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Effect of mixed liquor volatile suspended solids (MLVSS) and hydraulic retention time (HRT) on the performance of activated sludge process during the biotreatment of real textile wastewater

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ABSTRACT

Adequate information is available on colour and organics removal in batch mode using pure microbial cultures from dye contaminated wastewater. There was a need to develop environment friendly and cost effective treatment technique for actual field conditions. Therefore, the present study was undertaken with an aim to evaluate the potential of acclimatized mixed microbial consortia for the removal of colour and organics from real textile wastewater. Experiments were performed in laboratory scale activated sludge process (ASP) unit under steady state condition, varying mixed liquor volatile suspended solids (MLVSS) (2500, 3500 and 5000 mg/l) and hydraulic retention time (HRT) (18, 24 and 36 h). The results showed that decolourization and chemical oxygen demand (COD) removal increased with increase in MLVSS and HRT. At 18 h HRT, decolourization was found to be 46, 54 and 67%, which increased to 67, 75 and 90% (36 h HRT) at 2500, 3500 and 5000 mg/l MLVSS, respectively. COD removal was found to be 62, 73 and 77% (at 18 h HRT) which increased to 77, 85 and 91% (36 h HRT) at 2000, 3500 and 5000 mg/l MLVSS, respectively. On the basis of the results obtained in this study suitable treatment techniques can be developed for the treatment of wastewater contaminated with variety of dyes in continuous mode of

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operation. This shall have the advantage of treatment of larger quantity of wastewater in shorter duration.

1. Introduction

The wastewater generated from dyeing and textile industries is considered to be very problematic not only for containing high chemical and biological oxygen demands, suspended solids and toxic compounds but also for strong colour which is the first contaminant to be recognized by human eyes [1,2]. Textile finishing wastewater, especially dye house effluents, contain different classes of organic dyes and chemicals and thus they are coloured and have extreme pH, COD, BOD, different salts, surfactants, heavy metals, mineral oils, etc. [3]. The discharge of organic pollutants (either BOD or COD) into the receiving stream can lead to the depletion of dissolved oxygen and thus creates anaerobic condition [4]. Under anaerobic condition foul smelling compounds such as hydrogen sulphides may be produced. This will consequently upset the biological activity in the receiving stream. Government legislation is becoming more stringent in most developing countries regarding the removal of dyes from industrial effluent. Environmental protection in India is promoting prevention of transfer of pollution problems from one part of the environment to another. This means that most of the textile industries are developing on site or in-plant facilities to treat their own effluent prior to discharge [1]. The removal of polluting dyes from effluents is an important problem, particularly for small scale textile industries where working conditions and economic status do not allow them to treat their wastewater before disposal and they have no choice other than discharging the effluents into the main stream of water resources. Most physicochemical methods for dye removal have drawbacks because they are expensive, have limited versatility, are greatly interfered by other wastewater constituents, and/or generate waste products that must be handled [5–10]. Alternatively, biological treatment may present a relatively inexpensive way to remove dyes from wastewater. Microbial process for decolourization and degradation is an environment-friendly and cost-competitive alternative process over chemical decomposition processes [11,12].

A lot of work has been done on the decolourization of dyes by using pure cultures under growing condition in batch and continuous modes of operation [13–15]. Single bacterial and fungal strains are effective in the treatment of textile wastewater, especially for colour removal. However, difficultly in maintaining the purity of single cultures in the field and the inability of these cultures to degrade all different dyes present in the effluent are the drawbacks with respect to their commercial application [16,17]. The use of mixed cultures seems to be more promising for large scale application at the field level. The syntrophic interactions present in the mixed communities lead to complete mineralization of dyes [18]. Further, most of the studies have been conducted in batch mode for the decolourization/degradation of dyes using synthetic dye solutions and scattered information is available on the treatment of dye contaminated wastewater in continuous mode with actual textile wastewater. A continuous mode of operation shall have the advantage of treating a large quantity of wastewater in shorter duration as compared to batch treatment. Many parameters like MLVSS and HRT affect the performance of activated sludge process; therefore, the present study was undertaken for the treatment of real textile wastewater at different MLVSS and HRTs.

2. Materials and methods

2.1. Textile effluent

Actual industrial effluent (untreated wastewater) was procured from a local textile industry situated near Delhi, the capital city of India. The effluent was stored at 4 °C in a cold room. The characteristics of the effluent are shown in Table 1.