oil Spill

- An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially marine areas, due to human activity, and is a form of pollution.
- Largest oil spills:
 - Kuwait during the 1991 Persian Gulf War - 7,900,000 m³
 - Gulf War oil spill - 1,300,000 m³
 - Lakeview Gusher, United States, Kern County, California – 1.2 million tons
 - Deepwater Horizon, United States, Gulf of Mexico – more than half a million tons
 - Ixtoc I, Mexico, Gulf of Mexico – around half a million tons
- Environmental effects
- Sources and rate of occurrence
- Cleanup and recovery
- Environmental Sensitivity Index (ESI) mapping
 - Shoreline type
 - Biological resources
 - Human-use resources
- Estimating the volume of a spill



Competitive Methods

- Bioremediation
- Bioremediation Accelerator
- Dispersants
- Dredging
- Skimming
- Solidifying
- Vacuum and centrifuge
- Beach Raking



Remediation Case with the Questionable Success

BP Gulf Oil Spill

- [Slick Solution: How Microbes Will Clean Up the Deepwater Horizon Oil Spill](#)
- [Mapping Up The Sea: positive expectations on early use of Corexit](#) September 23rd 1968
- [VIDEO: Is the BP Oil Spill Cleanup Still Making People Sick?](#)
- [Carys Mitchelmore of the University of Maryland's Chesapeake Biological Laboratory, who helped write a 2005 National Research Council \(NRC\) : Report on dispersants](#)

Roughly five million liters of dispersants have now been used to break up the oil spilling into the Gulf of Mexico, making this the largest use of such chemicals in U.S. history. If it continues for 10 months, as long as Mexico's Ixtoc 1 blowout in 1979 in the same region.

The trade-off in this case is the addition of toxic chemicals in a bid to protect the marshes of Louisiana and the beaches of Florida. But the U.S. Environmental Protection Agency (EPA), for one, has become concerned about the toxicity of the most-used dispersant at the Gulf of Mexico spill—COREXIT 9500—and ordered BP to look at alternatives.

The problem? The EPA's industry-generated data is unclear as to the relative toxicity of various dispersants. "If you think the data on COREXIT is bad, try to find any decent toxicology data on the alternatives," says toxicologist Carys Mitchelmore of the University of Maryland's Chesapeake Biological Laboratory, who helped write a 2005 National Research Council (NRC) [report on dispersants](#).

"I couldn't compare and contrast which one was more toxic than the other based on that."



Our Products

Our full product line is certified ORGANIC under the European Community regulations which governs organic production, labeling and control of animal and human feedstuffs. All of our products can be sold and used in the eco-systems of agriculture in all member states of the European Union without special permission.

- Our main ingredient is brown seaweed (*Ascophyllum Nodosum*) marine algae extraction.
- Our unique competitive advantage and most important scientific discovery is a way to unlock the cell structure of our key ingredient.
- We are not introducing any new live forms, we simply use the bacteria already present in the area.
- Once the pollutant is consumed, the bacteria population is reduced to the natural balance as it was before the pollution occurred.

OUR NON-MICROBIAL REMEDIATION DOES NOT USE LAB GROWN ORGANISMS, THE PROCESS IS ENTIRELY NATURAL AND DEPENDS UPON NATURALLY OCCURRING BACTERIA FOR BIOREMEDIATION OF OIL CONTAMINATED SOILS AND WASTES.

For each of the products listed in the further sections we have extensive documentation and numerous success stories available, therefore please contact us for additional documentation specific to your interests.



Oil Split Remediation on Water and Soil

- Destroys hydrocarbons without the use of chemicals and the additional problems that chemicals cause when introduced into ecosystems.
- Provides immediate biological ion exchange which breaks down sulphur and blocks heavy metals in oils.
- Provides unique nutrients and alginates which comprehensively and simultaneously feed and protect the microbes which do the work.
- Our product uses a unique bio-active marine algae suspension which feeds and protects the microbes from the hostile hydrocarbon environment - allowing them to function, thrive, and multiply.
- Additive is easily applied to coastlines and marshlands via spray from boats or planes.
- Can be applied directly on birds and mammals for effective and safe cleaning of fur and feathers - no rinsing required.
- No chemicals.
- No surfactants/detergents.
- Fast, effective, and safe.
- Easy to apply – no secondary steps required.



Re-claiming Spilled Oil for Commercial Use

- The oil/water mix is put through a unique media filtration - either under pressure or gravity-fed. The media acts as both a filter and an oil sponge - filtering out the water and adsorbing the oil. Because oil and water have different viscosities – water goes through – oil is retained on the porous structure of the media.
- The water is filtered back into the sea, and the oil-saturated media can be thermally processed to remove the oil. The media can be re-used again and again in this filtration/adsorption process.
- We have a unique and effective solution for cleaning water from the hydrocarbon extraction industry.
- Our de-centralized plants require no energy and are suitable for both offshore and onshore applications.
- Effluent produced by our *biological* process exceeds quality standards for watercourse discharge or recycling as process water.
- Enhanced Filtration
- Anaerobic Digestion
- Biological Ion Exchange



Why is Our Product so Efficient?

- In other technologies, microbes:
 - Suspended in water
 - Depend on coagulates for shelter
 - Must „wait“ for nutrients
 - Vulnerable to toxins and predators
- In our product microbes:
 - Sheltered by porous bio-media
 - Force-fed nutrients (oligosaccharides)
 - Protected from toxins (via alginates)
 - Out-compete predators



Heavy Metal and Toxic Substances Remediation

- Our products did prove excellent results in heavy metal and toxic substances remediation.
- The Institute for Protection and Ecology was subcontracting the Metallurgical Institute of University of Zenica (Bosnia and Herzegovina) to perform thorough tests on soil from several sites polluted with heavy metals in Bosnia and Herzegovina and from Macedonia.
- The samples were taken from the depth of 0-25 cm.
- It was assured that soil was always moist by spraying water over the soil.
- After 7 days the soil was turned around and sprayed with Bioremediator.
- After that soil rotation process was repeated every 3 days and sprayed with Bioremediator every 7 days.
- In the jars some plants were planted (wheat, decorative urn, and begonia) to observe effects on the plants.
- At the same time the test was conducted simulating rain to observe effects on ground waters.
- For soil treatment the experiment duration was 6 weeks and for underground water 10 days.
- Chemical soil analysis was performed in chemical laboratory of Metallurgical Institute. Heavy metal analyze was conducted with the method “atomic adsorption spectrophotometry” (The Testing of Water; PERKIN ELMER Analytical Methods for Atomic Absorption Spectrometry).



Heavy Metal Test Results

Heavy Metal	Sample 1		Sample 2		Sample 3	
	Before	After	Before	After	Before	After
pH	7.6	8.2	8.1	8.3	7.7	8.4
Total oil and fat	<1	<1	<1	<1	<1	<1
Nitrogen (N)	840	70	210	70	2400	280
Potassium (K)	19000	29000	27000	33000	13000	13000
Phosphorus (P)	6450	3500	600	1200	7150	1400
Iron (Fe)	40000	40000	44000	41000	205000	151000
Manganese (Mn)	1100	1200	2000	1600	9000	5500
Zinc (Zn)	200	100	200	100	500	400
Nickel (Ni)	<1	<1	200	<1	<1	< 0.1
Lead (Pb)	200	<1	200	0.1	300	< 0.1
Vanadium (V)	100	<1	100	<1	<1	< 0.1
Molybdenum (Mo)	<1	<1	100	<1	<1	< 0.1
Cadmium (Cd)	180	30	<1	20	170	30

Fourth site (industrial sludge) was tested on fat and oil only:
Total fat and oil before treatment = >95 %, after treatment 1%.



Heavy Metal Test Learning and Recommendations

- It is important to follow manufacturers recommendations to achieve the success.
- The product is recommended for bioremediation of areas polluted with: oil, petroleum products, pesticides, detergents, polymers, phenols, organic solvents), other heavy metals (copper, mercury,), toxic elements (arsenic, cyanide), toxic gases, radionuclide (uranium, plutonium),
- In bioremediation of soil with the addition of native microflora microorganisms, which is isolated from the soil and propagated in bioreactors.
- In waste water treatment.
- In laboratory tests the jars were used that prevented substances to escape. It needs to be observed the behaviors in natural environment.



Heavy Metal Test Conclusions

1. In all tests radical reduction in heavy metals was observed.
2. pH level of treated soil was higher.
3. Radical reduction of fat and oil in industrial sludge was observed.
4. Heavy metals in underground waters were reduced on treated soil.
5. The capacity of holding water in the soil was enlarged.
6. Plants on treated soil were vital. The growth of plants was accelerated.
7. We can conclude that product side effect to the soil bioremediation is improved soil quality and healthy micro fauna.
8. The product binds with the minerals in the soil in the complexes that are not soluble in water, in the presence of metal salts receive and accumulate a significant amount of water. A combination of binding force and reducing the leaching of soil provides higher capacity of water in the soil; the soil gets better mechanical properties, which is very useful in terms of greening the same protection from erosion.



Crude Oil Contaminated Soil Bioremediation

- Bio-remediation of contaminated soils is a widely used procedure worldwide. Petroleum wastes such as oil spills, tank bottom sludge etc., are being bioremediated and mitigated with the aid of many systems available commercially all over the world.
- Bio-remediation techniques have been successfully used for the remediation of hydrocarbon contaminated soils. However, all the commercial systems in vogue use lab grown microbial cultures for bio-remediation.
- There is no single micro-organism which can consume the wide variety of hydrocarbon contaminants in the soil.
- Our bio-remediation process is using existing micro organisms in the environment to perform the remediation.
- We are using a bio-surfactant, which is very close in resemblance to the natural secretion of the microbes.
- As, this process evolves hydrogen and oxygen is consumed at rapidly, it is essential that these ingredients are introduced to the soils on a daily basis.
- Once the contaminants are totally consumed, the available food source diminishing, the microbes will die and their number will come back to original naturally balanced level.
- We have numerous case histories available where we performed successful bioremediation.
- It is also note worthy to mention that in many a case, along with hydrocarbons and contaminants, there is a marked reduction in heavy metals.



Non Microbial Enhanced Bio-remediation- Principle

- Non Microbial Bioremediation is the process adopted by which the Oily Sludge is biodegraded. The Environment friendly, biodegradable water soluble Bio-enzyme which is used, assists in breaking the long chains of the hydrocarbon in the oily sludge by the process of encapsulation at the molecular level.
- The hydrocarbon molecule which is encapsulated by the aqueous bio-enzyme solution then becomes a food source for the naturally occurring microbes present in the soil. The Microbes/bacteria consume the encapsulated hydrocarbon as food, consequentially the end products generated by them being carbon dioxide, water, cell mass and biological waste products.
- **The End result is the Bio-remediation of the oily sludge.**



Some Images from Treated Sites

Before



After 6- 8 weeks



Dust Treatment

Dust control at the stone mill showed the following results:

- Complete dust mitigation via single treatment point – at conveyor belt.
- Dust remains on ground even after drying.
- Our product adheres to dust particulates and bring dust to ground.
- Simple physical gel-like property of our product.

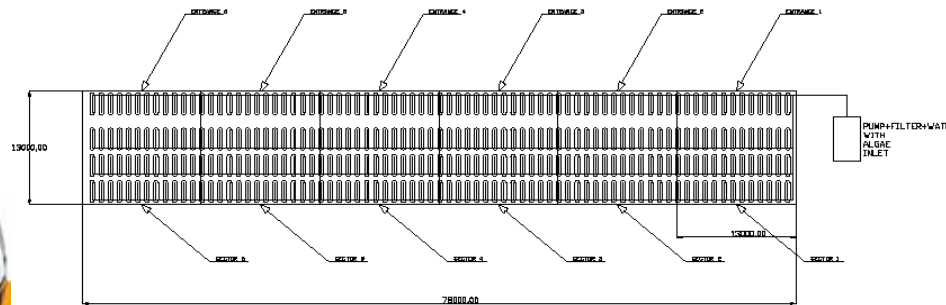
Please observe on the images below that result was practically immediate (within the same minute!).



Smell Treatment

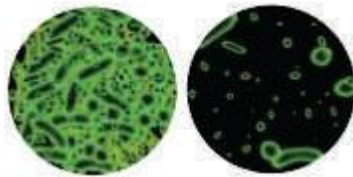
Our product is extremely successful when treating (waste) smell. By spraying our product over the waste dump, the smell will disappear within minutes.

Example of (waste) smell treatment solution:



Waste Water Remediation

- Our WWTP equipment is, same as all our product, based on bioremediation principles. Our units are very scalable, from 1-5 inhabitants (the smallest) and up to tenth of thousands inhabitants for large cities.
- The unit consists from primary settling tank separates larger particles and hard substance, which floats on the surface, while bio-chemical processes of hydrolysis and biological ion exchange takes place in waste water.
- From primary settling tank the water flows to the BIOFILTER, where biological degradation is taking place with the help of biological carrier crystallite in the anaerobic (without oxygen) environment.
- Crystallite is extremely porous volcanic rock on which we place colonies of anaerobic microorganisms (up to 16 billions microbes on 1 cubic centimeter).
- On the microscopic photo you can see difference in microbe population in our WWTP (left) compared with other biological WWTP available on the market:



Our WWTP

1. Does not need electricity;
2. There is no green house emission;
3. No active sludge left;
4. Up to 10x cheaper operations costs compared with competitive products;
5. No need for maintenance services;
6. Does not disturb landscape (not visible);
7. Can treat any waste waters;
8. Silent;
9. No odor;
10. Extremely quick lead time for water processing (6 hours);
11. Processed water can be safely released into the nature.

Our equipment, when correctly operated, achieves in special conditions even up to 99% of anaerobic degradation of antibiotics, pesticides, phenols, chrome, cyanide, acids, green algae, and petroleum products.

Exit water, once the process is completed, can be used for plants/fields watering systems.

It has minimum of 30 years manufacturer warranty.

Larger units are built as underground concrete containers. Due to no need for maintenance you can cover unit with ground and, for example, create a playground or park on top of it.



How Our Products Works

- Micro-organisms response to wide variety of hydrocarbon contaminants in the soil;
- Our Bioremediation process is using natural resources;
- Bio-surfactant and bio-enzymes;
- After treatment microbiological balance;
- Heavy metal reduction;
- Easiest, economic, most successful and the most environmentally friendly;
- Enhanced nutrition value of the soil.

OUR NON-MICROBIAL REMEDIATION DOES NOT USE LAB GROWN ORGANISMS, THE PROCESS IS ENTIRELY NATURAL AND DEPENDS UPON NATURALLY OCCURING BACTERIA FOR BIOREMEDIATION OF OIL CONTAMINATED SOILS AND WASTES.



Competitive Comparison (1)

Technology/Feature	Competitors	Our Product
Thermal desorption	Is simply “washing away”. The contamination remains, it is just moved to different location.	Removes contamination.
Excavation or dredging	Is collecting contamination and moving it to different location. The problem remains only in different location.	Removes contamination.
SEAR - surfactant enhanced aquifer remediation	The injection of hydrocarbon mitigation agents or specialty surfactants into the subsurface. Usually non biological, which means fighting pollution with the pollution, or choosing for “one that is less bad”.	No chemical, pure natural biological process.



Competitive Comparison (2)

Technology/Feature	Competitors	Our Product
Pump and treat	Pumping the water to the surface.	No need
	Chemicals used.	Pure biological.
	Sand filtering usually required.	No need
	May be a good method to quickly reduce high concentrations of pollutants. It is more difficult to reach sufficiently low concentrations to satisfy remediation standards.	Remediation above EU standards.
	It is expensive to treat the groundwater.	Most competitive prices, cheaper than any competitive product.
	Typically is a very slow process to cleanup a release with pump and treat.	Oil sludge and heavy metals in 6 – 8 weeks, waste and industrial water within few hours.



Competitive Comparison (3)

Technology/Feature	Competitors	Our Product
Solidification and stabilization	The addition of reagents to a contaminated material (e.g. soil or sludge) to produce more chemically stable constituents.	No additions, no chemicals, pure biology.
	The addition of reagents to a contaminated material to impart physical/dimensional stability to contain contaminants in a solid product and reduce access by external agents (e.g. air, rainfall).	No additions, no chemicals, pure biology.
In situ oxidation	Remediation by chemical oxidation involves the injection of strong oxidants such as hydrogen peroxide, ozone gas, potassium permanganate or per sulfates.	No additions, no chemicals, pure biology.



Competitive Comparison (4)

Technology/Feature	Competitors	Our Product
Soil vapor extraction	Limited usage. Complex appliance.	Extended usage. Simple (low cost) appliance.
Nan remediation	Tested only on ground water.	Tested on soil and ground water.



Competitive Comparison Bioremediation (1)

Technology/Feature	Competitors	Our Product
Bioremediation	Sometimes used in conjunction with a pump and treat system	Simple appliance by spraying or mixing.
	Specific use of plants, which means possibly introducing new species (plants) in ecological system.	No new species introduced – existing local micro fauna is used.
	Occasionally the bacteria can build up to such a point that they can affect filtration and pumping.	No pumping involved, therefore no comparable issues.
	Care must be taken to ensure that a sharp change in the groundwater chemistry does not kill the bacteria (such as a sudden change in pH).	Our product adjust pH to the best possible level for growth of bacteria.



Competitive Comparison Bioremediation (2)

Technology/Feature	Competitors	Our Product
Bioremediation	After four weeks, more than 95% of many of the PAH (polycyclic aromatic hydrocarbons) had been reduced to non-toxic components in the mycelia-inoculated plots.	Similar results. However, for soil treatment, dependent of thickness and deepness of pollution, it can take 6-8 weeks (or even more in extreme cases). Oil sludge average is about 6 weeks. Water splits can be cleaned faster.
	Microbial remediation is using lab-grown bacteria from different locations around the world. Therefore it is introducing usually new species to the location.	We are breeding existing bacteria in situ; therefore environment micro fauna is fully intact and same as before the treatment.
	Relatively high costs and relatively complex logistics due to the volume of bacteria powder needed for remediation.	Considerably lower costs. Simple logistics – 1 liter of our concentrate can cover are of 200 square meters for water splits.



Competitive Comparison Bioremediation (3)

Technology/Feature	Competitors	Our Product
Bioremediation	Simple appliance.	Simple appliance.
	Possible issues of preserving the bacteria powder.	No special conditions as long as our product is stored in temperatures lower than 30 degrees Celsius and does not get mixed with water, it can be used for minimum of 24 months.



Product Comparison Conclusions (1)

1. Our product is the only effective product in the market that is using non-microbial bioremediation. It sounds confusing, but it is the fact. In principle we are delivering activation and food for existing micro fauna, which is resulting in rapid multiplication of existing bacteria in the area air, water and soil. By that we multiply bacteria count on the location from 20 to 200 times. Every location has natural capability to recover; it just might take years or decades. We simply speed up natural recovery process 20 to 200 times!
2. Competitive products are based on microbial bioremediation, which means they do introduce new species to the environment. Although claims are made “we did not see any side effects so far” it is emphasize on “so far”. We all know that bacteria are mutating extremely fast. By introducing new species we have two possibilities: new species remains in the environment, and/or existing species might mutate due to the presence of new species. For that reason we would be careful with “so far” and would consider possible long term negative effects. Our product DOES NOT INTRODUCE ANY NEW SPECIES.
3. There are no single bacteria that can consume crude oil; therefore multiple species are introduced by competitive products. Again, with our product, no new species are introduced to the environment.
4. Bioremediation lead time of our product is comparable or often shorter than competitive products.



Product Comparison Conclusions (2)

5. When performing bioremediation on life species (birds and mammals) with competitive products the animals must be kept in captivity for 24 hours or more and we can only imagine stress of wild animal in captivity. Our treatment is practically spraying or washing animals and let them back to the nature (no captivity). Their naturally occurring micro fauna will do the rest. Survival rate is much higher.
6. Microbial bioremediation is focusing on and can treat single problem (for example crude oil split). Our product will treat any pollution in the area. It means that when treating crude oil our product will remove also any toxics or heavy metals from the area too. Therefore no need for multiple treatments or different products.
7. It goes further than that. As a side effect our product will treat (reduce/remove) in parallel green algae and it will enhance soil ability for plant growing. When soil is treated it will not only get clean, but also will have enhanced ability for keeping larger volumes of water in soil, which leads to better resistance in dry seasons. It will stimulate plant growth and photosynthesis. It means, after our treatment, your environment will not only be clean, but also healthy and fruitful.
8. When treating soil pollution you will observe, when using our product, also reduced level of pollution in the ground waters.
9. Our product is low costs solution. With considerably lower costs we will outperform competitive products.



Product Comparison Conclusions (3)

10. With competitive products composting treatment and costs are extremely high. Composting is one of the basic functions of our product and hence composting costs will not differ much from soil bioremediation.
11. Most of the pollutions can be treated In Situ, therefore no extra costs for Ex-Situ remediation.
12. For waste water treatment in canalization we have unique solution that will clean also canalization paths (pipes) and not only collected waste.
13. Our products can perform local bio remediation on slurry pits with no equipment required with the success rate of 90+% of bio mass degradation into the environment friendly substances.
14. We do provide end to end solutions. Besides bioremediation we are offering also equipment for oil collection and separation, water cleaning systems, bio gas plants, composting, etc. It means we might be “one stop shop” for all your environment improvement projects.



Costs Comparison

Bioremediation is often chosen not only as “better solution” for environment, but also as cost effective (low cost) solution. However, we perceive that our competitor costs are very high (<http://matts-bioremediation.tripod.com/id5.html>). Starting with In Situ bioremediation costs of USD 50 per cubic meter and up to USD 260 per cubic meter in slurry phase and USD 100 per cubic meter. Additional costs for lab test and field tests can be as much as USD 125,000-150,000.

It is of course dependent of level of pollution treated and contaminants, but our costs are considerably lower. In most of the cases you will find them in the range of 15% to 40% of competitor costs! For some methods, such as composting, the difference will be even bigger, with the fact that results will be above our competitor results.



Benefits - Short Term

We can identify the following short term competitive advantages:

1. Intact and healthy environment after treatment;
2. No harm to the environment can be caused by applying wrong processes or underdosing/overdosing of substance. Worst case scenario: no change (no improvement) will happen;
3. Results above competition and regulatory requirements;
4. End to end (complete) solutions;
5. Multiple pollutants (crude oil, heavy metals, toxins, sludge, etc.) treated at the same time;
6. Only fraction of the costs compared with competitive products;
7. Simple applications;
8. No complex logistics – In Situ remediation in most of the cases;
9. Low labor solutions;
10. Can be simply applied on remote locations as no energy sources are required. Only need is sufficient amount of water.



Benefits – Long Term

The identifiable long term competitive advantages are:

- Intact and healthy environment on the long run;
- Fruitful soil, better water management in soil and therefore dry seasons resistance, improved plant growth, better photosynthesis, etc.;
- Better soil resistance to the acid rains;
- Less pesticides and fertilizers required on the treated soil;
- Healthier ground waters;
- In marine applications the water quality and micro fauna will be improved producing more oxygen and food for marine life.



Final Conclusions

We have proven records that in most of the situation where we tested side by side competitive products with ours, we have outperform them heavily.

We are working with nature for nature and we are hoping we are small link in the chain for preserving and improving nature for future generations.

In most situations you will find us as “one stop shop” for your pollution and environmental issues.

All our products are certified by EU to be used in ecological systems without any special permission, as well as harmless to the humans, animals, insects, plants and environment In prescribed quantities.

Unlocked cell structure is our unique technology not available to our competitors. It is unlocked cells structure that helps our product outperforming all others.

Unlocked cells mean that we break cell “shield” and make cells content immediately available for microorganism. This is causing accelerated activity, reproduction (growth in numbers) and health.

Balancing pH levels and ion exchange ability, introduced by our product, are further improving healthy environment for micro flora.

Life time of our products is minimum 24 months. However, after that period we can verify and recycle the product for further 24 months minimum).

Simple, effective, low cost, environment friendly... what else can we say?

