

Extended Retention Time in full scale anaerobic digestion at Himmerfjärden WWTP

Maximilian Lüdtke^{1,2*}, Marie Berg³, Súsanna Berg³, Elin Åfeldt³, Christian Baresel¹, Lars Bengtsson¹

¹IVL Swedish Environmental Research Institute, ²KTH Royal Institute of Technology, ³Syvab

*maximilian.ludtke@ivl.se, +46-10 788 6595

Introduction

In a normal digester, an increased organic loading rate (OLR) decreases both the hydraulic retention time (HRT) and the solids retention time (SRT). This can lead to overloading, incomplete digestion and in the worst case wash-out of the active microorganisms. By employing recuperative thickening, where digester content is dewatered and returned to the digester, the OLR can be increased without decreasing the SRT significantly. Here, results from a full-scale evaluation of such a process called Extended Retention Time (EXRT) are presented with respect to process stability and gas yields.

Materials and Methods

Two 4300 m³ digesters (EXRT-reactor and Control-reactor) were operating in parallel and fed with the same substrate mix consisting of primary sludge, secondary sludge, and external substrate (mostly food waste). For recuperative thickening in the EXRT-reactor, a polymer dosed decanter centrifuge was used (Fig 1). During centrifuge operation, the Control and EXRT-reactor were fed at OLRs of 3 and 4.5 (50% more than control) kg VS m⁻³ d⁻¹, respectively. During centrifuge downtimes, the same OLR was applied to both reactors. The period of increased loading lasted in total for 34 weeks, i.e. 9.8 and 10.5 SRTs for Control- and EXRT-reactor, respectively.

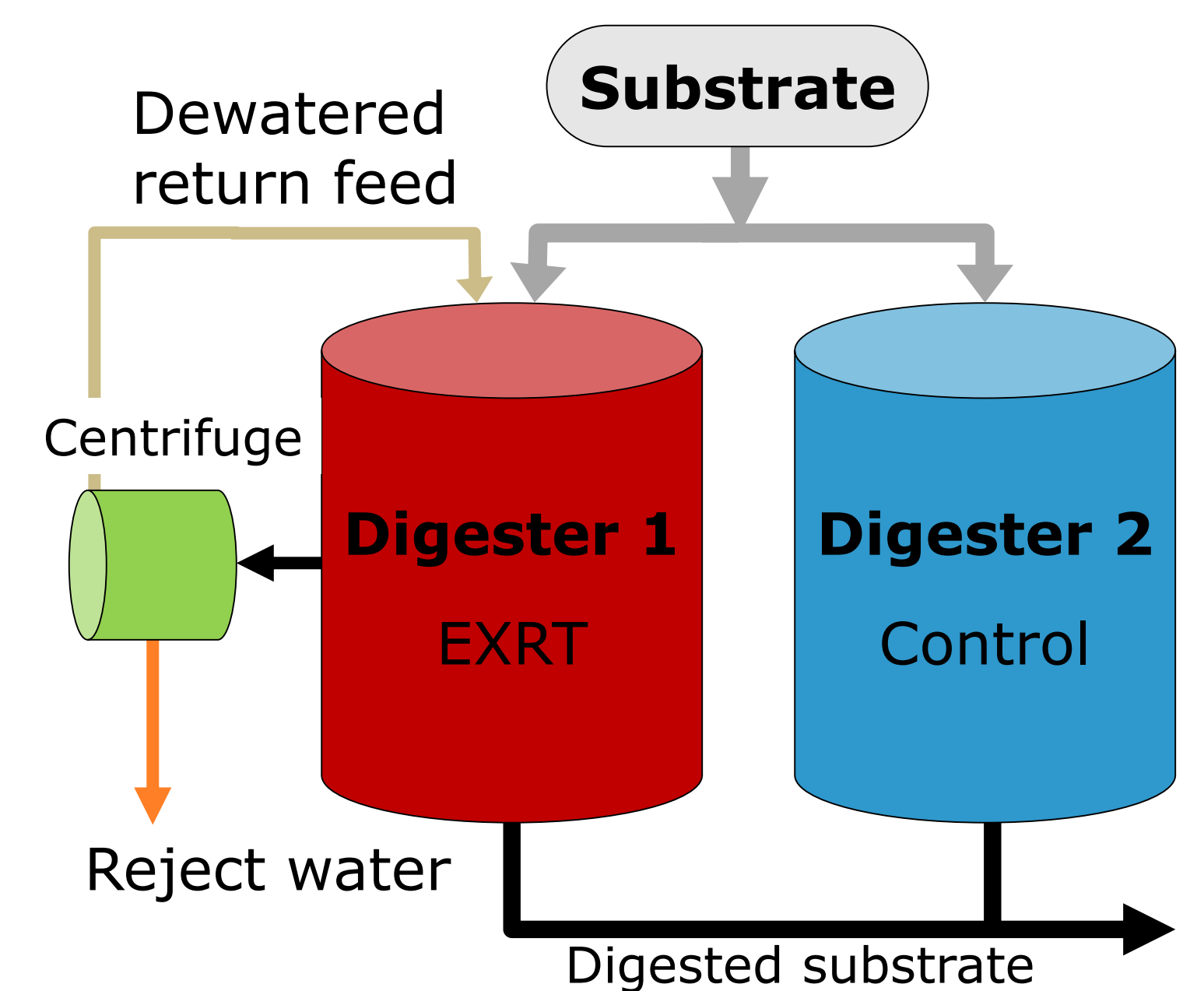


Figure 1. Process schematic overview.

Results

Due to faulty gas meters and frequent technical problems with the used old renovated centrifuge, the latter mainly caused by plastics coming from the external substrate, gas yields were calculated for the last 9 weeks (about 2.6 and 2.8 SRTs for Control and EXRT) and when the centrifuge was operating >50% per day. Data from this period indicated a 39 % increased methane production at a 44% increased OLR (Fig 2). Process parameter comparison showed no signs of significant process disturbances (Fig 3), but polymer use in the final dewatering had to be doubled compared to the Control.

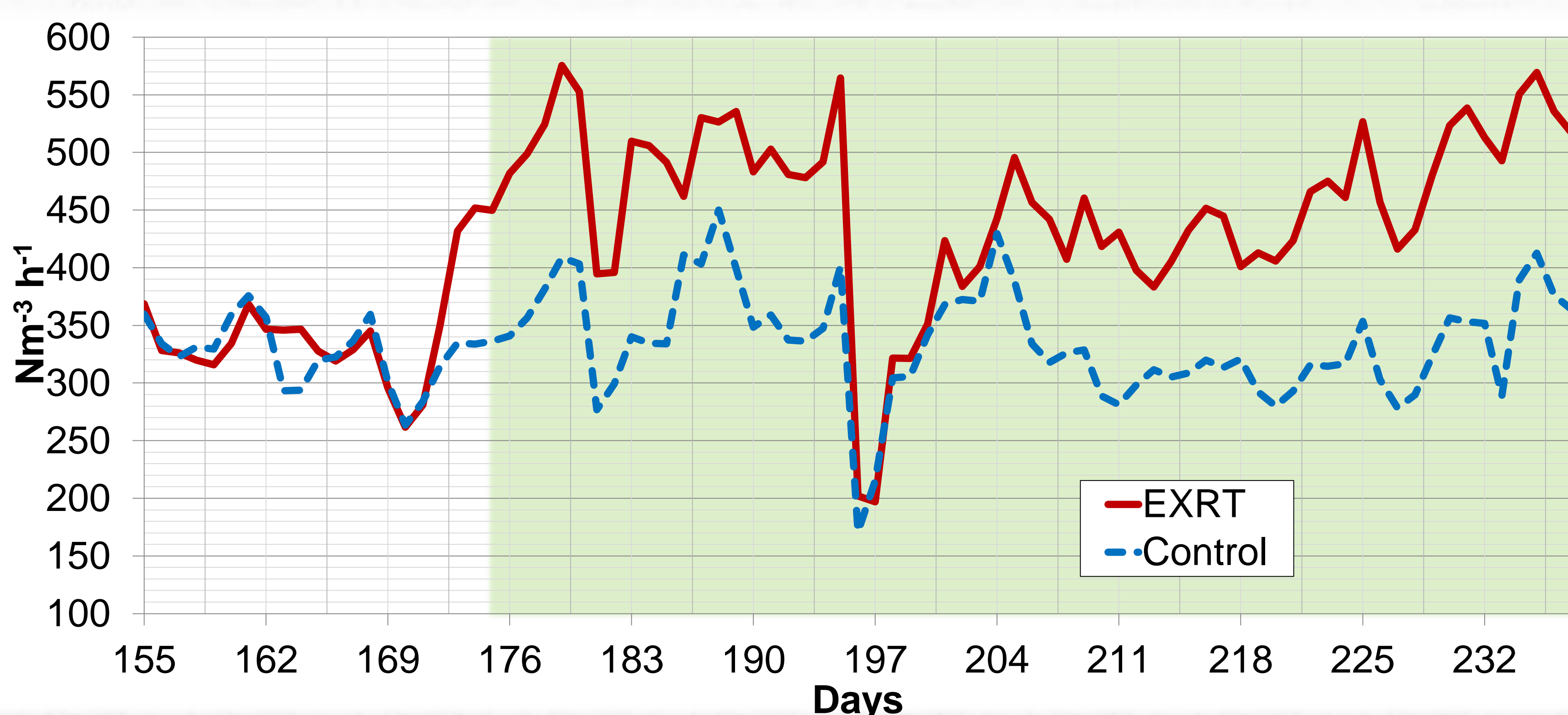


Figure 2. Biogas production. Green hue is 9 week long gas evaluation period.

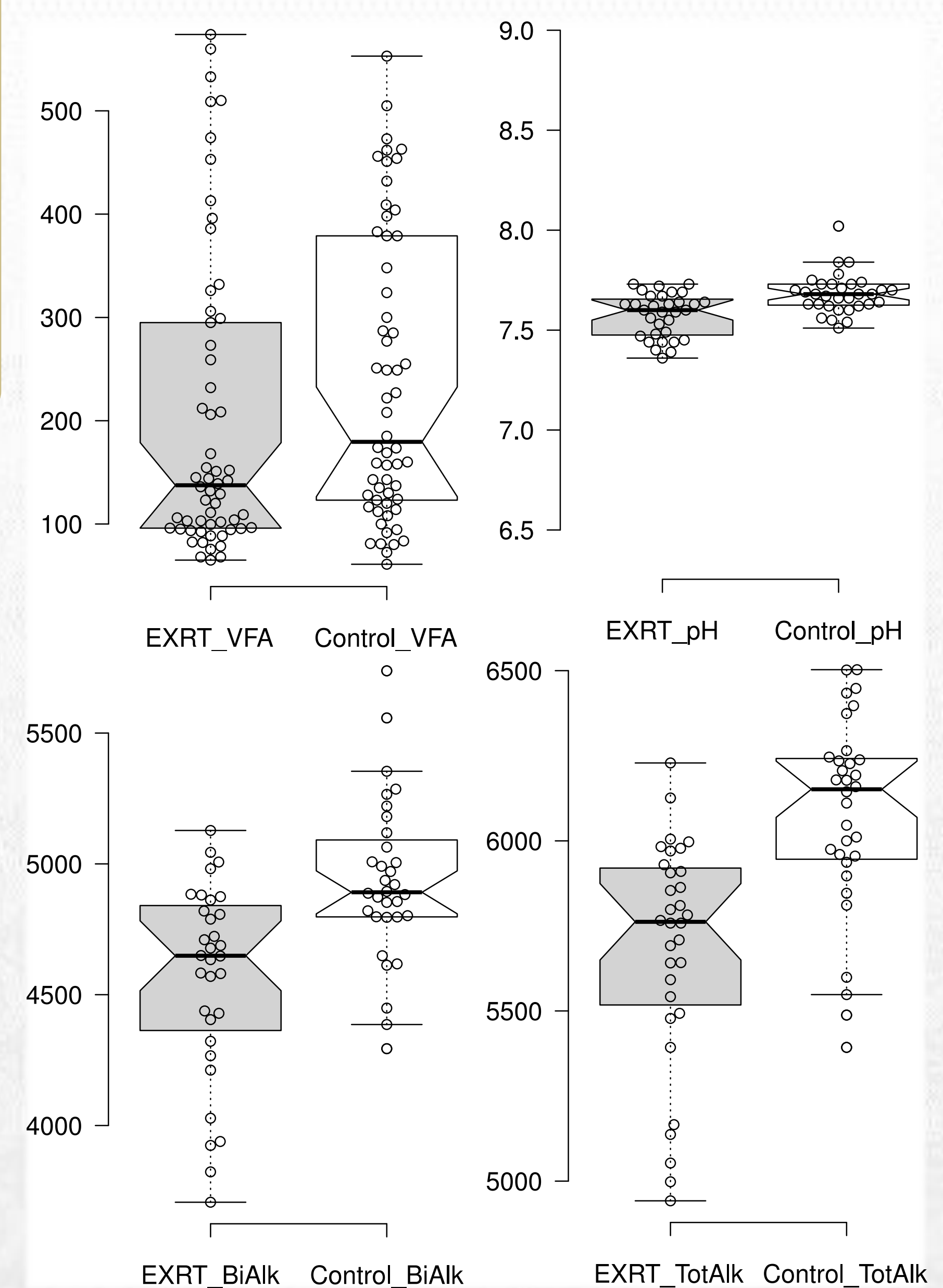


Figure 3. Process parameters (all 34 weeks). Boxes: 25-75 percentiles. Whiskers: 1.5 interquartile length. Thick line: median. Notches: 95% conf. int. of the median.

Conclusions

The full-scale evaluation of recuperative thickening has shown that it is possible to increase OLR of an already high-loaded digester with at least 44% without significant process disturbances and only minor losses in methane yield per VS. This indicates that the process can be used as is by facilities, e.g. to temporarily operate with fewer digester volumes but maintained substrate inflow during reactor maintenance or upgrade. The need for increased polymer use in the final dewatering has to be considered.