Decolorization for Industrial Wastewater Treatment with Immobilization of Laccase to the Nanocomposite Matrix

Sedef Ilk[a], Necdet Sağlam[b], Zakir M.O. Rzayev[b]
[a]*Faculty of Agricultural Sciences and Technologies, Nigde University, Nigde, Turkey*
[b]*Institute of Graduate in Science & Engineering, Division of Nanotechnology and Nanomedicine, Hacettepe University, Beytepe, Ankara, Turkey*
Contact: sedefilk@nigde.edu.tr

Abstract -In this study, laccase enzyme (E.C.1.10.3.2.) that produced *Trametes versicolor* was immobilized through physical adsorption to the nanocomposite structure which used for decolorization of reactive coloring substance (Reactive Red 5) in the industrial originated wastewaters. Optimum physiological conditions such as optimum pH, temperature, the initial colored substance concentration, time-dependent decolorization rate were determinated for the laccase immobilization and these datas were applied and compared both free and immobilized laccase for effective decolorization of industrial wastewater at lab scale.

Keywords: Nanocomposites, enzyme immobilization, laccase, removing of azo dyes.

Introduction-Using of microorganismal originated enzymes for decolorization of industrial waste water offers considerable advantages. This nanobiotechnological process is cheap and economic, also the last products that obtained during mineralization are not toxic [1, 2]. Even though physico-chemical methods are effective in dye removal, some problems such as the overall cost, regeneration, secondary pollutants, limited versatility, interactions with other wastewater constituents and residual sludge generation limit their usage [3]. As an alternative, biological treatments are a relatively inexpensive way to remove dyes from wastewater [4]. In this work, fungal originated laccase enzymes were studied with a nanotechnological way for this kind of removal process.

Experimental-Laccase immobilization to the synthesized poly(maleic anhydride-*alt*-methyl vinyl ether)/octadecylamine-montmorillonite nanostructures were examined under the optimum conditions (pH, temperature, laccase initial concentration and time). After then, for effectively decolorization process, the optimum conditions (pH, temperature, the initial coloring substance concentration, time-dependent decolorization rate) were determined for both free and immobilized laccase enzymes.

Results and Discussion-The optimum conditions for the fungal originated laccase immobilization to the poly(maleic anhydride-*alt*-methyl vinyl ether)/octadecylamine-montmorillonite nanocomposites were determined as 4.5 pH, 37^{o}C temperature, 0.025 mg/ml laccase initial concentration, and 60 minutes at the first stage of the study. After then, for effectively decolorization, the optimum pH was stated as 5.0 and temperature was also stated as 20 ^{0}C for both free and immobilized laccase. Moreover, the initial coloring substance concentration was 0,025 mg/L and 0,05 mg/L for free and immobilized laccase, respectively. In our research was determinated as optimum time 120 min.(63% decolorization rate) and 90 min. (70% decolorization rate) for free enzyme and immobilized laccase respectively. At the end of 27 days, while immobilized laccase activity was 65%, free enzyme activity was 33%. Lastly, laccase productivity was found as 77.3% for reusing in effectively decolorization at 10 times over in a period of three days.

References

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