

Abstract

In this study, β -1,4-endoglucanase an important enzyme in the textile industry was immobilized on different types of nanoparticles providing the new cost-effective alternatives to the traditional denim stone washing. Different types of the nanoparticles (FeSO₄ IOMNPs, silica nanoparticles, FeCl₂, and C-FeCl₂ IOMNPs) were chemically synthesized. Their particle size was optimized by altering the ultra-sonication time (15-35 mins) to obtain nanoparticles within the range of 10-100nm. All the nanoparticles were then modified with APTES (3-aminopropyltriethoxysilane) followed by the enzyme immobilization. APTES functionalization was determined by FT-IR peaks around 550-600 cm⁻¹ and 1509-1658 cm⁻¹ which clearly confirmed the formation and functionalization of magnetic nanoparticles. β -1,4-endoglucanase was immobilized on different nanoparticles by adsorption and covalent binding methods, with the intention of making it reusable. Impact of different types of washing processes of denim using enzyme immobilized nanoparticles on different properties of denim fabric were explored in comparison with the traditional enzyme stone washing of denim. All these properties were examined according to the ISO (International Organization for Standardization). According to the results, FeSO₄ IOMNPs and silica nanoparticles revealed improved tensile strength (913 N, 975 N), tear strength (57.8 N, 53.5 N) and stretch properties (grade 4-5). The moderate grade (1-2) was observed for colour fastness to wet rubbing. The grade observed for the dry rubbing and the color fastness to laundering (4-5) was good in case of denim washed with enzyme immobilized FeSO₄ IOMNPs and silica nanoparticles. On the basis of the good performance, enzyme immobilized FeSO₄ IOMNPs and MSNs nanoparticles were re-used up to three cycles and minor loss in enzyme activity (8%, 8.9% and 13.0%) was observed even after the third cycle. As a result, denim washing with enzyme immobilized nanoparticles not only improves the fabric quality but also helps in decreasing the cost of enzyme washing process of denim.