To remediate or to not remediate?

Pollution of coastal areas in marine and freshwater ecosystems is a direct consequence of the anthropogenic pressure on these areas. In addition, pollutants that are originated afar do enter aquatic ecosystems through a variety of processes, including atmospheric deposition and continental run-off. In aquatic environment, the sediment (i.e. the particle matter that covers seafloors, riverbeds and lake bottoms) is the final repository for contaminants, where they accumulate and reach concentrations that are much higher than in the water column. The proper management of contaminated aquatic sediments is a modern day issue of significant concern. Because of a variety of maintenance activities in commercial ports and other aquatic areas affected by industrial activities, thousands of tonnes of contaminated sediment are dredged worldwide per year. Integrative approaches are needed and strategies should include an accurate analysis of the possible environmental consequences.

In the search of viable alternatives to the high costs and impacts of conventional strategies, bioleaching has been often proposed as promising biotechnology for reclaiming dredged materials that are contaminated by metals. Through bioleaching approach, Fe/S oxidizing bacteria are exploited to solubilize metal contaminants and remove them from the sediment. Once decontaminated, the material could well suit the building industry, or could be used for beach nourishment.

Our work at Universita` Politecnica delle Marche has addressed the use of bioleaching techniques for the decontamination of dredged sediments, in view of their potential re-use. Our studies have highlighted that, although it can be successfully applied to remediate to metal contamination in dredged materials, bioleaching could not be the most suited approach. Sediments, especially the marine ones, are often characterized by high buffering capacity, which in field applications would results in the need of high volumes of acids, high consumes of water and CO_2 emissions. The content of carbonates and aged organic matter are the main responsible for these problems. Then, sediment characteristics result to be a factor of primary relevance in the choice of bioleaching techniques as sediment cleanup tool. Dredged materials with high amount of carbonates and organic matter and middle-low contamination levels should be treated by alternative approaches, like phytoremediation, or be managed by conventional strategies, including capping.

Research efforts in the last four decades have generated a significant breakthrough in human understanding of environmental processes and on the consequence of human activities on the environment. There are several examples of environmental remediation actions that have successfully reclaimed polluted sites. However, there are also examples of remediation actions that have failed in their purposes and, not infrequently, have generated high environmental impacts for low-level environmental risk, generated hazardous by-products or increased exposure risk.

On the light of the knowledge that humans have gained, environmental remediation is not always the answer to environmental issues. Modern society should invest much more efforts in reducing pollution and environmental degradation instead of tempting to remediate after the die is cast.

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