

HYDROCARBON PLUME BIODEGRADATION AT DEEP SEA CONDITIONS BY INDIGENOUS MICROBIAL CONSORTIA, VIA A NOVEL HIGH-PRESSURE EXPERIMENTATION SYSTEM

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ABSTRACT

Deep-sea oil spills came in public aware after the DWH accident in 2010. Since no response strategies had been developed for such incidents, hopes were pinned to indigenous microorganisms to combat oil contamination. In an effort to avoid oil reaching coastal lines and to assist microbial degradation, an unprecedented amount of dispersants were applied to break oil into smaller droplets. Since then, oil biodegradation rates have been extensively studied to be used in modelling the fate of deep-sea oil spills, however, indigenous microbial communities (IMC) are mainly studied under atmospheric pressure which can provide misleading biodegradation rates. In this work, we present a novel deep-sea sampling system for high-pressure seawater sampling and experimentation which has been successfully used to emulate a deep-sea oil spill. A high-pressure sampling device (HP-Sampler), equipped with a unidirectional check valve, is set to retrieve seawater at a specific depth range and maintain pressure during retrieval. A known sample volume from the HP-sampler is then passed into a high-pressure reactor (HP-reactor) for experimentation via a piston pump (HP-Pump) without pressure disruption. This set-up was used to study the degradation of crude oil hydrocarbons at plume concentrations by deep-sea microbial communities collected from the Eastern Mediterranean Sea with and without dispersant application. Undecompressed seawater was retrieved from a depth range between 600 – 1,000 m and incubated for 77 days in the HP-Reactor at 10MPa and *in situ* temperature (14°C). In the first part of the experiment, light Iranian crude oil was added at day 0 and was replenished regularly until day 35. The incubation was maintained for the second part of the experiment, which involved the weekly addition of dispersed crude oil (1:25 v/v COREXIT 9500). GC-MS analysis showed high capacity of the IMC for aliphatic compounds degradation regardless of dispersant application. Higher degradation efficiency was observed after the dispersion of oil of more recalcitrant compounds such as heavier alkanes and polycyclic aromatic hydrocarbons. The degradation rates provided by this study differ to most of the published data, thus showing that high-pressure is an important factor and should be taken into consideration.

KEYWORDS: Oil bioremediation, High-Pressure, Deep-sea, Indigenous microbes, dispersants

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