Enhanced bioremediation of contaminated sediments in coastal areas of ex-industrial sites

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Introduction: Environmental contamination by polycyclic aromatic hydrocarbons (PAHs) and toxic metals is reaching a global dimension and represents a serious risk for the sustainable provision of ecosystems' goods and services and human wellbeing. In Europe, environment contamination is often linked to intense industrial activities, that in many cases, are located near the coast, representing a high ecological risk for both terrestrial and aquatic environments, especially after the end of the industrial exploitation. Among the most polluted coastal areas in Italy there is the Bagnoli site, located in Naples. This area is considered at high risk of environmental crisis in Italy and it has been included in the list of polluted sites of National interest. The site, now dismissed since 1990, was characterized by steel industry, asbestos processing, fertilizer, and concrete production. Knowledge on benchmark contamination is well developed and a complete characterization of the contamination in this area (14 Km^2) is available thanks to ISPRA (and to the ABBACO project recently concluded). Bagnoli's sediments contamination is characterized by high levels of PAHs and toxic metals, such as Pb, Zn, Cd, Cu and Hg [1]. These values not only tremendously exceed the thresholds of the chemical quality of marine sediments, but also have major detrimental biological and ecological consequences. Conventional remediation practices by mechanical dredging of the contaminated marine sediments can be highly costly and could cause environmental damage. The LIFE SEDREMED project [2] will demonstrate for the first time the cost-efficiency of *in-situ* bioremediation of different types of toxic contaminants, present in the Bagnoli's sediments, through the adaptation, combination, and field implementation of 2 innovative *in-situ* remediation technologies (EKO and IDRA), provided by the industrial partners.

Methods: The project proposes the (1) installation of an electro-kinetic system (EKO) and the (2) application of biofixed microorganisms (IDRA) (Fig. 1) to run bioremediation of contaminants in two selected Bagnoli's areas with different contamination level. The solution will be complemented by an innovative and up to date monitoring methodology to investigate the efficiency of the remediation technologies and the effect on the local biodiversity.

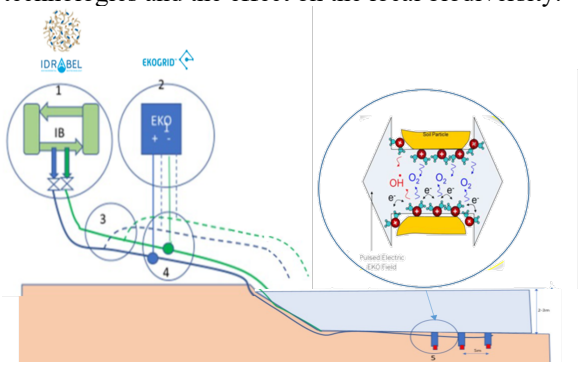

Fig. 1: *1. Pumping unit. Delivery IDRABEL; 2. EKO unit. Output cables, 3. Number of pipes; 4. The electric cables will go inside the injection pipes; 5. Electrode shall have the active tip (electrode) deep in the soil. The tip has perforations to allow injection.*

Expected Results and Discussion: For the first time a holistic approach to remediate a polluted area of 2 hectares will be implemented, combining two innovative technologies. We expect to reduce the concentration of toxic metals and hydrocarbon contaminants up to 80% and to save up to 6-times of remediation costs compared with the ex-situ remediation approaches. Finally, the plan will be delivered at project end with the extent to set the basis for a successful continuation, replicability, and transferability roadmap.

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References: [1] Morroni et al. (2020) *Marine environmental research* **160:** 104984. [2] https://life-sedremed.eu/