DELHI TECHNOLOGICAL UNIVERSITY

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DEPARTMENT OF ENVIRONMENTAL ENGINEERING

CERTIFICATE

This is to certify that the research work embodied in this dissertation entitled "**Design and Performance Evaluation of Functionalized Polymer Packed Continuous Reactor for Treating Industrial Dye Methylene Blue** " has been carried out in the Department of Environmental Engineering, Delhi Technological University, New Delhi. This work is original and has not been submitted in part or full for any other degree or diploma to any university or institute. The work is approved for submission.

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Prof. S.K. Singh
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Date: .07.2014

Place: Delhi

Dedicated

To

My mentor

Acknowledgement

As I write this acknowledgment, I must clarify that this not just a formal acknowledgment but also a sincere note of thanks and regard from my side. I feel a deep sense of gratitude and affection for those who were associated with the project and without whose co-operation and guidance this project could not have been conducted properly.

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Arpita Anand

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SYNOPSIS

The present study deals with a survey on impact of dyes – methylene blue on water pollution and its treatment. Several dyes and textile industries have released more than 10,000 dyes out of which methylene blue has wider application in medicinal usage, temporary hair color, etc. methylene blue is not strongly hazardous but response acute effect such as vomiting, increased heart rate, cyanosis, etc. Industrial effluent containing dyes also affects aquatic life and food webs.

Adsorption study was carried out for adsorption of methylene blue by employing amine based functionalised polymer polyaniline synthesized on the surface of jute fibre. Batch process was replaced by continuous column process in industries. Hence, the work was conducted through continuous column process. Parameters of industrial waste water considered for studies are pH, initial concentration of methylene blue, flow rate of methylene blue and different bed depth of the reactor.

Firstly, pH factor was investigated and observed that the maximum adsorption with maximum breakthrough time was achieved for basic pH against acidic pH of 2 and 4. Hence, all the remaining experiment was conducted nearly about neutral pH. At acidic pH polyaniline polymer gets protonated and therefore, would repel the cationic methylene blue, thereby decreasing the removal at acidic pH. However, at basic pH the surface of polymer gets deprotonated and would prefer binding with methylene blue through coordinate bond with nitrogen atoms of amine.

Second study conducted was emphasized on different bed depth of column reactor. For initial methylene blue concentration of 5mg/l and flow rate of 5ml/min, the breakthrough time at bed depth of 15, 30 and 45 cm are 60, 130 and 190 hours, respectively. The average uptake capacity yields around 6mg of methylene blue per gm of polyaniline jute. In order to design for higher flow rate and higher initial concentration we applied BDST model. A linear plot bed depth versus breakthrough time shows linearity with co-relation co-efficient R^2 very close to unity i.e. 0.998. Therefore, a reactor for initial concentration of 20mg/l and flow rate of 5 ml/min was designed and breakthrough time was evaluated. Chi^2 error of 1.564, 0.85 and 0.37 for bed depth of 15, 30 and 45 cm suggest well applicability of BDST model for higher

initial concentration of 20mg/l and 20 ml/min was also tried. The design was approached in two ways- firstly by predicting from experiment reactor of initial methylene blue 5mg/l and initial flow rate of 5ml/min. Secondly, it was tested from experiment reactor of 20mg/l and initial flow rate of 5mL/min. The validification of prediction was carried out by experimenting bed at initial methylene blue 20 mg/L and flow rate 20 mL/min. A predicted Chi square of 0.33 to 2.07 for second prediction compared to 1.09 to 1.53 for 1st prediction suugest a better prediction from the later model of 5mg/l and flow rate of 5 ml/min. a sharp wavefront of breakthrough curve for all the bed depth suggest rapid chemical adsorption of methylene blue by PANI jute.

Desorption was conducted to revert back the adsorbed methylene blue and concentrated it in very small volume. Desorption was carried out by 0.1 M of HCL fed at 2mL/min. This acid desorbent was able to concentrate upto 1000 mg/l of methylene blue i.e. more than 260 times that of initial methylene blue concentration.

Reuse of the column reactor was checked by again running the column experiment. It was observed that the adsorption capacity was decreased by manifolds. However, the sharp wave front or the breakthrough curve was still maintained, suggesting strong chemical adsorption. Probably all the methylene blue was not recovered back and still adsorbed in adsorbent matrix yielding low adsorbent capacity in second cycle. Therefore, this study suggests the well effective adsorption of methylene blue by continuous column reactor filled with functionalised polyaniline jute polymer. This study also suggests well applicability of BDST model for higher initial concentration and flow rate.

Keywords: Adsorption, BDST, Dyes; Methylene Blue; polyaniline.