Chapter VI
Conclusion

The present investigation is concerned with the treatment of textile dyeing effluent in anaerobic sequential batch reactor. The experiments are conducted in batch reactors and in four ASBR at various hydraulic retention time and for different initial substrate concentrations. The results of anaerobic bench scale SBR confirmed the capability of the reactor for textile dyeing industry effluent treatment. It showed to be an efficient biological process, producing low COD effluent under optimum conditions. From the present study, it is found that the anaerobic sequential batch reactor along with the addition of sorbent and biomass support can be utilized for the treatment of textile dyeing industry effluent. Various benefits like small space requirements, operating flexibility and potential capital cost savings by eliminating clarifiers and other equipment rather than in activated sludge processes are clearly depicted during the study.

The ASBR is found to be effective for treating the textile dyeing industry wastewater. The results are summarized as follows.

- The characteristics of the textile dyeing industry effluent are analyzed. From the results it is observed that it has high organic content, color and total solids.

- Anaerobic sludge is collected from various industrial effluent treatment plant and domestic waste. From the results it is found that the sludge collected from tannery, textile dyeing industry, cow dung and domestic sludge gives better results. Hence these sludges are selected and screened for better decolorization.

- Screening of sludge is carried out in batch reactors. The variables like pH, temperature, wastewater dilution ratio and MLVSS are optimized using RSM. At the optimized condition, the sludge collected from textile dyeing effluent gives better decolorization. Hence it is employed in ASBR for the treatment of textile dyeing effluent.
The data obtained from the batch study are represented by various kinetic models namely, first order model, diffusional model and Singh model. Of these models, First order model represents the batch data well with high $R^2$ values ($>0.9$). Whereas Diffusional and Singh model fails to represent the batch study. This is proved by their low $R^2$ values.

Various cheap materials and algae are screened for its ability to decolorize the effluent. The result shows that groundnut shell powder has better ability for the decolorization process. Therefore it is used as sorbent in ASBR – 2 and ASBR – 4.

In ASBR-2, a combination of biodegradation and sorption is involved. Groundnut shell powder is used as sorbent. The process parameters like, sorbent dosage and cycle time are optimized using CCD. The maximum decolorization and COD reduction occurs at a cycle time of 24 h and sorbent dosage of 11.2 g/L. SVI is found to be in the range of 93 – 107, which indicates good settling property of sludge.

In ASBR-3, suspended growth and attached growth system are employed by the addition of microbes and fujino spirals. The process parameters like, biomass support and cycle time are optimized using CCD. The maximum decolorization and COD reduction occurs at a cycle time of 24 h and biomass support 23.5 % (v/v). SVI in the range of 98 – 112 indicates good settling property of sludge in SBR-3.

In ASBR-4, both sorption and biodegradation process occurs. Groundnut shell powder and fujino spirals are added. The process parameters like, sorbent dosage and biomass support are optimized using CCD. The maximum decolorization and COD reduction is obtained at the optimum condition of sorbent dosage – 10.2 g/L and biomass support – 20.2% (v/v). The SVI in the range of 84 – 101 indicates good settling of sludge in SBR-4.
The degradation study is carried out at optimum conditions by varying initial substrate concentration and hydraulic retention time in all ASBR. From the results it is found that, decolorization and COD reduction decreases below a HRT of 6 days.

Low VFA and F/M ratio indicates the good performance of ASBR in treating the textile dye wastewater treatment. The biogas production is found to be stable after little variations because of change in HRT and SC.

The results obtained in all the four ASBR’s are compared. It is observed that the addition of sorbent increases the percentage color removal by 14 - 16%. Introduction of plastic media in an ASBR enhances the performance of SBR by 10%. Addition of sorbent and plastic media in a single reactor (ASBR - 4) enhances the decolorization by 20-25%. Also acclimatization time of the ASBR - 4 is 1 - 2 d shorter than that of the other SBR’s.

The results reveal that the ASBR - 4 provides higher color and COD removal efficiencies when compared to other SBR’s. The reactor is resistant to shock loads and performs well under various operational conditions.

ASBR – 4 is an efficient reactor that is easy to operate and maintain, making it a technically and economically feasible and promising technology for industrial application.

SEM analysis indicates the sorption of dyes on the surface of sorbent and also the formation of biofilm on the surface of biomass support.

FTIR confirms the sorption dye molecules onto the groundnut shell powder.

Kinetic study indicates that the degradation process in all the four ASBR’s follows first order system.
All the four ASBR’s are modeled using ANN. The experimental values are well predicted by ANN. This is confirmed by high $R^2$ values (more than 0.97), low ABSD and RMSE.

6.1 Scope for future work

In future, the work can be extended in the following aspects

- A combination of aerobic and anaerobic process in SBR may by employed to enhance the performance of SBR
- Effect of mixing can be studied in ASBR
- ASBR can be operated at thermophilic conditions for the treatment of textile dye wastewater
- High strength wastewater like pharmaceutical, distilleries can be treated in this reactor
- Removal of specific pollutants like phenol, BTX, from industrial wastewater can be tried
- Mathematical modeling of the ASBR can be done
- A detailed study on the degradation of textile dyeing industry effluent based on adsorption and biodegradation can also be made individually
- A detailed study on the degradation pathway of dyes can also be made.