NEW PROCEDURE FOR ANOXIC MARINE SEDIMENTS REMEDIATION

DESCRIPTION OF THE TECHNOLOGY

The "**Ecosystem and Biodiversity Management**" and "**Agricultural Chemistry**" research groups at the University of Alicante have developed a new anoxic marine sediment remediation procedure which consists of injecting oxygen-saturated sea water into the sediment in order to displace the anoxic/hypoxic pore water it contains.

As a general rule, the concentration of dissolved oxygen in aquatic hypoxic/anoxic sediments is very low or null. Application of this procedure improves the content of dissolved oxygen in water, facilitating oxidation of organic matter and other reduced inorganic compounds that accumulate in the sediment, and thus enhancing the environmental conditions and potential for use of these sediments. In addition, oxidation helps eliminate substances toxic to the fauna that inhabit the sediment, such as H_2S, as well as foul-smelling volatile substances such as reduced sulphur compounds, which restrict the use of shallow beaches for recreational purposes.

As a result of this remediation procedure, soft, black, muddy, anaerobic sediment with a high organic matter content and a characteristic fetid odour is transformed into well-oxygenated, firmer sediment that has a much lower organic matter content and is no longer black or foul smelling.

The procedure entails the following sequence of steps (***Image 1***):

1. Sea water collection using a suction pump;
2. Storage of collected sea water in a tank;
3. Treatment in the tank of the collected sea water using a bubbling system to achieve a concentration of dissolved oxygen of between 6 and 9 mg O_2/L at 20ºC;
4. Pump-driven injection of oxygen-saturated sea water into a hydraulic circuit equipped with multiple nozzles inserted at different depths into the sediment to treat;
5. Injection of oxygen-saturated sea water into the sediment using an injection sequence of between 90-180 minutes of rest and 50-70 minutes of injection.

The injection nozzles form a key element of the system, and their number will depend on the number, diameter and length of the pipelines that constitute the hydraulic circuit used to inject the oxygen-saturated water into the sediment. They are opaque and rigid (made of stainless steel or PVC) and are inserted into the sediment at depths of between 10 and 30 cm (***Image 2***). Their pointed ends facilitate insertion in the sediment, and behind these they have radial perforations through which the oxygen-saturated water is pumped, creating an oxygenation bulb.

This procedure also offers the possibility of implementing an **environmental monitoring plan** and **testing the efficiency of the method** used by analysing changes in the pore water and the treated sediment.

MARKET APPLICATION SECTORS

This invention falls within the field of **decontamination technologies for sediments** affected by organic and inorganic substances, and more specifically of actions and techniques aimed at **regenerating sediments**, **enhancing conditions** for public and recreational use of beaches and **environmental remediation** of anoxic sediments extracted during port dredging.

TECHNICAL ADVANTAGES AND BUSINESS BENEFITS

The advantages of this remediation system with respect to other available decontamination techniques are:

- Its lower environmental impact, since it does not involve the introduction of exogenous substances into the environment.
- Its application achieves in situ transformation of soft, black, muddy, anaerobic sediment with a high organic matter content and a fetid odour into well-oxygenated, firmer sediment that has a much lower organic matter content and is no longer black or foul smelling.
- It regenerates the sediment and enhances conditions for public and recreational use of the areas treated.

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- It improves the sediment's capacity to host fauna, infauna, plant and algae communities.
- Remediation of sediments extracted during port dredging would allow them to be deposited onto beaches without negatively affecting the ecosystem, since the procedure eliminates the organic matter and toxic substances responsible for the black colour and foul odour.
- Even, it could also be used to prevent the need for dredging, which is more expensive and may even be impossible in certain locations for legal or technical reasons.
- It could be used to immobilise certain heavy metals and other toxic inorganic compounds that accumulate in anoxic/hypoxic sediment and pore water. As a result, the sediment would no longer act as a sink for heavy metals present in the water.
- It could be used as preventive measure to forestall the formation of anoxic sediments in a variety of environments (e.g. the open sea, reservoir and river beds, seagrass meadows and aquariums).

CURRENT STATE OF DEVELOPMENT

This technology has been developed at laboratory scale.

INTELLECTUAL PROPERTY RIGHTS

The technology is protected by **patent application**. Title: Injection system and procedure for anoxic marine sediment remediation. Application number: P201730723. Date of application: 24th of May, 2017.

COLABORATION SOUGHT

The research groups are seeking companies or public sector authorities interested in acquiring this technology for **commercial exploitation** through patent licencing agreements; Technical cooperation agreements (R&D projects) for use/adaptation of this technology; Subcontracting/ technical assistance agreements; Others.

RELATED IMAGES

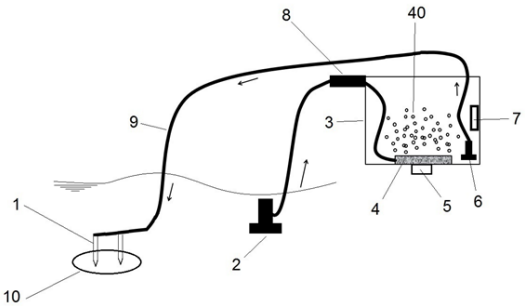

Image 1: *Diagram of the injection system, showing all the elements involved in the anoxic marine sediment remediation procedure. 1) Nozzles; 2) Suction pump; 3) Tank; 4) Diffusers; 5) Air blower; 6) Drive pump; 7) Oximeter; 8) Filters; 9) Pipes; 10) Sediment to treat; 40) Small bubbles.*

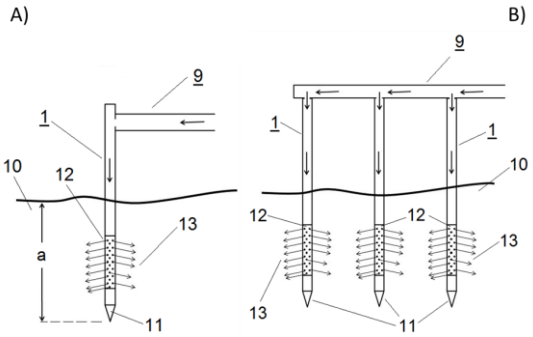

Image 2: *A) Diagram of an injection nozzle, which forms part of the system and is inserted into the marine sediment to treat. B) Diagram of a set of injection nozzles. 1) Injection nozzle; 9) Pipes; 10) Sediment to treat; 11) Lower end of the injection nozzle; 12) Perforations; 13) Bulb; a) Depth at which the injection nozzle is inserted into the sediment.*

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