Evaluation of Energy Neutrality Approaches in Hong Kong Sewage Treatment Plants: A Review

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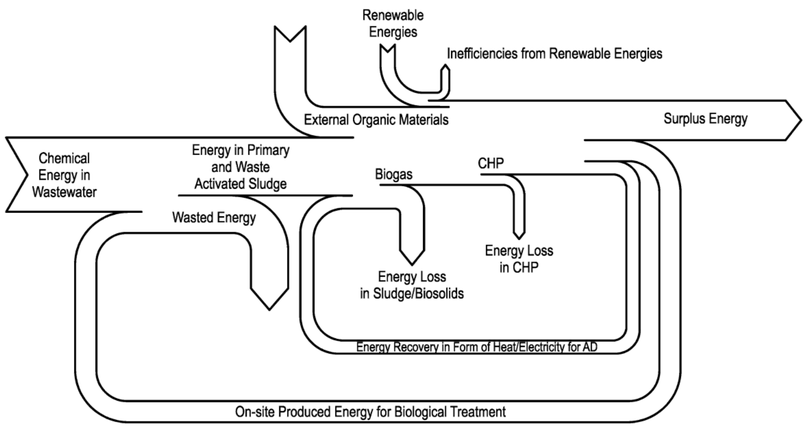
Background

In 2015, the Paris Climate Agreement was signed to limit temperature rise to 2 ºC. To achieve this goal, many countries announced their carbon neutrality targets. The Chief Executive announced that Hong Kong would aim to achieve carbon neutrality by 2050. There is also a pressing need to move toward energy neutrality in sewage treatment as one of the main energy consumers. The main demand for electricity comes from pumps, mixers, aerators, etc. The wastewater treatment plants (WWTPs) have adopted a variety of technologies to increase energy efficiency and utilize renewable energy sources. The energy input from chemical energy in wastewater and additional energy from external sources has the potential for WWTP to meet energy neutrality. In this literature review, the various approaches would be discussed for Hong Kong's WWTPs to achieve energy neutrality.



- Energy distribution
- Source: Maktabifard, M.

Objectives

This study aims to investigate the environmental performance of energy conservation measures and renewable energy management in Hong Kong's WWTP.

By exploring 3 key approaches:

- Increase energy saving in wastewater treatment processes
- Increase energy recovery from internal sources
- Utilize renewable energy

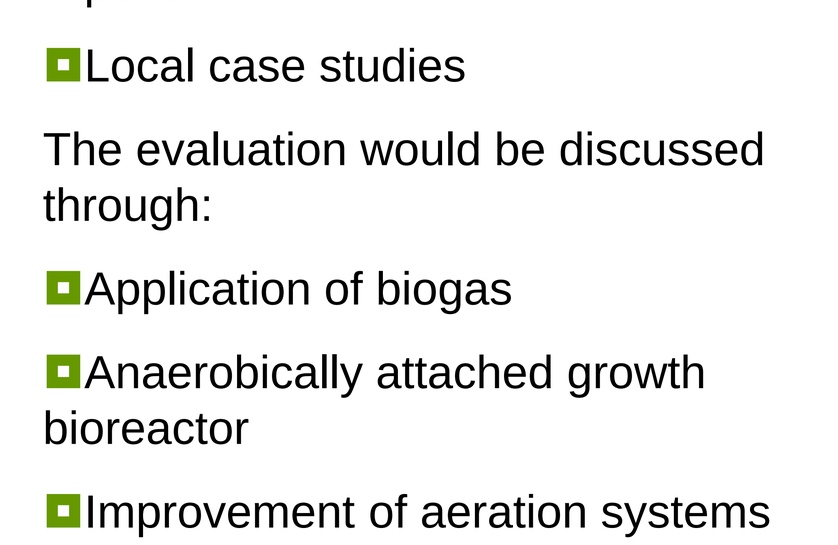
Methodology

The evaluation was analyzed by reviewing:

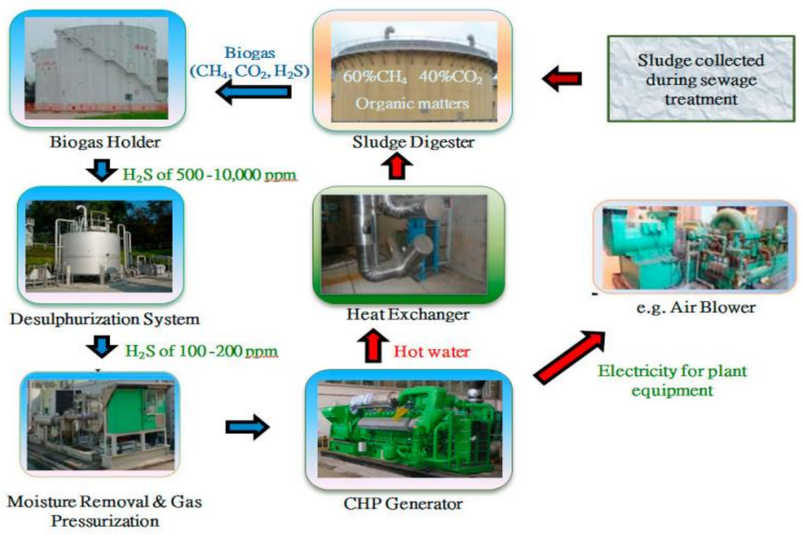
- Extensive literature
- Experimental data from DSD's R&D reports
- Local case studies

The evaluation would be discussed through:

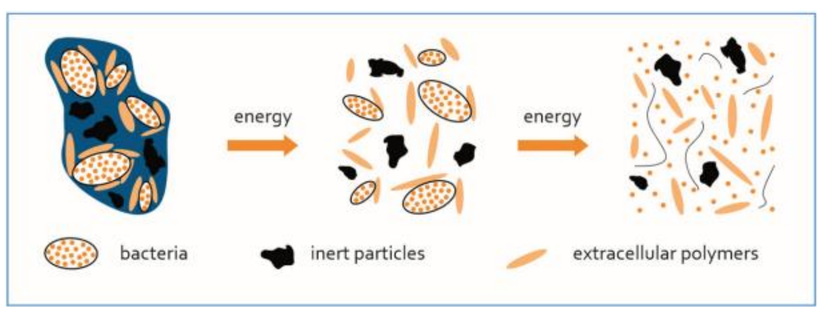
- Application of biogas
- Anaerobically attached growth bioreactor
- Improvement of aeration systems
- Performance of co-digestion
- Development of PV cells



- Anaerobic Digestion
- Source: Panico, A.



- CHP system
- Source: Li, R. C. L.



- Ultrasound technology
- Source: Ultrawaves

Findings

Some WWTPs have already achieved energy neutrality in foreign countries. In fact, a WWTP has the potential to generate more electricity than it needs to operate. By applying energy-efficient design in the pumping system, the aeration system, and the anaerobic digestion (AD) system, as well as energy production facilities from PV panels and CHP, energy neutrality can be achieved.

Energy conservation measures only account for 20% of energy saving. Renewable energy can recover 80% of electricity consumption. To do this, the sludge pre-treatment approach for the AD system coupled with CHP engines can most effectively recover the chemical energy from raw sewage. Besides, the utilization of on-site solar energy production is also instrumental in electricity generation. At this stage, it is not yet sufficient to achieve complete energy neutrality. Organic municipal food waste co-digestion is the key to increasing methane production. The environmental performance of current Hong Kong's WWTPs is found below.

Electricity consumption can be met by:

- 7% in Yuen Long Effluent Polishing Plant (YLEPP) by combination of CHP and PV panels.
- 20-25% in Siu Ho Wan Sewage Treatment Work (SHWSTW) by PV panels.
- 13% in Shek Wu Hui Effluent Polishing Plant (SWHEPP) by combination of CHP and PV panels.

Conclusion

The absence of data and the uncertainty of recently developed treatment methods continue to be a challenge. There is still room for improvement in Hong Kong's current WWTPs. It is an ambitious goal for Hong Kong's WWTPs to achieve energy self-sufficiency.