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S. Sathian
Abstract

Dyes are natural and xenobiotic compounds that make the world more beautiful through coloured substances. However, the release of coloured textile dye wastewater represents a serious environmental problem and a public health concern. Colour removal, especially from textile dye industry wastewater, has been a big challenge over the last decades, and up to now there is no single and economically attractive treatment is available for effective decolourization of dyes. In the past years, notable achievements are made in the use of biotechnological applications to textile dye wastewater for colour removal. Different microorganisms such as aerobic and anaerobic bacteria, fungi and actinomycetes have been found to catalyse dye decolourization. In recent years, there has been an intensive research on fungal decolourization of dye wastewater. It is becoming a promising alternative to replace or supplement present treatment processes.

In this work, the capabilities of white rot fungus (WRF) like *Coriolus versicolor*, *Pleurotus floridanus*, *Ganoderma lucidum* and *Trametes pubescens* are explored for the decolourization of textile dye industry wastewater. The wastewater collected from the small scale industry is analysed. The process parameters viz. pH, temperature, agitation speed and wastewater concentration are optimized using response surface methodology (RSM). At the optimum conditions, a maximum decolourization of 81.4% is achieved using *G. lucidum*. Experiments are also performed at various combinations of these four WRF’s. From the results it is found that the combination of *Pleurotus floridanus*, *Ganoderma lucidum* and *Trametes pubescens* yields better results in terms decolourization (87.2%). Hence this combination is selected for the use in sequential batch reactors. The kinetics of the degradation process is studied using first order model, diffusional model and Singh model. From the results it is found that the degradation process follows first order system.

Experiments are carried out in four sequential batch reactors (SBR). In SBR – 1, the mixed WRF’s is used for the decolourization process. The process variables, air flow rate, sludge retention time (SRT) and cycle period are optimized using RSM. At the optimized condition, the maximum decolourization and COD reduction is found to be 57.7% and 63% respectively.
In SBR-2, along with the microorganisms, a sorbent, tamarind seed is added into the reactor. It involves simultaneous biodecolourization and sorption process. The process parameters like air flow rate, SRT and sorbent dosage are optimized using RSM. At these optimized condition, the maximum decolourization and COD reduction is found to be 69.2% and 79.2% respectively.

In SBR – 3, along with the suspended sludge, fujino spirals are added. The addition of plastic media causes attached growth process in SBR-3. Hence the biodegradation occurs by both suspended and attached growth process. The variables, air flow rate, SRT and particle loading are optimized and the maximum decolourization and COD reduction is found to be 67.2% and 70.1% respectively. In SBR – 4, mixed microbes, sorbent and fujino spirals are added, which means both biodegradation and sorption occurs in the SBR. Hence it causes more decolourization and COD reduction. Also the SVI is found to be in the range of 30-60 mL/g, which is very low. The variables, air flow rate, SRT, sorbent dosage and particle loading are optimized and the maximum decolourization and COD reduction is found to be 78.2% and 90.8% respectively.

At these optimized conditions, the performance of all the four reactors are studied by varying the HRT’s (5, 4 and 3d) and initial wastewater concentration (1650 and 2450 mgCOD/L). The results obtained are compared. The low SVI for all the SBR’s indicates good settling property. From the results, the SBR - 4 system proved to be very effective for the decolourization of textile dye wastewater.

SEM analysis and FTIR analyses are carried out to characterize the decolourization process in the SBR’s. A first order kinetic model is applied to all the SBR’s. A high R² value of more 0.9 indicates that the process follows first order system. A mathematical model is used to describe the performance of SBR for the treatment of textile dye wastewater. Artificial neural network (ANN) has been employed to predict and model the SBR for the treatment of textile dye wastewater. From the results it is found that the ANN predicts the data well with R² more than 0.94 in all the SBR’s.