

Biodegradation of Used Engine Oil by Bacterial Cultures

Pravinkumar A. Domde¹, Hemant J. Purohit², Rajpal Singh Kashyap³, Shardul S. Wagh⁴

¹Assistant Professor, Biochemistry Department, Kamla Nehru Mahavidyalaya, Nagpur, Maharashtra, India

²Ex-Cheif Scientist G, National Environmental Engineering and Research Institute (NEERI), Nagpur

³Director Research, Central India Institute of Medical Sciences (CIIMS), Nagpur

⁴Assistant Professor, Biochemistry Department, Kamla Nehru Mahavidyalaya, Nagpur

Abstract: In the present study biodegradation of used engine oil by four bacterial cultures was targeted. Versatile catabolic capability of four bacterial cultures *Bacillus subtilis* PD6, *Bacillus sp.* PD9, *Enterobacter sp.* PD11 and *Bacillus sp.* PD14 was assessed by subjecting them for the utilization of used engine oil in 250ml 0.1XM9 media containing flasks. Biodegradation of used engine oil was analysed by COD analysis and observation were statistically processed by ANOVA. Out of four bacterial cultures, *Bacillus sp.* PD9 and *Bacillus sp.* PD14 were found to be efficient cultures which were able to degrade 67.8% and 65.5% used engine oil within six days. Other two cultures *Bacillus subtilis* PD6 and *Enterobacter sp.* PD11 also exhibited successful biodegradation of used engine oil but less efficiently compared to *Bacillus sp.* PD9 and *Bacillus sp.* PD14. This study accentuate the role of isolated four bacterial cultures in removal of used engine oil and its possible application in bioremediation studies.

Keywords: Biodegradation, Bioremediation, Bacterial cultures, COD, Used engine oil, ANOVA

REFERENCES

- [1]. Atlas, R. M. (1977) Stimulated petroleum biodegradation. *Crit. Rev. Microbiol.* 5:371-386.
- [2]. Atlas, R. M., and R. Bartha. (1972) Biodegradation of petroleum in seawater at low temperatures. *Can. J. Microbiol.* 18:1851-1855.
- [3]. Atlas, R. M., and R. Bartha. (1972) Degradation and mineralization of petroleum by two bacteria isolated from coastal water. *Biotechnol. Bioeng.* 14:297-308.
- [4]. Benkacaker MO, Ekundayo JA (1997) Applicability of evaluating the ability of microbes isolated from an oil spill site to degrade oil. *Environ. Monit. Assess* 45:259-272.
- [5]. Bogan B.W., Lahner L.M., Sullivan W.R. and Paterek J.R. (2003) Degradation of straight-chain aliphatic and high-molecular weight polycyclic aromatic hydrocarbons by a strain of *Mycobacterium austroafricanum*, *Journal of Applied Microbiology* 94:230-239.
- [6]. Chhatre Suneel, Purohit Hemant J., Shanker R., Chakrabarti Tapan and Khanna P. (1996). Bacterial consortia for crude oil spill remediation. *Water, Science and Technology* 34(10):187-193.
- [7]. Diaz MP, Grigson SJW, Peppiatt CJ, Burgess JG (2000) Isolation and characterization of novel hydrocarbon-degrading euryhaline consortia from crude oil and mangrove sediments. *Mar. Biotechnol.*, 2: 522-532.
- [8]. Dominguez-Rosado Elena, Pichtel John, and Coughlin Melissa. (2004) Phytoremediation of Soil Contaminated with Used Motor Oil: I. Enhanced Microbial Activities from Laboratory and Growth Chamber Studies *Environmental Engineering Science* 21(2):157-168.
- [9]. Ghazali FM, Abdul R, Salleh AB RNZ, Basri M (2004). Biodegradation of hydrocarbons in soil by microbial consortium. *Int. Biodeterm. Biodegrad.* 54: 61-67.
- [10]. Hadibarata Tony, And Tachibana Sanro. (2009) Microbial Degradation of *n*-Eicosane by Filamentous Fungi. *Interdisciplinary Studies on Environmental Chemistr* 323-329.
- [11]. Holden P. A., LaMontagne M. G., Bruce A. K., Miller W. G., and Lindow S. E. (2002) Assessing the Role of *Pseudomonas aeruginosa* Surface-Active Gene Expression in Hexadecane Biodegradation in Sand, *Applied And Environmental Microbiology.* 68(5):2509-2518.

- [12]. Jain Pankaj Kumar, Gupta Vijai K., Pathak Hardik, Lowry Madan, Jaroli D. P. (2010) Characterization of 2T engine oil degrading indigenous bacteria, isolated from high altitude (Mussoorie), India. *World J Microbiol Biotechnol* 26:1419–1426.
- [13]. Joshi P A and Pandey G B (2011) Screening of Petroleum Degrading Bacteria from Cow Dung. *Research Journal of Agricultural Sciences*, 2(1): 69-71.
- [14]. Kaczorek E., Olszanowski A., Cybulski Z. (2005) Analysis of Surface Tension During Biodegradation of Hydrocarbons. *Polish Journal of Environmental Studies* 14(2):179-183.
- [15]. Kas J., Burkhard J., Demnerova K., Kostal J., Macek T., Mackova M., and Pazlarov J. (1997) Perspectives in biodegradation of alkanes and PCBs. *Pure & Appl. Chem* 69(11):2357-2369.
- [16]. Kebria D. Yousefi, Khodadad A., Ganjidoust H., Badkoub A., Amoozegar M. A. (2009) Isolation and characterization of a novel native *Bacillus* strain capable of degrading diesel fuel. *Int. J. Environ. Sci. Tech.* 6(3):435-442.
- [17]. Kevin G. Kropp, Irene A. Davidova, and Joseph M. Suflita, (2000) Anaerobic Oxidation of *n*-Dodecane by an Addition Reaction in a Sulfate-Reducing Bacterial Enrichment Culture, *Applied and Environmental Microbiology* 66(12):5393–5398.
- [18]. Khardenavis Anshuman A., Kapley Atya and Purohit Hemant J. (2008) Phenol mediated improved performance of Active biomass for treatment of distillery wastewater. *International Biodeterioration Biodegradation*, 62:38-45.
- [19]. Kim Chi-Kyung, (2001) Microbial Degradation of Chlorinated Aromatic Hydrocarbons through Ring-Cleavage and Dechlorination, *J. Environ. Sci. Eng.* 3:65-68.
- [20]. Leahy SG, Colwell RR (1990) Microbial degradation of hydrocarbons in the environment. *Microbiol Res* 54 (3):305-315.
- [21]. Micky Vincent (2000), Microbial Bioremediation of Polycyclic Aromatic Hydrocarbons (PAHs) in Oily Sludge Wastes. *Microbiology* 143:1567-1574.
- [22]. Moneke Anene and Nwangwu Chika (2011) Studies on the bioutilization of some petroleum hydrocarbons by single and mixed cultures of some bacterial species. *African Journal of Microbiology Research* 5(12):1457-1466.
- [23]. Noordman Wouter H., Johann Wachter H.J., Boer Geert J. de, Janssen Dick B., (2002) The enhancement by surfactants of hexadecane degradation by *Pseudomonas aeruginosa* varies with substrate availability. *Journal of Biotechnology* 94:195–212.
- [24]. Nwaogu L. A., Onyeze G. O. C. and Nwabueze R. N. (2008) Degradation of diesel oil in a polluted soil using *Bacillus subtilis*. *African Journal of Biotechnology* 7(12):1939-1943.
- [25]. Patrauchan Marianna A., Florizone Christine, Dosanjh Manisha, Mohn William W., Davies Julian, and Lindsay D. Eltis. (2005) Catabolism of Benzoate and Phthalate in *Rhodococcus* sp. Strain RHA1: Redundancies and Convergence. *Journal of bacteriology* 187(12):4050–4063.
- [26]. So Chi Ming and Young Lily Y. (2001) Anaerobic Biodegradation Of Alkanes By Enriched Consortia Under Four Different Reducing Conditions *Environmental Toxicology and Chemistry*, Vol. 20(3) 473–478.
- [27]. Suenaga Hikaru, Mitsuoka Mariko, Ura Yuko, Watanabe Takahito, and Furukawa Kensuke (2001): Directed Evolution of Biphenyl Dioxygenase: Emergence of Enhanced Degradation Capacity for Benzene, Toluene, and Alkylbenzenes *J Bacteriol.* September; 183(18): 5441–5444.
- [28]. Thangaraj K., Kapley Atya and Purohit Hemant J. (2008) Characterisation of diverse *Acinetobacter* isolates for utilization of multiple aromatic compounds. *Bio-resource Technology* 99(7):2488-2494.
- [29]. Whyte Lyle G., Luc Bourbonnie`Re, And Charles W. Greer, (1997) Biodegradation of Petroleum Hydrocarbons by Psychrotrophic *Pseudomonas* Strains Possessing Both Alkane (*alk*) and Naphthalene (*nah*) Catabolic Pathways. *Applied and Environmental Microbiology* 63(9):3719–3723.
- [30]. Wrenn Brian A (1998) Biodegradation of Aromatic Hydrocarbons authored by Wrenn Brian A.
- [31]. Zhang Yimin and Miller Raina M. (1995) Effect of Rhamnolipid (Biosurfactant) Structure on Solubilization and Biodegradation of *n*-Alkanes *Applied And Environmental Microbiology*, 61(6):2247–2251

- [32]. Grimmer G, Jacob J., Naujack K.-W. (1981) Profile of the Polycyclic Aromatic Hydrocarbons from Used Engine Oil - Inventory by GC, GC/MS- PAH in Environmental Materials Part 1. *Fresenius Zeitschrift fur Analytical Chemistry*. 306:347-355.
- [33]. Kapley Atya, Purohit H. J., Chhatre S., Shanker R., Chakrabarti T. and Khanna P. (1999) Osmotolerance and Hydrocarbon degradation by genetically engineered bacterial consortium. *Bio-resource Technology* 67:241-245.
- [34]. Chinenyeze Madu Anthony Joseph, EkeneUgwu Richard (2017), Physical and Chemical properties of crude oil and their geological significance. *IJSR*, Vol. 6, Issue 6.
- [35]. Wang Dan, Lin Jiahui, Junzhang Lin, Weidong Wang, Shuang Li (2019), Biodegradation of Petroleum Hydrocarbons by *Bacillus subtilis* BL-27, a Strain with Weak Hydrophobicity, *Molecules* 24, 3021.
- [36]. Katiyar Veenet, Husain Sattar (2010), Environmental Impacts of Used Engine Oil, *Mat. Sci. Res. India*, Vol. 7(1), 245-248