Centre for Research in Nanotechnology & Science

IIT Bombay

Application of GCxGC-TOFMS for analysis of oily sludge and fate of organic contaminants in oily sludge

Prof. Suparna Mukherji

Abstract:
Oily sludge management is a global environmental concern. The complex mixture of hazardous organic components in theoil associated with sludge can cause air, water, and soil contamination. Two-dimensional gas chromatography coupled withtime-of-flight mass spectrometry (GCxGC-TOFMS) is an emerging analytical technique that can provide insights on the diverse mixture of organic contaminants in the various maltene fractions and the asphaltene fraction of oil. Composition of oil in the sludge also affects the concentration of components in the water-soluble fraction (WSF).The components in oil and WSF can both be analysed using different injection modes in the GCxGC-TOF MS. When analysed using liquid injection mode the aliphatic fraction of oil in oily sludge was found to contain n-alkanes (n-C12 to n-C34), branched alkanes, isoprenoids and cycloalkanes. The aromatic and polar fractions contained derivatives of benzene, naphthalene, biphenyl, chrysene, phenanthrene, quinoline, pyridine and phenol. During slurry phase bioremediation of oily sludge, GCxGC analysis of n-alkanes in the oily sludge showed an increase in the lower n-alkanes, i.e., dodecane and tridecane over the first 30 days, whereas the higher n-alkanes showed significant degradation. Simultaneous analysis of asphaltenes through pyrolysis GCxGC revealed that this was caused by the biotransformation of asphaltenes.
WSF of oily sludge was analysed using solid phase microextraction (SPME) and stir bar sorptive extraction (SBSE)/Twister. Analysis using a polydimethyl siloxane (PDMS) Twister showed the highest number and abundance of analytes in the WSF. NIST library together with the retention index method helped in the identification ofvarious compounds such as, benzene derivatives, methyl-naphthalenes, di and tri-methyl naphthalenes and di-methyl quinolines. Semiquantitative analysis of targeted group of components in the WSF revealed that oil components percolating from the sludge to the aqueous phase were simultaneously degraded by oil degrading microbes.