AMPC

SNAPSHOT Wastewater Treatment with Anaerobic Digestion & Anammox

AUSTRALIAN MEAT PROCESSOR CORPORATION

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Background

Australian red meat processing facilities can produce significant volumes of wastewater during slaughtering and cleaning operations. This wastewater stream can be rich in organic contaminants and nutrients, and thus can require varying levels of treatment to comply with water discharge regulations. The traditional treatment technologies can have either a large space demand or high operating cost, particularly if nitrogen and phosphorus removal is required. However, the treatment cost can be significantly reduced using novel approaches to minimize energy and chemical inputs as well as physical footprints, while also maximizing recovery options for energy and nutrients.

AMPC has recently concluded a research project with the University of Queensland involving an investigation into a novel treatment system for red meat processing wastewater that incorporates three key elements (shown in Figure 1): (A) a high-rate sequencing batch reactor (SBR) process for carbon and nutrient removal; (B) an anaerobic digestion process for sludge stabilisation and bioenergy (methane) production; and (C) an anaerobic ammonium oxidation (anammox) process for elimination of residual nitrogen.

The proposed treatment system is expected to compare favorably in terms of treatment performance and economics with current lagoon-based or biological nutrient removal (BNR) treatment technologies at a commercial scale. The proposed treatment system offers the following advantages over are expected current lagoon-based or biological nutrient removal (BNR) treatment technologies:

- Reduced energy consumption (in fact a considerable net energy output is expected);
- Lower greenhouse gas emissions and low/no odor release;
- Good nutrient removal performance with significantly less requirement for land (smaller footprint).

Performance Optimisation

A - High-rate SBR wastewater treatment

The high-rate aerobic (SBR) wastewater treatment process (Figure 1, A) was tested under different operating conditions to optimise its performance. The most promising results were achieved with a hydraulic retention time (HRT) of 12 hours and a sludge retention time (SRT) of around 2 days. Under these conditions, the SBR captured 85% of the chemical oxygen demand (COD), 60% nitrogen (N) and 80% phosphorus (P) from the wastewater.

Most of the captured COD was converted to biomass through growth and/or accumulation, rather than oxidation. This suggests aeration requirements can be substantially reduced in real applications compared to current aerobic

operations, thus lowering the electricity demand. The SBR effluent was also shown to be suitable for irrigation or sewer discharge, with a relatively low biological oxygen demand (BOD) level of less than 100 mg/L.

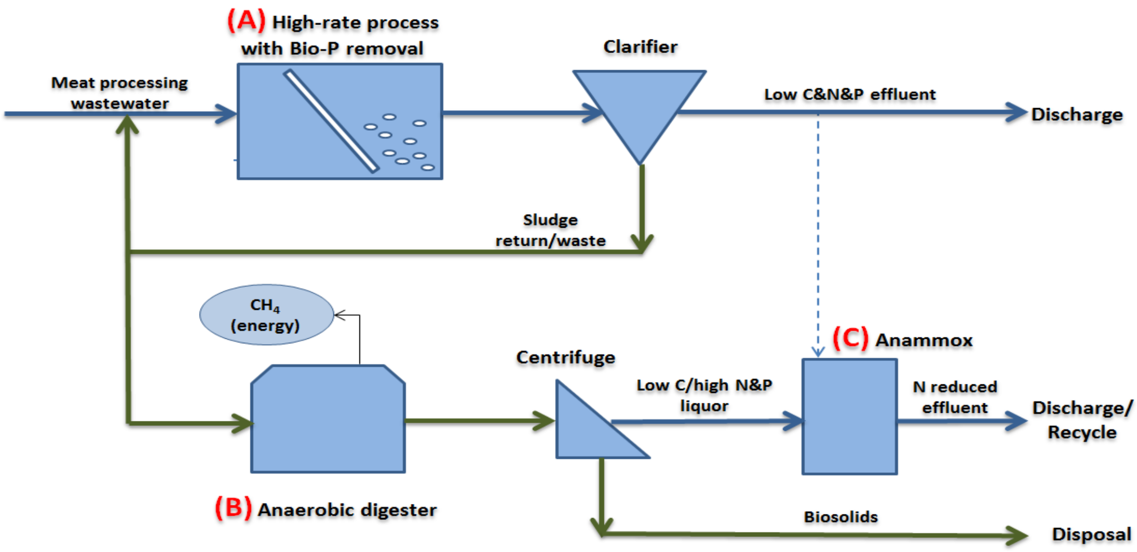

Figure 1: High-rate activated sludge process with integrated anaerobic digestion and anammox processes.

Element B - Anaerobic digestion

Anaerobic digestion (shown in Figure 1, B) is an ideal option for sludge stabilization in this case, as it can convert the carbon accumulated in the waste sludge generated from the SBR to a renewable energy source (methane).

Element C - Anammox

Anammox (Figure 1, C) is a novel process for N removal. It requires low energy input and no carbon requirement, and has been found to be particularly suitable to treat the sludge dewatering liquor (rich in NH_4^+) generated from anaerobic digestion. Therefore, Anammox can provide a significant N removal capability for the overall process. Results showed that the residual N in the sludge dewatering liquor from the anaerobic digester can been effectively removed, indicating a major potential for successful full-scale application.

Cost – Benefit Analysis

A basic cost-benefit analysis of this integrated system was performed in terms of energy balance (shown in Figure 2) and space requirements. Evaluation of the energy balance was conducted by comparing the expected energy production from the methane in the biogas (assuming 35% conversion efficiency from methane to electricity in a cogeneration engine) against the energy demand of the whole integrated system (aeration, pumping, mixing, etc.). The results suggested that a net energy output can be gained from this system, achieving an energy self-sufficiency of around 140%.

A semi-quantitative estimation for the reactor sizes of the integrated high-rate system was performed against the conventional system of anaerobic lagoons followed by an SBR-based nutrient removal process. The estimated reactor volumes of the integrated high-rate system is more than 90% smaller than the conventional treatment system, which does not include anaerobic sludge digestion. This drastic reduction in reactor size is expected to significantly lower construction costs. The smaller reactors will also reduce the energy demands and achieve lower operating costs compared to a fully aerobic or even a combined anaerobic/aerobic process.

It also should be noted that the electricity production from cogeneration and the usage of renewable energy could generate considerable renewable energy credits (RECs). Therefore, a net operating benefit is expected to be achievable. This is an excellent result compared to the typically considerable net operating expenses of such wastewater treatment systems.

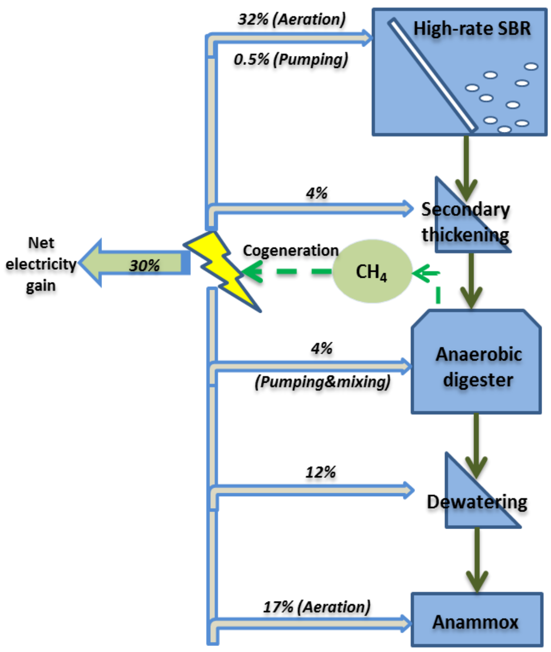

Figure 2: Flow scheme of potential electricity generation from the integrated high-rate wastewater treatment system.

Further Information

For further information relating to this fact sheet please contact AMPC via email info@ampc.com.au or by phoning the office on 02 8908 5500.

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