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Chemical Papers 67 (12) 1577–1584 (2013)
DOI: 10.2478/s11696-013-0447-0

ORIGINAL PAPER

Anoxic granulated biomass and its storage

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Received 6 March 2013; Revised 15 June 2013; Accepted 16 June 2013

Laboratory experiments involving shutdown and repeated start-up of a denitrification USB reactor with granulated anoxic biomass were conducted in order to find suitable conditions for a safe storage period of the biomass. Anoxic granulated biomass stored under anaerobic conditions for a half year period at 6 °C and for a half month period at 18–20 °C retained its activity and granular morphology. Storage of anoxic granules under anaerobic conditions for a half year period at 18–20 °C led to the loss of the biomass original activity and a significant portion of the granules disintegrated. Anoxic granulated biomass stored for a one and a half month period under endogenous anoxic conditions at 18–20 °C retained its activity and granular morphology. A two month storage under endogenous anoxic conditions at 18–20 °C was too long and the shutdown of the reactor had to be followed by repeated anoxic granulation. Minimum loading of the USB reactor with N-NO_3 to maintain endogenous anoxic conditions in the sludge bed was in the range of 0.06–0.1 kg of N-NO_3 per m^3 per day. Restart of the USB reactor can be accelerated by an addition of anaerobic granulated biomass.

Keywords: anoxic granulation, denitrification USB reactor, storage of anoxic granulated biomass

Introduction

A denitrification USB reactor is an up-flow reactor with a sludge bed containing anoxic granulated biomass and a gas–liquid–solid (g-l-s) separator, where nitrogen and biomass are separated. Anoxic granulated biomass enables maintaining high concentration of mixed liquor suspended solids (MLSS) in the reactor and due to its high load, the reaction volume can be significantly lower. Effluent from the reactor contains suspended solids (SS) in minimum concentrations.

The USB reactor was originally designed as a UASB reactor with anaerobic granulated biomass (Lettinga et al., 1980; Lettinga & Hulshoff Pol, 1986). Additionally, it was discovered that denitrifying biomass has a similar ability to generate well-settling granules and that it can be utilized for the reduction of N-NO_3 either in drinking water (van der Hoek & Klapwijk, 1987; van der Hoek et al., 1987, 1988a, 1988b; Green et al., 1994; Tarre & Green, 1994; Kratochvíl et al., 1997; Bhatti et al., 2001) or in wastewater (Borzacconi et al., 1999; Cuervo-López et al., 1999; Eiroa et al., 2004; Franco et al., 2006; Ruiz et al., 2006; Pagáčová et al., 2009, 2010; Galbová et al., 2010; Babjaková et al., 2013).

The main condition for the denitrification in an USB reactor is to cultivate well-settling anoxic granules (Fig. 1). Anoxic granulation is a relatively complicated process and final parameters of a denitrifying USB reactor with anoxic granules depend mainly on the wastewater composition, granulation procedure, as well as on the quality of the inoculum. The principle of granulation (i.e., spontaneous cultivation of

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