Enhanced degradation of ternary dye effluent by developed bacterial consortium with RSM optimization, ANN modeling and toxicity evaluation

Priya Banerjee[a], Shramana Roy Barman[a], Dolanchapa Sikdar[b], Uttariya Roy[b], Aniruddha Mukhopadhayay[a], Papita Das[b],*

[a]*Department of Environmental Science, University of Calcutta, 35, Ballygunge Circular Road, Kolkata – 700 019, India, email: prya_bnrje@yahoo.com (P. Banerjee), shromonaroybarman123@gmail.com (S. Roy Barman), am_cuenvs@yahoo.co.in (A. Mukhopadhayay)*
[b]*Department of Chemical Engineering, Jadavpur University, 188, Raja S.C. Mullick Road, Kolkata - 700 032, India, email: dolanchapa30@gmail.com (D. Sikdar), uttariyar@gmail.com (U. Roy), papitasaha@gmail.com (P. Das)*

ABSTRACT

The present study investigated the simultaneous removal of Safranin (SA), Crystal violet (CV) and Methylene blue (MB) by a bacterial consortium consisting of *Dietzia* sp., *Bacillus* sp. and *Pseudomonus mendocina* in batch reactors. The effect of experimental parameters like initial dye concentration, solution pH, salinity and temperature on the process of biodegradation was also studied. On optimization of ternary dye degradation using both RSM (CCD) and ANN on a comparative scale, RSM was found to be a more suitable approach. Application of RSM optimised conditions resulted in 99.87, 98.74 and 97.57% decolorization of SA CV and MB respectively. Effect of dye exposure on bacterial cells was investigated using atomic force microscopy (AFM). The untreated and treated samples were analysed using Fourier transform infrared (FTIR) spectroscopy for characterization of metabolites formed due to dye degradation. Phytotoxicity assay with *Cicer arietinum* showed that seedlings exposed to untreated effluents showed significantly impaired growth, biochemical and enzyme (oxidative stress response and detoxification) parameters in comparison to those exposed to treated effluents which in turn were at par with control levels. The results obtained denoted efficient detoxification of ternary dye effluent by the selected bacterial consortium and hence proved its applicability for treatment of real effluent.

Keywords: Ternary azo dye system; Biodegradation; Response surface methodology; Artificial neural network; *Cicer arietinum*; Phytotoxicity assay

*Corresponding author.