Technologies ECOFIXE

BUSINESS CASE

Wastewater from an industrial slaughterhouse

Project highlights

Industry: Pigs slaughterhouse, 1M pigs per year.
Total investment: CAN$590,000
Impact:

- 2.6x increase in treatment capacity of NH_4+.
- 10% of sales increase, ROI within 6 months.
- Reduction in energy consumption.
- Greenhouse gas (GHG) emissions avoidance.

Products: 12 modules installed in the Sequencing Batch Reactor (SBR).
Economic benefits:

- 28% less expensive to acquire than the closest solution.

Baseline

Sequencing Batch Reactor (SBR) installation

The slaughterhouse described in this case slaughters 1M pigs per year. The wastewater is directed to a biological treatment called Sequencing Batch Reactor (SBR). The following table presents the design parameters, the current situation and the needs to be addressed.

Wastewater treatment plant:

Parameters	Design	Current	Needs
Flow **US gal/min** (m^3/d)	293 (1,600)	220 (1,200)	275 (1,500)
Organic load **mg/L** (kg BOD_5/d)	588 (941)	491 (590)	500 (750)
Ammoniacal nitrogen **mg/L** (kgN/d)	50 (80)	129 (155)	130 (195)

Overview

The animal slaughter industry is one of the most polluting agricultural-food processing activities due to the large amount of water used and, consequently, the large amount of highly contaminated wastewater being discharged. In Quebec, for example, there are 84 slaughterhouses that produce an organic load equivalent to a population of 300,000 people (the equivalent of the city of Gatineau).

In the United States, there are more than 900 federally inspected slaughterhouses with over 5,000 establishments of all sizes across the country. According to the USDA National Agricultural Statistics Service Information, 100 million hogs are slaughtered per year. In 2018, the environmental integrity project (EIP), a non-profit organization, reported that a plant that processes hogs rejected a variable amount of wastewater, producing between 291 and 532 gallons of wastewater per 1,000 pounds of animals.

This wastewater contains high contaminants loads such as organic loads, total suspended solids, ammoniacal nitrogen, phosphorus, oil, grease, and fecal bacteria. When released into waterways in large quantities and high concentrations, these pollutants can cause extensive damage. They drive excess algae growth, create low oxygen dead zones that suffocate fish and other aquatic life, and turn waterways into public health hazards.

The specific issue of ammoniacal nitrogen is particularly important since some slaughterhouses discharge as much ammoniacal nitrogen as a small town. For example, one of the hog-processing plants in Illinois, released 1,850 pounds of ammoniacal nitrogen a day in 2017 to the tributaries of the Illinois River, which is equivalent to the load of raw sewage released from a city with a population of 80,000.

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Current problems and restrictions

The slaughterhouse in question is growing rapidly and demand continues to increase. To meet this demand, the plant had to be able to increase its production. However, the existing wastewater treatment plant was almost at full capacity. The main problem was the exceeding amount of ammoniacal nitrogen. Before government authorities could allow the slaughterhouse to increase production, the company had to first implement a solution that would enable it to treat the additional contaminant loads and, above all, to meet the company's discharge regulations.

For ammoniacal nitrogen, the company's discharge limit is 5 mg/L in the summer and 10 mg/L in the winter. The meat processing industry is often subjected to bad press in public opinion; however, the company attached high importance to protecting the environment and its impact on its community. For this reason, the slaughterhouse was looking for the best solution to meet its needs, at the best prices and above all by selecting a solution that respects the environment.

The traditional solution

The nature of the contaminants that compose the wastewater discharged by a slaughterhouse makes biological treatment the most appropriate choice. Systems such as SBR, a Moving Bed Biofilm Reactor (MBBR) or activated sludge systems are particularly effective. These allow for the reduction of the largest quantity of organic load.

The installation of one of these treatment systems requires the construction of heavy infrastructure. In addition, a considerable amount of equipment, such as pumps and blowers, is required for the installation to be functional. The maintenance of these mechanical parts must be done regularly, not to mention the high energy consumption. Finally, sludge removal operations must be managed on a yearly basis. Each maintenance operation is costly and may require a complete shutdown of the treatment system. These shutdowns have a direct impact on the company's operations.

The BIOFIXE solution

The BIOFIXE system is biological wastewater treatment systems that increases the treatment capacity of biological reactors by 20 to 60%.

The major difference of the BIOFIXE system is that it is installed directly in the biological reactor instead of involving the construction of new concrete tanks.

Each module contains one enclosure, which is anchored at the bottom of the concrete tank. The enclosure features a fixed bed media (bacteriological support) on which biomass develops.

Each module is equipped with a fine-bubble aeration system placed under each module, which helps to oxygenate the biomass, while ensuring maximum oxygen transfer. The aeration system is more efficient than standard coarse bubble aeration, that's why the BIOFIXE system reduces the installation's energy consumption.

The ECOFIXE system has been designed to maximize the reduction of organic load. **The new BIOFIXE system makes it possible to target specific contaminants such as ammoniacal nitrogen, while preserving all the advantages of the standard ECOFIXE system.** Once installed, both ECOFIXE and BIOFIXE systems are self-sufficient, and do not require an operator to be present.

ADVANTAGES OF THE BIOFIXE SYSTEM

- No additional land required;
- No chemicals;
- Fast and simple installation (within a week);
- Modular;
- Sturdy;
- Energy efficient;
- Low operating costs;
- 100% of the flow treated;
- Stable and constant performance.

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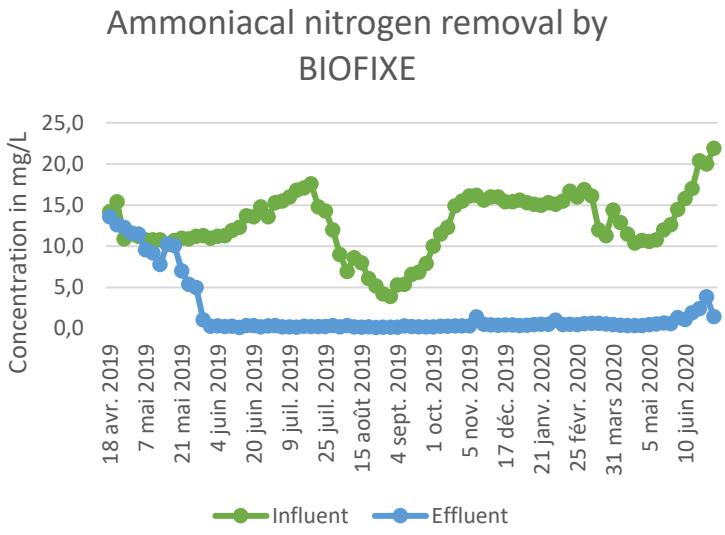
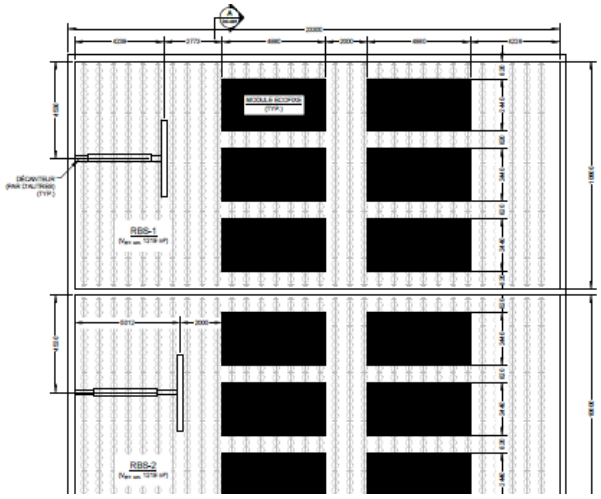
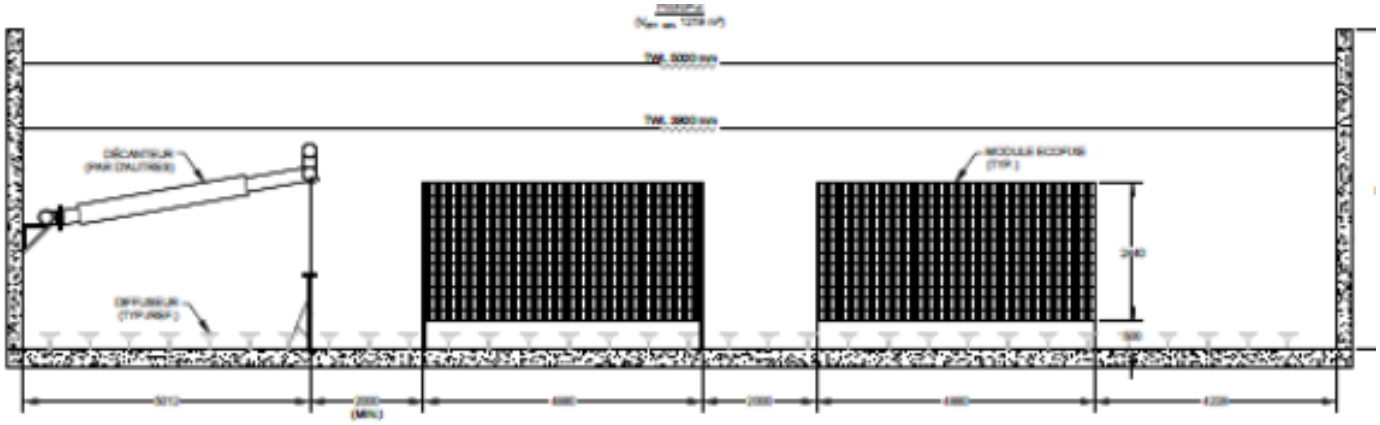
Performance





Plan view - SBR with 2 cells and 12 BIOFIXE modules



Profile view - SBR with BIOFIXE modules

To meet the slaughterhouse needs, i.e. increasing the ammoniacal nitrogen treatment capacity by 2.6x, the Technologies Ecofixe team determined that 12 BIOFIXE modules were required. The company's R&D has led to the development of a modelling tool that allows the team to design custom projects. The model takes into account the customer's parameters (organic load, ammoniacal nitrogen, flow, etc.) as well as the customer's needs, in terms of additional treatment capacity.

The BIOFIXE system increases the treatment capacity of a biological reactor from 20 to 60%. An abatement rate of 98% of the ammoniacal nitrogen is observed.

The BIOFIXE modules are completely prefabricated in the factory. They are then transported to the site for assembly. The 12 BIOFIXE modules took 1 week to assemble and 2 days to install in the SBR cells, without interrupting the treatment process. This made it easier for the slaughterhouse to continue operating during this time. The construction of a new cell would have taken 6 to 8 weeks before being operational.

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IMPACT ON GREENHOUSE GAS EMISSIONS

Slaughterhouses are also responsible for large outputs of greenhouse gases such as methane and carbon dioxide, both of which are major contributors to climate change. These gases are created during the slaughtering process and through the degradation of wastewater. By increasing their treatment capacity by 2.6x without building a new cell for the SBR, the slaughterhouse has reduced its emissions by at least 15%.