

Enhanced Bioremediation Approaches to Combat Marine Oil Spills

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Oil spill disasters remain a serious worldwide problem. An integrated approach considering at the same time: (i) metabolic requirements of biodegrading organisms alongside the properties of the oil, (ii) environmental limitations on oil biodegradation and (iii) innovative delivery mechanisms for agents that alleviate these bottlenecks is critical for further developments in this area. This is the essence of the FP-7 project Kill•Spill “Integrated Biotechnological Solutions For Combating Marine Oil Spills”. It represents a European initiative fully committed to tackle oil spill disasters in an integrated and interdisciplinary fashion employing highly efficient bioremediation strategies.

In general, once crude oil is spilled, it takes at least one week before biodegradation processes begin to take effect. Kill•Spill aims to shorten this start up period to the absolute minimum by providing technologies for example, that provide the necessary nutrients together with hydrocarbon degrading consortia and/or enhancing compounds (biosurfactants) to both accelerate and maximize bioremediation rates from the time of application. In addition, when the use of dispersants is recommended, the previously mentioned biostimulation and bioaugmentation formulations are applied together with specific compounds acting as dispersants that take the oil from the surface to the water column and ultimately to the sea floor. Taking into account that as we go deeper in the water column, the amount of dissolved oxygen is more difficult to replenish by diffusion, Kill•Spill also offers specific novel technologies (OxygelTM and AerobeadsTM) that release oxygen over longer periods of time. It maintains as a result greater bioremediation rates of dispersed oil in the water column, even when it reaches the sediments. In cases where it is not feasible, this approach will be complemented with the development of processes to stimulate oil biodegradation anaerobically in anoxic sediments. Once the dispersed oil reaches the sediments, bioremediation rates are substantially reduced due to the prevailing anoxic conditions. Kill•Spill provides a series of highly innovative technologies (e.g., "Kill•Spill snorkel", "Kill•Spill Robot", "Kill•Spill Sed-Cleaner") that overcome this problem and induce enhanced biodegradation rates in the sediments. These technologies can also be used for the remediation of recurrently polluted sediments (from old oil spills) in all types of environments; field-tested from the Eastern Mediterranean to Disko Bay in Greenland. In addition, several other innovative products are being developed, e.g., "Kill•Spill All-in-One", "Kill•Spill Deep-sea", "Kill•Spill Bio-boom", besides the "Kill•Spill Biosensor" for in situ monitoring of oil degradation.

In this presentation, besides an overview of the Kill•Spill project, recent advances in specific areas will be presented in detail. These include: (i) novel biostimulants for remediation of beach sand contaminated with crude oil, (ii) effect of biosurfactants addition on bioremediation rates of weathered crude oil in seawater, (iii) novel approaches to bioremediation of contaminated sediments via the “Kill•Spill snorkel” prototype and (iv) use of nanoparticle-based bioremediation agents

The Kill•Spill consortium is multidisciplinary and is comprised of 35 partners from 11 EU and EU-associated countries and USA; 22 research & academic institutions, 15 small-medium enterprises (SMEs), and 1 association of oil spill companies working together with the support of a high level advisory board to cover the whole chain of oil spill (bio)remediation.

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