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Effects of chlortetracycline amended feed on anaerobic sequencing batch reactor performance of swine manure digestion

Teal M. Dreher [a], Henry V. Mott [a], Christopher D. Lupo [a], Aaron S. Oswald [a], Sharon A. Clay [b], James J. Stone [a,*]

[a] Department of Civil and Environmental Engineering, South Dakota School of Mines and Technology, Rapid City, SD 57701, USA
[b] Department of Plant Sciences, South Dakota State University, Brookings, SD 57007, USA

HIGHLIGHTS

- Effects of manure from CTC amended feed on ASBR performance assessed.
- ASBR biogas extent unaffected, but methane content reduced by CTC treatment.
- CTC acclimatization apparent after 56 d.

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ABSTRACT

The effects of antimicrobial chlortetracycline (CTC) on the anaerobic digestion (AD) of swine manure slurry using anaerobic sequencing batch reactors (ASBRs) was investigated. Reactors were loaded with manure collected from pigs receiving CTC and no-antimicrobial amended diets at 2.5 g/L/d. The slurry was intermittently fed to four 9.5 L lab-scale anaerobic sequencing batch reactors, two with no-antimicrobial manure, and two with CTC-amended manure, and four 28 day ASBR cycles were completed. The CTC concentration within the manure was 28 mg/L immediately after collection and 1.02 mg/L after dilution and 250 days of storage. CTC did not inhibit ASBR biogas production extent, however the volumetric composition of methane was significantly less (approximately 13% and 15% for cycles 1 and 2, respectively) than the no-antimicrobial through 56 d. CTC decreased soluble chemical oxygen demand and acetic acid utilization through 56 d, after which acclimation to CTC was apparent for the duration of the experiment.

1. Introduction

Modern swine production in the United States consists of high animal throughput within a small operations area, making operations more susceptible to disease outbreaks (Cheng, 2003). Many swine production facilities use animal feeds containing moderate to high doses of antimicrobial agents to prevent outbreak, treat existing disease, and promote growth in the animals (Dewey et al., 1999). The most commonly used antibiotics in animal feed are tetracyclines, carbadox, and bacitracin, while the most commonly administered antimicrobial agent is chlortetracycline (CTC), which is added to feed in all phases of swine production (Dewey et al., 1999). This is problematic because the animals metabolize only a small percentage of antimicrobials, and thus the majority of the parent compound, in addition to daughter product degradates, is readily excreted through animal urine and feces. As a result, many strains of antimicrobial-resistant bacteria have been reported within manure matrices (Chenier and Juteau, 2009; Jindal et al., 2006). There is conflicting evidence as to whether the presence of these antimicrobial compounds may inhibit manure treatment processes (Lallai et al., 2002; Masse et al., 2000; Shimada et al., 2008; Sponza and Celebi, 2012; Stone et al., 2009). Treating manure using traditional methods, such as lagoons or land application, compared to use the use of anaerobic digesters, can lead to indirect human exposure of antimicrobial compounds and resistant bacteria within impacted soil and water environments (Chapin et al., 2005).

The use of psychrophilic anaerobic digestion (PAD) using anaerobic sequencing batch reactors (ASBR) has been reported as a viable swine treatment option for cold climates found in northern US and Canada, where traditional management practices may not be applicable (Masse et al., 2010). The presence of antimicrobials and their subsequent impact on ASBR operations were previously investigated by Masse et al. (2000), who reported that of six antimicrobial compounds analyzed (tylosin, lyncomycin, tetracycline, suphamethazine, penicillin, and carbadox), only penicillin and tetracy-

* Corresponding author. Tel.: +1 605 394 2443; fax: +1 605 394 5171.
E-mail address: james.stone@sdsmt.edu (J.J. Stone).

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