

XENOESTROGEN REMOVAL FROM SEWAGE SLUDGE

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Abstract

The removal of 4-nonylphenol, 4-nonylphenol monoethoxylate, 4-tert-octylphenol and bisphenol A from sewage sludge was investigated under aerobic and anaerobic conditions. Static batch, semi-continuous batch and flow through experiments were realised under different controlled temperature and oxygen conditions. Alkylphenols were eliminated from waste water through adsorption to sewage sludge. An aerobic degradation of xenoestrogen studied was established. The formation of alkylphenols during anaerobic sewage sludge digestion confirmed own field studies (Tennhardt et al. (in press)). Bisphenol A was rapidly and extensively degradable under aerobic and anoxic conditions. The reason of anaerobic formation of bisphenol A is indistinct yet. In conclusion anaerobic sludge digestion is not suitable for reduction of the studied xenoestrogen. Therefore an aerobic sewage sludge stabilisation or the aerobic secondary treatment of anaerobic sludges is recommended.

Introduction

- Endocrine disruption has become one of the most important environmental issues. One important class of hormonally active agents (HAA), also called endocrine disrupting compounds (EDC), are substances that mimic female sexual hormones (estrogens).
- Environmental occurrence and behaviour of selected natural estrogens and xenobiotic estrogens (4-nonylphenol (NP), 4-nonylphenol monoethoxylate (NP1EO), 4-tert-octylphenol (OP) and bisphenol A (BPA)) are studied.
- In this study the removal of xenoestrogen from sewage sludge was investigated under aerobic and anaerobic conditions.

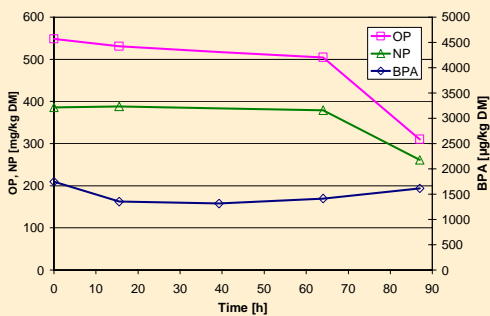


Figure 1: octylphenol, nonylphenol and bisphenol A concentrations during aerobic-thermophilic sludge digestion batch experiment

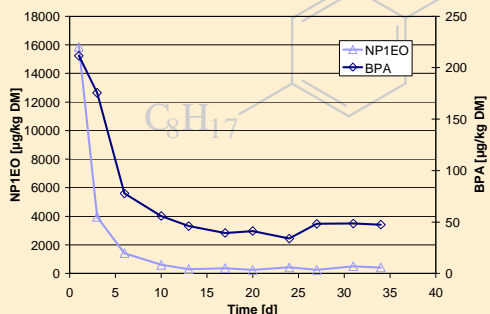


Figure 2: nonylphenol monoethoxylate and bisphenol A concentrations during aerobic-psychrophilic sludge digestion batch experiment

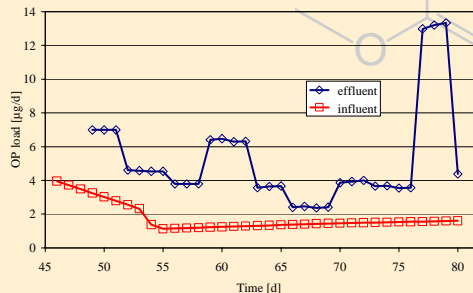


Figure 4: octylphenol mass fluxes during anaerobic-mesophilic sludge digestion; semi-continuous batch experiment

Materials and Methods

- Static batch (aerobic-thermophilic and aerobic-psychrophilic) and semi-continuous batch (anaerobic-mesophilic) experiments were realised using 1.5 and 5 liter bio reactors under controlled temperature and oxygen conditions.
- Simultaneous-aerobic degradation experiments were carried out using two parallel operating lab-scale waste water treatment plants (WWTP).
- Analytical procedure is displayed by Gehring et al. and described in detail by Weltin et al.

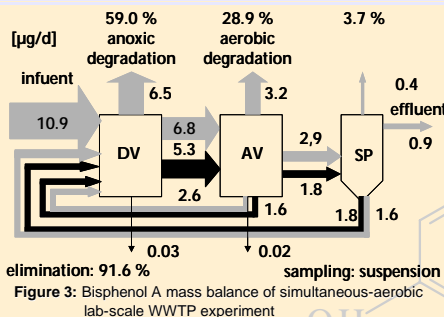


Figure 3: Bisphenol A mass balance of simultaneous-aerobic lab-scale WWTP experiment

Gehring et al. (2003): Recycled Paper Distingly Contributes ..., SETAC Conference, York, 2003

Weltin et al. (in press): Proceedings of the Institute of Waste Management and Contaminated Site Treatment, Dresden University of Technology, vol. 18

Tennhardt et al. (in press): Proceedings of the Institute of Waste Management and Contaminated Site Treatment, Dresden University of Technology, vol. 30

Results and Discussion

- Aerobic-thermophilic:** OP, NP no elimination before sludge stabilisation; after 64 h clear degradation by 44 and 32 %, respectively; BPA inconsistent behaviour (Fig. 1)
- Aerobic-psychrophilic:** NP elimination 59 %; within first 2 days ~ 75 % elimination of NP1EO (Fig. 2); BPA strong degradation by 60 % in first 5 days, 80 % in 35 days

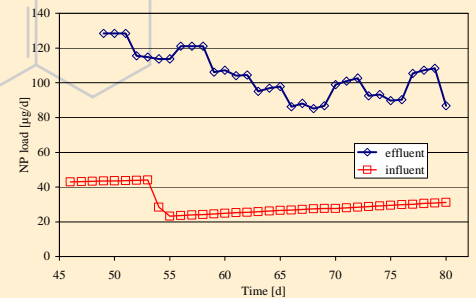


Figure 5: nonylphenol mass fluxes during anaerobic-mesophilic sludge digestion; semi-continuous batch experiment

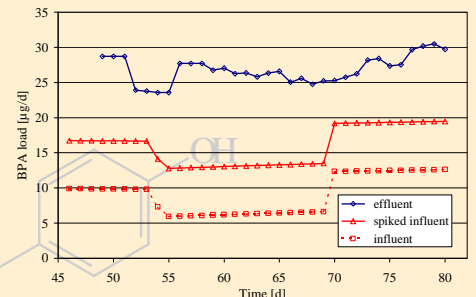


Figure 6: bisphenol A mass fluxes during anaerobic-mesophilic sludge digestion; semi-continuous batch experiment

- Simultaneous-aerobic:** OP and NP elimination from waste water ~ 75 % and 85 to 90 %, respectively; BPA elimination 80 to 98 % (Fig. 3)
- Anaerobic-mesophilic:** formation of NP: 160 to 413 % (Fig. 4); OP: 54 to 739 % (Fig. 5); BPA: 32 to 116 % (Fig. 6)
- see Tennhardt et al.

Conclusions

Aerobic-psychrophilic sewage sludge digestion showed the best elimination rates of Alkylphenols and BPA. Under anaerobic conditions the formation of OP, NP and BPA was observed. Thus, the widely spread applied anaerobic-mesophilic sewage sludge digestion is not suitable for reduction of the xenoestrogens studied. Aerobic sewage sludge stabilisation or an aerobic secondary treatment of fermented sludges is recommended.



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