Recent Innovative Biological Wastewater Treatment Process for Textile Dyeing Wastewater

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Background/Objectives. Background Indian textile industry is one of the leading industries in the world, consuming large amounts of water and chemicals releasing 20-50% dye in spent dye batch. The conventional textile finishing industry requires 100 litres of water to process 1 kg of fabric. Textile dyeing wastewater is strongly colored due to utilization of various reactive dyes and contains recalcitrant organic compounds which cannot be easily degraded by biological treatment processes as the biodegradability of dyeing wastewater ranges from 0.23 to 0.31. Hence, a hybrid method consisting of advanced oxidation process (AOP) to enhance the biodegradability of the wastewater followed by biological treatment is effective method to achieve better effluent quality and improve the treatment performance. Application of attached growth system in sequencing batch reactor (SBR) could improve the sludge quality, reduce the excess bio-sludge generation, increase the removal efficiency and reduce the acclimatization period of the system, leads to development of sequencing batch biofilm reactor (SBBR). A pre-treatment for SBBR is crucial to modify the structure of pollutant by transforming complex into easily biodegradable. AOP namely O3/UV/H2O2generates highly reactive hydroxyl radicals (eV=2.8 V) which can destroy the recalcitrant pollutants, that are resistant to conventional technologies.

Approach. This study aimed to evaluate the performance of laboratory scale AOP followed by SBBR with polyester fiber bio-carrier in removing color and organics from textile dyeing wastewater. The MLSS concentration was maintained in the range of 5000 to 5500 mg/L. The color absorbance at 436 nm, 525 nm and 630 nm were 0.701 to 0.978, 0.587 to 0.955 and 0.504 to 0.678, respectively, measured using spectrophotometer. The influent concentrations of organics contributed by dyes and other dye fixation chemicals was measured in terms of BOD5 and COD and biodegradability of wastewater was measured by BOD5/COD ratio. The influent concentrations of BOD5 and COD, TSS, TDS and BOD5/COD were found to be 220 to 285 mg/L, 800 to 980 mg/L, 210 to 290 mg/L, 6240 to 6720 mg/L and 0.23 to 0.31, respectively. The AOP pre-treatment (O3/UV/H2O2) was done with ozone concentration of 150 mg/L, H2O2 concentration of 150 mg/L and 18 W low pressure mercury vapor lamp (254 nm) for a contact time of 120 minutes. Performance of the SBBR with polyester fiber was investigated by optimizing various reaction parameters namely aeration time (4, 6, 8 and 21 hours), solids retention time (SRT) (10, 15 and 20 days) and number of cycles (1, 2 and 3 cycles per day).

Results/Lessons. The experimental results of O3/UV/H2O2 pre-treatment improved the biodegradability to 0.40 to 0.45. AOP treated wastewater was fed into SBBR with polyester fiber bio-carrier exhibited maximum removal at 6 hours reaction time and 15 days of SRT and 2 cycles per day. The removal efficiency of AOP followed by SBBR with polyester fiber for color, BOD, COD and TSS was 90 to 93%, 82 to 86%, 83 to 86% and 89 to 90%, respectively. The treated effluent contains BOD, COD and TSS concentration of 35 to 40 mg/L, 105 to 157 mg/L and 20 to 30 mg/L, respectively. From the results, it was observed that simultaneous color and organics removal were achieved in AOP followed by SBBR with polyester fiber bio-carrier. The results reveal that AOP followed by SBBR could be an extremely promising technology for color and organics removal and the textile dyeing wastewater could meet the stringent effluent discharge standards.