Effect of fermented wastewaters from butter production on phosphates removal in a sequencing batch reactor

Wojciech Janczukowicz a,*, Joanna Rodziewicz a, Arthur Thornton b, Kamila Czaplicka a

a University of Warmia and Mazury in Olsztyn, Department of Environmental Protection Engineering ul. Prawochenskiego 1, Olsztyn 10-900, Poland
b Atkins, Woodcote Grove, Ashley Road, Epsom, KT18, UK

HIGHLIGHTS

► Fermented butter production wastewaters may be exploited as a carbon source in SBR.
► The wastewaters dose increase had a direct impact on phosphate and nitrate removal.
► Effluent phosphate and nitrate concentrations were lower than in the control reactor.
► This is due to the increased concentrations of VFAs and predominance of acetic acid.
► The highest dose introduction to the reactor resulted in an increased effluent COD.

ARTICLE INFO

Article history:
Received 1 April 2012
Received in revised form 6 June 2012
Accepted 11 June 2012
Available online 19 June 2012

Keywords:
Dairy wastewaters
Pre-fermentation
Carbon source
Phosphates removal

ABSTRACT

This study determined the potential for fermented wastewaters from butter production plant to act as a carbon source to facilitate phosphates removal. Synthetic dairy waste waters were treated using SBR, with doses of fermented wastewaters.

An increase in the fermented wastewater doses were found to improve the effluent quality in respect of phosphates and nitrates. The lowest concentrations of phosphate and nitrates, respectively $0.10 \pm 0.04 \text{ mg PO}_4\text{-P L}^{-1}$ and $1.03 \pm 0.22 \text{ mg NO}_3\text{-N L}^{-1}$, were noted in the effluent from the reactor fed with fermented wastewaters in a dose of $0.25 \text{ L d}^{-1}$ per $0.45 \text{ L d}^{-1}$ of wastewaters fed to the reactor. In the case of the two highest doses, an increase in effluent COD was stated.

The higher effectiveness resulted from the fact that the introduction of fermented wastewaters caused an increase in the easily-available carbon compounds content and the predominance of acetic acid amongst VFAs available to dephosphatating and denitrifying bacteria.

© 2012 Elsevier Ltd. All rights reserved.

1. Introduction

The process and effectiveness of denitrification and dephosphatation processes are, to a great extent, determined by the composition of wastewaters. The effective elimination of biogenes depends on the presence of easily-available organic compounds, including volatile fatty acids (VFAs), in wastewaters.

Sequential batch reactors (SBR) are amongst the treatment technologies used, for the treatment of dairy wastewaters. Such reactors are, in most cases, effective at treating carbon and nitrogen compounds, whereas phosphorus removal is often impaired by an insufficient quantity of available carbon (Janczukowicz, 2001).

One approach to boost the efficiency of SBR type reactors may be the introduction of additional sources of carbon to the wastewaters being treated, for example adding volatile fatty acids (Gerber et al., 1986; Tam et al., 1992; Randall et al., 1997; Kargi et al., 2005; Puig et al., 2008). Research conducted under dynamic conditions by Janczukowicz (2005) demonstrated that in the case of SBR type reactors treating dairy wastewaters, the most effective source of carbon in the dephosphatation process turned out to be propionic acid, followed by acetic acid. In the associated denitrification processes, the effectiveness of this process in the presence of propionic acid was lower than in the reactors with acetic and butyric acids.

Many authors emphasize that wastewaters and waste products from the agri-food industry, including dairy wastewaters, are an excellent source of volatile fatty acids both in the denitrification and dephosphatation process (Lim et al., 2000, 2008a,b; Cappai et al., 2004; Sage et al., 2006; Rodriguez et al., 2007; Dragicevic et al., 2010; Fernández-Nava et al., 2010; Hong and Haiyun, 2010; Fernández et al., 2011). Thus applied wastewaters are referred to as an external source of carbon (Fernández-Nava et al., 2010). Amongst dairy wastewaters, those resulting from the pro-