Bioresource Technology 123 (2012) 106–111

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Integrated fungal biomass and activated sludge treatment for textile wastewaters bioremediation

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HIGHLIGHTS

- A textile effluents treatment was integrated with a fungal biodegradation step.
- *Trametes pubescens* MUT 2400 was the best, over nine strains, in terms of decolourisation.
- The following step by activated sludge was effective in COD and toxicity reduction.
- The fungus was packed in a bioreactor in order to treat larger volumes of wastewater.
- Further steps must be taken in order to set this process at an industrial scale.

ARTICLE INFO

Article history:
Received 25 May 2012
Received in revised form 6 July 2012
Accepted 10 July 2012
Available online 15 July 2012

Keywords:
Biodegradation
Bioreactor
Ecotoxicity
White-rot fungi
Wastewater treatment

ABSTRACT

A combined biological process was investigated for effective textile wastewater treatment. The process consisted of a first step performed by selected fungal biomasses, mainly devoted to the effluent decolourisation, and of a subsequent stage by means of activated sludge, in order to reduce the remaining COD and toxicity. In particular, the treatment with *Trametes pubescens* MUT 2400, selected over nine strains, achieved very good results in respect to all parameters. The final scale-up phase in a moving bed bioreactor with the supported biomass of the fungus allowed to verify the effectiveness of the treatment with high volumes. Despite promising results, further steps must be taken in order to optimize the use of these biomasses for a full exploitation of their oxidative potential in textile wastewater treatment.

1. Introduction

The supply of clean freshwater is critical to the future of man and indeed to that of the biosphere itself (Johnston, 2003). In recent years, there has been an intensive research in industrial wastewaters treatments, in order to develop more effective technologies and to reduce the release of toxic and polluting substances in watercourses.

Considering both the volume and the composition of the effluents, the textile industry is rated as one of the most polluting among all industrial sectors. Textile effluents are one of the most difficult-to-treat on account of the considerable amount of suspended solids and of the massive presence of dyes, salts, additives, detergents, and surfactants (Prigione et al., 2008). Traditional technologies include various physical and chemical processes (primary treatments) coupled with a secondary biological treatment performed by activated sludge. These methods are often ineffective for wastewater decolourisation and a tertiary treatment is necessary (i.e. ozonation, photochemical processes). These additional methods, however, are very expensive and not always solve the problem of toxicity (Vanhulle et al., 2008).

In recent years, many attempts have been made to obtain a higher efficiency of treatment by modifying conventional treatment process with additional physical, chemical and/or biological processes (Park et al., 2011); studies on innovative biological approaches have investigated the possibility to use selected microorganisms in order to degrade dyes in wastewaters.

Fungi, particularly white rot fungi, have long been recognized for their ability to degrade a wide range of recalcitrant compounds, such as synthetic dyes, through the use of relatively non-specific, extracellular oxidative enzymes (Kaushik and Malik, 2009; Singh and Arora, 2011). This enzymatic system, which in nature is involved in lignin degradation, consists mainly of oxidative enzymes

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http://dx.doi.org/10.1016/j.biortech.2012.07.026