Research Article Open Acces

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Introduction

Biodegradation is the chemical dissolving of organic and non-organic pollutants by use of micro-organisms or other biological agents [1]. In recent years, biodegradation of pollutants by microbes has received signi cant interest as mankind attempts to reduce orgagradatiion; Bioremr

in line with the molecular weight and number of rings in the structure. Degradation was most rapid at pH 7.5 followed by pH 7, pH 8, pH 6.5, pH 8, pH 6, pH 8.5, pH 5.5 and pH 5 respectively. In general, soil pH 7.5 exhibited greatest and fastest rates of biodegradation for all the four PAH's over 45 days.

Total bacterial and fungal populations over 70 days in PAH contaminated soil

During biodegradation studies, bacterial populations at day 7, 14, 21, (Figure 5) increased whilst the highest population was evident at day 35. All the time points (from 0 to 70 days) had the greatest bacterial population exhibited at soil pH 7.5 (Figure 5b). e bacterial population dropped from its peak at day 35, dropping each week until the end of the experiment at day 70. e bacterial populations measured in soil samples without microbial inocula were (log 2 10^3) cfu below the detection limits at day 0 and a er 7 days (Figure 5a). Bacteria were evident in soil without microbial inocula Figure 5a indicating recolonisation of the soil from 14 to 70 day of incubation. e total fungal population was evaluated. e fungal cfu counts per gram of soil exhibited higher di erence in soil samples with and without microbial inocula. Aspergillus and Penicillium strains exhibited increased population count by at-least one log (from 1.0 $\times 10^6$ cells per ml) in soil sample with microbial inocula. A total number of fungal cfu counts measured per gram of experimental soil in each individual week and for each soil pH are exhibited in Figure 6.

e greatest fungal populations were found in day 29 followed by time point of days 21, 14 and 42 (Figure 6). e highest population was found in soil pH 5 a er 21 and at 29 day of incubation. In Figure 6b the greater fungal populations were found at low soil pH acidic conditions. However, alkaline soil pH 8 and 8.5 had higher populations compared to neutral soil pH. Soil pH 7.0 and 7.5 had the lowest fungal populations. Interestingly, Penicillium species predominated at acidic soil pH and with lower Aspergillus populations whereas at alkaline conditions of (pH 8 and 8.5) Aspergillus were predominant and Penicillium was not detected. e bacterial populations in microbial inoculated soil were greatest at soil pH 7.5 which also resulted in the greatest degradation rates suggesting that bacteria were involved in the biodegradation of polycyclic aromatic hydrocarbons. erefore, it may be that microbial community particularly bacteria was more prevalent and active in degradation at pH 7.5. Conversly, fungal populations were greatest at acidic soil pH and with some evident at alkaline soil suggests degradation at lower pH might be initaited by fungal popu

soilat varying pH:

soil pH. Soil inoculated with microorganisms resulted in di erences in phosphatase activities over time and pH at acidic soil pH when compared to neutral and alkaline soil pH. Phosphatase activity measured at bu er pH 8.5 continued to increase over time especially at alkaline and neutral pH reaching a peak of 1-1.2 mg pNP g^{-1} soil d.w. h^{-1} at pH 8.5 at 70 days whilst at the same time point at soil pH of 5.5 the activity was between 0.6-0.8 mg pNP g^{-1} soil d.w h^{-1} (Figure 10b) compared to (Figures 8b and 9b).

-Glucosidase soil activity

-glucosidase activities were measured at bu er pH 5.5 (Figure 11), pH 7 (Figure 12) and pH 8.5 (Figure 13) and these showed signi cantly greater activity with microbial inocula with greater activity measured in bu er pH 8.5 (approximately 0.06 mg pNP g^{-1} soil d.w. h^{-1}) at alkaline soil pH and the lower activity rates obtained in bu er pH 7 (approximately 0.04 mg pNP g^{-1} soil d.w. h^{-1}) is potentially associated with bacteria respectively.

L-Arginine ammoni cation soil activity

L-Arginine ammoni cation activity was measured in PAH contaminated J. Arthur bower's topsoil at varying soil pH. L-arginine ammoni cation activities were measured at bu er pH 5.5 (Figure 14), pH 7 (Figure 15) and pH 8.5 (Figure 16) exhibited higher activities (approximately 0.18-0.2 mg NH_3

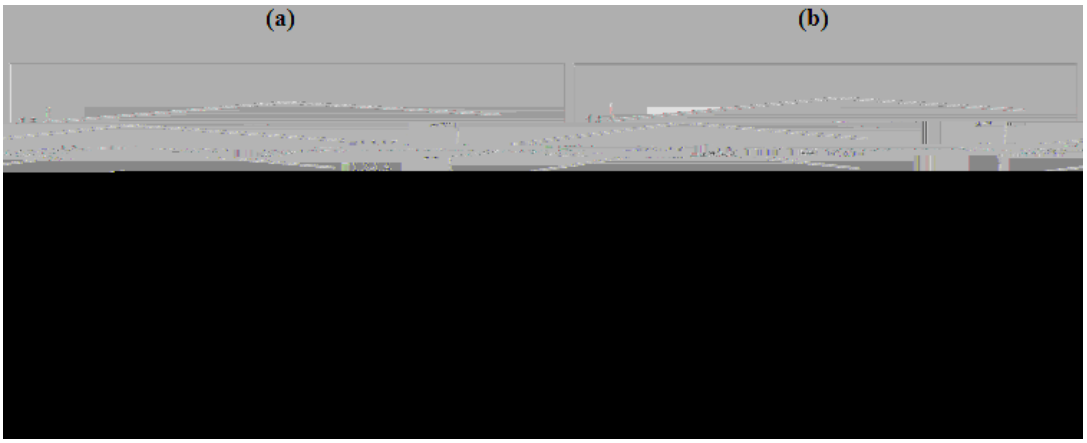

Figure 8: 3KRVSKDWDVH DFWLYLW\ RI - $UWKXU %RZHU¶V WRSVRLO DWDY3KRVSKDWDVH DFWLYLW\ LQ FRQWURO VDPSOHV ZLWKRXW PLFURELDO LQRFXOD E 3KRVSKDWDVH DFWLY strains.

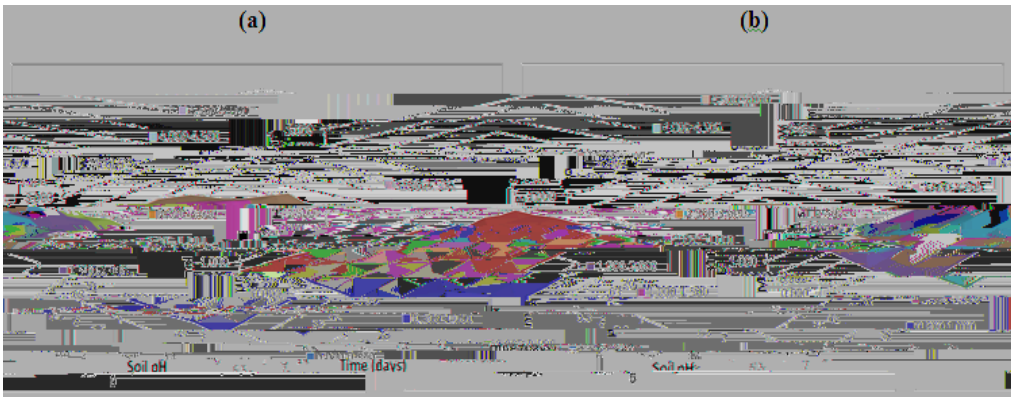

Figure 23: 0DQJDQHVH SHUR[LGDVH DFWLYLW\ RI - $UWKXU %RZHU¶V WRSVRLO DW YDU\LQJ VRLO S SHUR[LGDVH DFWLYLW\ LQ FRQWURO VDPSOHV ZLWKRXW PLFURELDO LQRFXOD E 0DQJDQHVH microbial strains.

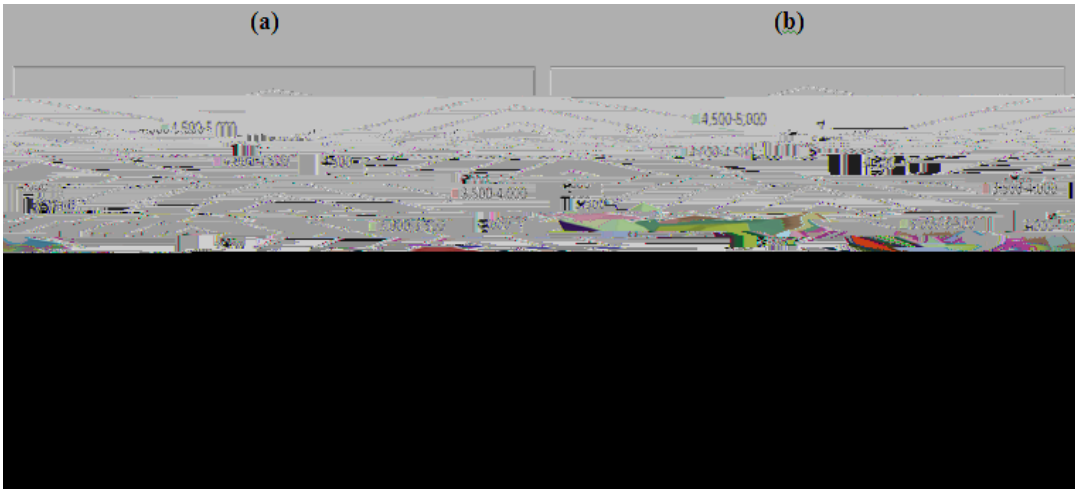

Figure 24: 0DQJDQHVH SHUR[LGDVH DFWLYLW\ LQ - $UWKXU %RZHU¶V WRSVRLO DW YDU\LQJ VRLO SHUR[LGDVH DFWLYLW\ LQ FRQWURO VDPSOHV ZLWKRXW PLFURELDO LQRFXOD E 0DQJDQHVH microbial strains.

Figure 25: 0DQJDQHVH SHUR[LGDVH DFWLYLW\ LQ - $UWKXU %RZHU¶V WRSVRLO DW YDU\LQJ VRLO S SHUR[LGDVH DFWLYLW\ LQ FRQWURO VDPSOHV ZLWKRXW PLFURELDO LQRFXOD E 0DQJDQHVH microbial strains.