



## University Microbiology Study

Dr. Antonio Camacho González, Professor of the Department of Microbiology and Ecology at the University of Valencia, at the request of Mr. Enrique Correcher, from the Water Quality area of the Júcar Hydrographic Confederation, issues the following REPORT:

Bioremediation is the use of the activity of microorganisms to reduce pollution accumulated in the environment. These techniques are based on two possible alternatives, the addition of microorganisms capable of attacking the contamination, or the enhancement of the activity of existing ones to accelerate the rate of degradation.

Unlike conventional sediment extraction techniques for conventional dredging, Bioremediation techniques minimize the environmental impact, since the microorganisms or nutrients for these are injected into the sediments, thereby fully maintaining the hydromorphological characteristics of the riverbed.

A fundamental aspect of the functioning of this type of ecosystem, while the non-removal of sediments prevents the pollutants from abruptly releasing and causing acute damage to the downstream living beings and the quality of the water. The consumption of organic matter by microorganisms degrades these pollutants to inert substances, such as carbon dioxide, methane (which by its insolubility is released into the atmosphere) and molecular nitrogen (the most abundant inert gas in the atmosphere land).

Both microorganisms and substances that are used in an alternative or complementary way in bioremediation techniques are absolutely harmless to living beings, since in the case of using exogenous microorganisms these come from selected natural strains, without any genetic manipulation, which are normally found in nature, and which are, on the other hand, the same ones that proliferate in the different treatments of sewage treatment plants, being therefore present in the waters of the rivers to which they discharge.

In the case of techniques capable of enhancing the activity of autochthonous microorganisms, the added substances try to favor the natural processes of degradation of organic matter, and equally innocuous, since they are inorganic nutrients of slow dissociation (technique used with success, for example, for the elimination of oil still remaining in the Prestige tanks), nitrate, which favors denitrification (anaerobic respiration process - usual sediment conditions) in which organic matter is consumed, and which has been used with good results for the elimination of polluting substances, like PCBs, in places like the great American lakes), or air (that favors the processes of aerobic degradation), among others.



The relative simplicity of the equipment required for the application of Bioremediation techniques allows access to remote places to which the heavy machinery necessary for conventional dredging is incapable of reaching, unless specific accesses are constructed, which would multiply the negative environmental impact of the dredging operations with such heavy machinery.

Previous experiments carried out in pilot trials carried out in several rivers in its area by the Júcar Hydrographic Confederation, in collaboration with the University of Valencia, have revealed that this technology could be used, under certain conditions, for the reduction of organic matter accumulated historically in river beds affected by wastewater discharges for decades. The 2 year study was carried out by the University of Valencia, co-directed along with the Eduardo Vicente Pedrós and Enrique Andreu Moliner, both professors of at the university.

It included experimental tests in which dozens of physico-chemical and biological quality parameters were assessed for the water and river ecosystems in which the trials were conducted, resulting in more than 10,000 samples analysed from the conclusions outlined in the final report, used by the Júcar Hydrographic Confederation since December 2003. Due to its zero environmental impact and its susceptibility to use, these bioremediation techniques were selected for the treatment of sediments of certain fluvial stretches of the Magro river in a project by Júcar Hydrographic Confederation. In this project, a small-scale on-site test is planned to assess which of the different possibilities of use of Bioremediation techniques may be more appropriate, considering both the independent use of substance addition and the aforementioned Natural microorganisms or both, to opt for the best option in case the desired results are obtained, or for other alternatives already designed in the project if it were not so.

Regarding the objections to the possible application of bioremediation techniques carried out by the Department of Territory and Housing of the Generalitat Valenciana, it should be considered that:

- The environmental impact of bioremediation techniques is positive, since eliminating some of the pollutants do not produce any hydromorphological alteration nor remobilize pollutants in an abrupt way, as opposed to the conventional dredging techniques that suppose acute negative impacts in both aspects. In the documentation prepared for the environmental process of the project, the corresponding preliminary evaluations of the impacts of all the actions envisaged, including the corresponding matrices of their impact with and without palliative measures, also included in this project.

- The microorganisms to be used, in the case of choosing techniques with addition of bacteria, are natural, not genetically manipulated, present naturally in our aquatic



ecosystems, and have sanitary authorization for use in water purification techniques or treatment of liquid wastes with high organic (e.g. slurry, waste water).

Therefore, it is possible to use in the treated sediments to reduce pollution in the riverbed because Vanex breaks down the organic waste. Ideally, the sources of the pollutants, e.g. urban wastewater treatment plants, also need to treat waste in order to stop the recontamination of the river.

- The microorganisms to be used, in the case of opting for techniques with addition of these, have tested, through ecotoxicological tests, their null toxicity. Living organisms used as indicators in ecotoxicological tests have been selected over decades of study with the participation of thousands of researchers around the world whose work has resulted in the publication of tens of thousands of scientific publications on the subject. These tests are consequently totally accepted by the international scientific community, so that a negative result of these tests guarantees the absolute innocuity of the product tested on any living being.
- The design of the techniques to be used does not, in any case, include a definitive decision on the possibility of using such non-allochthonous bacteria, since it may be possible, based on previous tests, to add them to the sediments where substances such as nitrate and air favor the natural action of microorganisms already present.
- Previous studies carried out in the pilot study included river sections of the Magro river, show not only a decrease in the organic content of the sediments, but also an increase in the values of the biotic indexes estimated by the lotic biological communities. This denotes the beneficial effect on them, not directly, but through the improvement of the natural environment in which they inhabit.
- In the environmental regeneration project of the Mago River, and in terms of Bioremediation actions, a pilot-scale on-site test is planned, which aims to optimize these applications and to evaluate, specifically for the ecosystem to regenerate, its effects prior to the actions, in order to redesign them when necessary. In this test, the control and evaluation measures required by the Department of Territory and Housing could be implemented, so that it could issue a definitive opinion with the data it says it needs. On the other hand much of the information requested regarding the activities of bioremediation is found in the Final Report of the aforementioned pilot study, released by the Universitat de Valencia the Júcar Hydrographic Confederation in December 2003.