

Treatment of biosorption and ozonation on elimination of the day pollution in treated water

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Received: March 2019

Accepted: October 2019

Abstract

Textile wastewater is characterized by strong color, saturation of unfixed dyes and their residues, and organic and inorganic chemicals, such as bleaches, detergents, optical brighteners, fixing, sequestering and finishing agents, carriers, surfactants, equalizers, It is characterized by consumption of high amount of water and production of large volumes of wastewater from various processes, such as dyeing, printing, finishing, The wastewater treatment methods are broadly categorized as physical, chemical and biological. The integrated processes including some combinations of three treatment classes are mostly employed to remove color from dye contaminated effluents and comply with severe regulations. This review revealed that a combination of biosorption followed by ozonation might more efficient in terms of time, cost and toxicity reduction than separately using these processes. To compensate the negative points of both the processes, combined treatment of biosorption followed by subsequent ozonation have been implied. The treatment of ozonation has been increasing for the decolorization of textile dyes, the main disadvantage of this way of apply being related to the by products, which can have toxic and carcinogenic actions. The other disadvantage related to ozonation is its cost and time taken by ozonation. On the other hand, biosorption is a cheap process for the treatment of textile dyes, but it is less efficient in removing dyes as compared to ozonation at higher dye concentrations. It can be suggested that a combination of biosorption followed by ozonation might more efficient and effective for the decolorization of textile dye and to reduce the toxicity of ozonation process.

Keywords: Biosorption, Elimination, Ozonation, Water Pollution, Textile dyes

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Introduction

The textile industry is one of rapidly growing field worldwide. It is one of the world's most polluting industries due to the volume and different chemical composition of its discharges (Tapalad *et al.*, 2008). It is characterized by consumption of high amount of water and production of large volumes of wastewater from various processes, such as dyeing, printing, finishing, etc. (Babu *et al.*, 2007). Textile wastewater is characterized by strong color, saturation of unfixed dyes and their residues, and organic and inorganic chemicals, such as bleaches, detergents, optical brighteners, fixing, sequestering and finishing agents, carriers, surfactants, equalizers, etc. (Sundrajana *et al.*, 2007). The colored material having an affinity to the substrate to which it is being applied is known as dye. It is mostly applied as an aqueous solution in the presence of a mordant to improve its fastness on the fiber. The dye chromophores are usually composed of double bonds and conjugated rings such as aromatic and heterocyclic, with oxygen, sulphur and nitrogen, imparting color to the dye by absorbing UV light of some wavelength (Jia-le *et al.*, 2007). The reactive dyes are the only textile colorants which bond covalently with cellulosic fiber. These dyes are typically azo based chromophores combined with various reactive groups such as chlorotriazine, vinyl sulfone, difluorochloropyrimidine. The often use of reactive dyes in textile dyes in textile and other industrial applications regards to their splendid properties including low cost, fast dyeing,

brilliant shades, water solubility, ease of application, broad color spectrum and good wet and light fastness profiles (Song *et al.*, 2008; Siddique *et al.*, 2011). The presence of water soluble reactive dyes in effluent is problematic pertaining to environmental regarding. These are resistive to aerobic degradation and their anaerobic degradation residuals such as aromatic amines are destructive for aquatic life (Song *et al.*, 2008). Also, in humans, these may cause skin sensitization, skin and eye irritations and even cancer upon inhalation, dermal contact and oral digestion (Mohamadian-Fazli *et al.*, 2010).

The major concern of textile wastewater is its strong color which is unsightly, undesirable and displeasing on aesthetic basis. Apart from aesthetic problems, the aquatic life of receiving media is severely affected (Fahimi *et al.*, 2010). The suspended solids may clog gills of fish, resulting in their reduced growth or death. Many endemic plants and animals may be threatened by organic and inorganic compounds (Asgher *et al.*, 2009). Wastewater treatment methods are broadly categorized as physical, chemical and biological. The type of pollutant to be removed is the base of this classification (Guendy, 2007). The wastewater treatment methods are broadly categorized as physical, chemical and biological. The integrated processes including some combinations of three treatment classes are mostly employed to remove color from dye contaminated effluents and comply with severe regulations (Sundaraman *et al.*, 2009). Some traditional physicochemical techniques, such as

reverse osmosis, membrane filtration, ion exchange, and adsorption on various adsorbents such as silica gel, fly ash, activated carbon, wood chips, corncob, peat, barley have successfully been used for color removal from textile waste (Siddique *et al.*, 2011). The chemical coagulation and flocculation is useful to treat insoluble dyestuff wastewater but restricted for soluble dyestuff wastewater. The insoluble dyestuff wastewater is also difficult to treat by the adsorption method. The complex organic dyestuffs at low concentration are difficult to oxidize by conventional oxidation (Inaloo *et al.*, 2011).

Biosorption is defined as the ability of particular biomolecules or biomass to adsorb and concentrate certain ions or molecules from aqueous solution (Igwe and Abia, 2006). It is a passive process that occurs basically due to forces of affinity between functional groups in cell wall or surfaces of biosorbent and sorbate (Figueria, 2000; Ismail *et al.*, 2012; Mane and Bhusari, 2012).

Ozonation is one of the most effective and advanced methods to decolorize dye-bearing contaminants. The major treatment goals achieved by ozonation included combined high color and chemical oxygen demand elimination in one step, enhanced biodegradability and recovery of heavy metal (Hsing *et al.*, 2006).

Ozone is a potent oxidant and its oxidizing ability is owed to nascent oxygen atoms and hydroxyl radicals. This cleavage shifts the absorption spectra of the molecule out of the visible region (Palit, 2009).

Ozone reaction with dye wastewater follows two degradation pathways. The direct route involves molecular ozone activity as the electron acceptor in acidic pH. Whereas indirect route corresponds to decomposition of ozone into secondary oxidants like HO, HO₂ and HO₃ favored by alkaline pH (Jia-le *et al.*, 2007). Ozone reacts more effectively with reactive dyes but is found ineffective for nonsoluble disperse; sulfur and vat dyes that react slowly and take longer time to decolorize (Khan *et al.*, 2010).

We would say that ozone decolorizing ability may be in direct relation with ozonation time, ozone dosage and inverse to increase in dye concentration. The treatment of ozonation has been increasing nowadays for the decolorization of textile dyes, the major disadvantage of this type of apply being related to the by products, which can have toxic and carcinogenic effects. The other disadvantage related to ozonation is its cost and time taken by ozonation. On the other hand, biosorption is a cheap process for the treatment of textile dyes, but it is less efficient in removing dyes as compared to ozonation at higher dye concentrations. To compensate the negative points of both the processes, combined treatment of biosorption followed by subsequent ozonation has been reviewed.

Conclusions

Biosorption and ozonation only good for the removal of color from dye solution but in fact on the other hand they can increase the pollution load and could not meet the requirements of textile industry standards.

It can be suggested that a combination of biosorption followed by ozonation might be more efficient and effective for the decolorization of textile dye and to reduce the toxicity of ozonation process. It was found that pollution indicators showed a high pollution load in treated water. That means that biosorption and ozonation are only good for the removal of color from dye solution but in fact on the other hand they increase the pollution load and did not meet the requirements of textile industry standards. It was suggested that a combination of biosorption followed by ozonation is more efficient.

This review revealed that a combination of biosorption followed by ozonation might be more efficient in terms of time, cost and toxicity reduction than separately using these processes in high pollution load in treated water.

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