**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI**
**SHORT ABSTRACT OF THESIS**


Name of the Student : **RAHUL VERMA**

Roll Number : **166152005**

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Thesis Title: **Advanced treatment methods of melanoidin for the effective remediation of distillery spentwash**


Name of Thesis Supervisor(s) : **Prof. Lalit Mohan Pandey & Prof. Lal Mohan Kundu**

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## SHORT ABSTRACT


The melanoidin-containing wastewater, particularly distillery spentwash possesses very high loads of chemical oxygen demand (COD) and other organic and inorganic pollutants. The discharge of this dark brown colour wastewater to water bodies results in eutrophication, reduction of dissolved oxygen level, obstruction of sunlight penetration, inhibition of photosynthesis of aquatic plants and groundwater contamination. The treatment efficacies of the conventional methods are quite low due to the poor biodegradability of melanoidin. In this regard, the present study explores adsorption, advanced oxidation process, and photocatalysis to remove melanoidin from wastewater. In addition, the bioprocessing of molasses to produce alternative metabolite biosurfactants has been investigated to decrease the pollution load of wastewater. Chapter 1 and chapter 2 demonstrate the introduction and literature review on melanoidin removal in distillery spentwash.

In chapter 3, low-cost bio-sorbents were prepared from different plant sources and further amine-modified by forming self-assembled monolayers (SAMs). The experimental parameters like temperature, pH and adsorbent doses have been optimized by RSM-CCD for the maximum removal of melanoidin. Amine-modified *Phyllanthus emblica* leaf resulted in the maximum adsorption of melanoidin (616 mg $g^{-1}$). These adsorbents were tested for reusability and retained their adsorption capacity up to the $5^{th}$ consecutive adsorption/desorption cycle.

In chapter 4, the photochemical degradation of melanoidin has been investigated by the photo-Fenton process. The experimental parameters such as temperature, time, $H_2O_2$ and Fe concentrations were optimized. At the optimized condition (34°C, 117 min, 158 mM of $H_2O_2$ and 0.74 mM of Fe), the 99 ± 1 % degradation of 1 % w/v of melanoidin solution was observed along with 88 ± 2 % of COD reduction.

Chapter 5 investigates the photocatalytic degradation of melanoidin using different photocatalysts such as ZnO, $TiO_2$, Fe doped ZnO (FZO) and $WO_3$. The FZO and synthesized

$WO_3$ nanoparticles were investigated with excellent results under UV light and visible light illumination, respectively, for melanoidin degradation. The FZO showed 98 ± 0.5 % and 85 ± 2 % of melanoidin and COD reduction, respectively of 1 % (w/v) of initial melanoidin concentration at the optimized conditions: 34 °C, contact time of 117 min, 163 mM of $H_2O_2$ and 261 ppm of FZO. Similarly, the $WO_3$ showed 99 ± 1 % of colour and 93 ± 1 % of COD reductions, at 0.5 % (w/v) of initial melanoidin concentration under the optimized conditions. These photocatalysts also displayed complete degradation of 4 % (v/v) of real spentwash and excellent reusability for multiple cycles.

In the last chapter (Chapter 6), microbial utilization of molasses has been investigated to produce biosurfactants using an isolated inherent microbe *Bacillus subtilis* RSL-2. At the optimized conditions, a large biosurfactant concentration of 12.34 ± 0.1 g $L^{-1}$ was obtained. The produced biosurfactant was identified to be lipopeptide in nature. Further, a reactor study was performed in a 5 L bioreactor, and the biosurfactant concentration was enhanced to 13.92 g $L^{-1}$. The produced wastewater had 75 to 80 times lower COD value as compared to distillery spentwash.

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