

## **Enhanced Bioaugmentation of Oily Sludge by Locally Isolated Beneficial Microorganisms (LIBeM) Consortia Using Different Delivery Techniques**

### **ABSTRACT**

The use of selective oil degrading strains in remediating oil sludge has become a promising technique that could generate economy and it is a green technology to clean the environment. The main aim of this study is to determine and compare the best LIBeM consortia formulation in liquid (LIBeMLIQ), powder (LIBeM-POW) and capsule form (LIBeM-CAP) for bioaugmentation of oil sludge contaminated soil at 20% (v/v) concentration levels. This consortia consists of *Candida tropicalis* RETL-Cr1 + *Chromobacterium violaceum*-MAB-Cr1 + *Pseudomonas aeruginosa*-BAS-Cr1 was selected as proven to be best consortia in degrading oil sludge contaminated soil based on previous study. A laboratory scale-up experiment was conducted using Aerated Static Pile (ASP)-bioreactor system made up of acrylic materials as a treatment plot. The laboratory scale-up experiments were incubated for 56 days with standard Technical Procedures Protocol (TPP) and the TPH reduction was observed along with physiochemical parameters such as pH, soil moisture content, temperature and microbial population (CFU/mL) and biodegradation kinetic evaluation. The results showed that bioaugmentation of LIBeM-POW at 20% v/v oil sludge show great improvement in TPH degradation with 92% within a shorter period of 56 days as compared to LIBeM-CAP with (86%) LIBeM-LIQ (81%) and NA (26%) degradation. LIBeM either in liquid, powder and capsule had also shown their capabilities in degrading aliphatic and PAH. The findings justified that LIBeM-POW was proven to be the most efficient delivery technique as compared to LIBeM-CAP, LIBeM-LIQ and NA. The excellent control of bioprocess parameters along with Technical Procedures Protocol (TPP) were also discussed in this paper.