THE IMPACT OF BIODIESEL ON THE BIODEGRADATION OF *N*-ALKANES IN CRUDE OIL CONTAMINATED SOIL

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Introduction

The contamination of soil by petroleum hydrocarbons is a widespread occurrence which can detrimentally affect the environment where spills occur. The clean-up of such crude oil contaminated sites has therefore led to the development of a number of physical, chemical and biological methods. However, biological treatments (bioremediation) remain the most preferred because they are generally cost effective and environmentally friendly. The use of co-substrates together with nutrient supplementation has been shown to positively influence the degradation rate of hydrocarbon pollutants, as some agents that are added, increase the solubilisation and bioavailability of recalcitrant pollutants for enhanced microbial degradation (e.g. Taylor and Jones, 2001).

Biodiesel is a readily degradable, non-toxic solvent that has been considered a good solubilisation agent that can aid the removal or recovery of hydrocarbons from contaminated/oil spill sites (Miller and Mudge, 1997; Taylor and Jones, 2001; Pereira and Mudge, 2004). This study therefore investigated the extent of degradation of crude oil *n*-alkanes, particularly the longer chain components which are reported to show reduced bioavailability to microbial degradation due to their hydrophobic waxy nature (Tyagi *et al.*, 2011), after both biodiesel and nutrient amendment, and their efficiencies were comparatively evaluated.

Results

The addition of biodiesel to nutrient treated soil containing crude oil to enhance the biodegradation of *n*-alkanes (C_{14}-C_{30}) was investigated over a period of 180 days. Results obtained from laboratory microcosm experiments after 60 days showed that biodiesel slowed down the rate of removal of compounds as percentage depletions of <50% was observed for compounds C_{17}-C_{30}. Samples treated with nutrients alone, however, showed more significant reductions in C_{17}-C_{24} (64-78%; $p \leq 0.03$). However, after 180 days, losses peaked for both straight and branched chain alkanes in the biodiesel amended experiments which had the least residual concentrations compared to the nutrient-amended and control experiments (Figure 1). This was possibly due to the increased bioavailability of these compounds to degradation from enhanced solubilisation in the presence of biodiesel. The initial delay in the biodegradation of *n*-alkanes observed for these treatments, was attributed to the preferential utilisation of biodiesel as a source of carbon by the indigenous soil microorganisms.

In this study, the removal of the *n*-alkanes was significantly enhanced by nutrient amendment alone, while degradation of the branched alkanes was increased in the biodiesel treatments. Results obtained from the 180 day incubation experiments also suggest that the active window of enhanced degradation of *n*-alkanes for the biodiesel amended treatments occurred after the first 60 days of incubation.

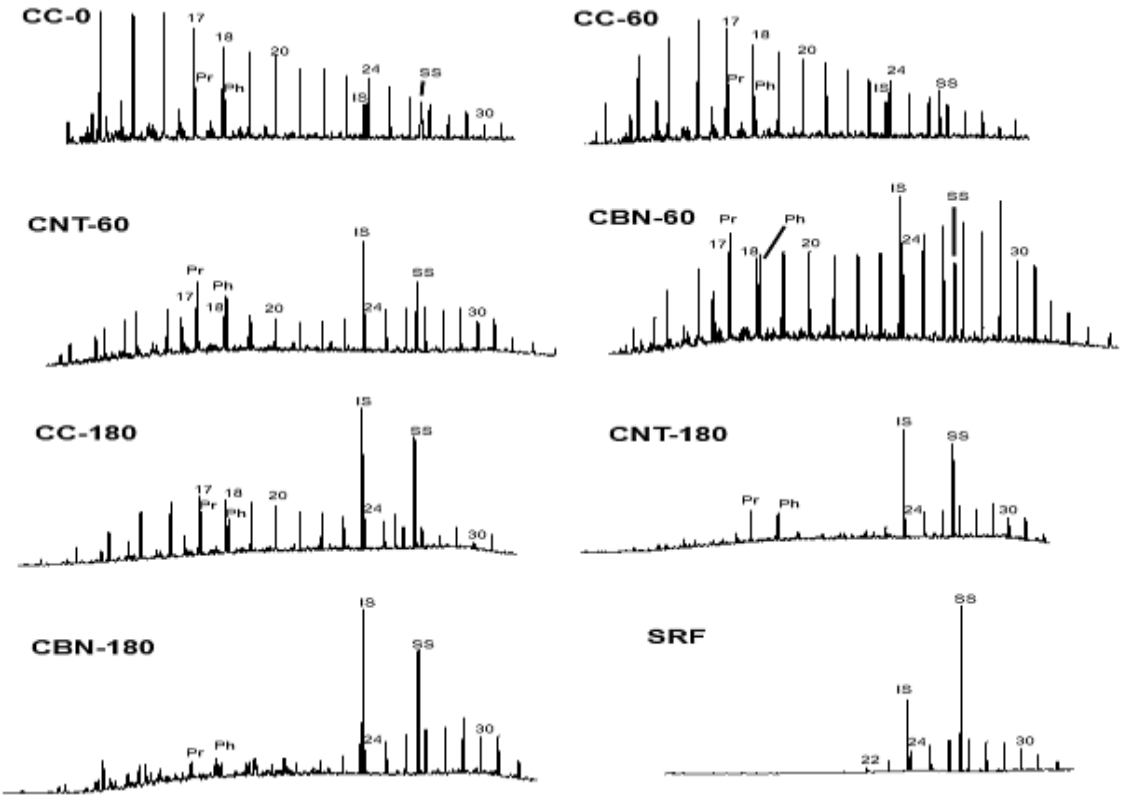

Figure 1*. Gas chromatograms of the saturated hydrocarbon fractions of the crude oil at the start of the experiment (day 0), at days 60 and 180 for all treatments and for the extract of the added slow release fertiliser (SRF). CC=Untreated control, CNT=Nutrient only, CBN=Biodiesel amended, IS= Internal standard (heptadecylcyclohexane) and SS=Surrogate standard (squalane).*

References

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