Bioresource Technology 128 (2013) 351–358

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

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

The use of the dynamic respiration index to predict the potential MSW-leachate impacts after short term mechanical biological treatment

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HIGHLIGHTS

- We aimed to describe leachate impact reduction after short-term full scale MBT process.
- The dynamic respiration index (DRI) was used to measure leachate impact reduction.
- Leachate impact was measured after 1 year in landfill reactors.
- Short-term MBT getting a DRI < 1000 mg O_2 kg VS^{-1} h^{-1} greatly reduced leachate impacts.
- COD, BOD_5 and total heavy metal reduced of −70%, −81% and −16%, respectively.

ARTICLE INFO

Article history:
Received 22 August 2012
Received in revised form 19 October 2012
Accepted 23 October 2012
Available online 31 October 2012

Keywords:
Dynamic respiration index
Landfill impacts
Leachate
Mechanical–biological treatment
Municipal solid waste

ABSTRACT

The aim of this work was to evaluate the effects of short full scale MBT process (28 d) getting a biological stability of DRI < 1000 mg O_2 kg VS^{-1} h^{-1}, on the impact of leachate produced in simulated landfill. As consequence of that, waste was processed by full scale MBT and both untreated and treated waste were successively incubated in simulated landfills for 1 year. Leachates were collected at different incubation times and characterized. Results obtained indicated that MBT allowed waste-organic matter (OM) reduction favoring, also, optimal condition for successive OM degradation in the simulated landfill.

Final results indicated a total reduction of leachate impact for the treated waste (DRI of 978 mg O_2 - kg VS^{-1} h^{-1}) with respect to the untreated waste of: −54%, −69%, −77%, −70%, −81% and −16% for NTK, NH_3, TOC, COD, BOD_5 and total heavy metal contents, respectively.

1. Introduction

Municipal solid wastes (MSW) are mainly disposed into landfill, which represents the simplest and cheapest method of waste management (Allen, 2001; Zheng-Hao et al., 2009). Nevertheless MSW disposal in landfill caused different impacts, i.e. methane and other greenhouse gases and hazard emissions, odours production, polluted leachates, etc.

In landfill the biodegradation of organic fractions contained in MSW is the major mechanism that governs biological pollution with particular reference to leachate productions (Read et al., 2001). Leachate is formed when moisture content in waste exceeds its water holding capacity (WHC), i.e. maximum moisture that is retained in a porous medium without producing percolation (Driessen et al., 1995; El-Fadel et al., 1997). Water percolation provides a medium in which waste can undergo into simpler substances through a range of chemical reactions (dissolution, hydrolysis and redox reactions) and microbial metabolism activity (El-Fadel et al., 1997). As result of these processes, leachates contain organic molecules, inorganic water-soluble component, heavy metals and xenobiotic compounds (Kjeldsen et al., 2002). The chemical composition of leachates varies in function of landfill age (Li et al., 2010), MSW biological stability and moisture content (Barlaz, 2006). Therefore leachate characterization is often used as an indicator of the landfill conditions and it is essential to understand the long-term effects of landfills (Kjeldsen et al., 2002). Young landfill leachates are characterized by high organic carbon concentrations (COD of 10,000 mg O_2 l^{-1}), high content of biodegradable fraction (BOD_5/COD in the range 0.4–0.7) and low pH values (pH < 6.5), whereas leachate of old landfill shows lower organic carbon content (COD < 4000 mg l^{-1}; BOD_5/COD < 0.1) and higher pH value (7.5–8.5) than young landfill.

In order to reduce or prevent environmental pollution, the European Commission emanated the Landfill Directive (European Parliament and Council Directive, 1999) to drive the member states

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0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.10.101