Technologies ECOFIXE

CASE STUDY- Industrial Slaughterhouse SBR

Objective: Increase ammonia treatment to allow for production growth and to meet discharge regulations

Project highlights

Industry: Pig slaughterhouse, 1M pigs per year.
Problem: Excess effluent ammonia
Solution: 12 BIOFIXE modules installed in an existing two-cell Sequencing Batch Reactor (SBR).
Total investment: CAN$590,000

Economic benefit:

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

Impact:

- 2.4x increase in treatment capacity of ammonia
- ROI within 6 months
- Reduction in energy consumption
- Avoidance of Greenhouse gas (GHG) emissions

Project Baseline

Sequencing Batch Reactor (SBR) installation

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)
Ammonia-Nitrogen **mg/L** (kgN/d)	**50** (80)	**129** (155)	**130** (195)

Industry Overview

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

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 hog processing plant produces between 291 and 532 gallons of wastewater per 1,000 pounds of animals.

This wastewater contains high contaminant loads including organic loads, total suspended solids, ammonia, 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 ammonia is particularly important since some slaughterhouses discharge as much ammonia as a small town. One example: a hog-processing plant in Illinois released 1,850 pounds of ammonia per day (in 2017) to the tributaries of the Illinois River. This 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 wastewater treatment plant was almost at full capacity and the slaughterhouse is experiencing increased growth and demand. The largest challenge was excessive ammonia. Before government authorities could allow the slaughterhouse to increase production, the company had to implement a solution that would treat the additional contaminant loads and meet the company's discharge regulations. For ammonia, the company's discharge limit is 5 mg/L in the summer and 10 mg/L in the winter.

The company knows that the meat processing industry can be subjected to bad press and poor public opinion. They want to combat that image by protecting the environment and having a positive impact on their community. The slaughterhouse was looking for a solution that would meet these goals while also being cost effective.

Options Considered

Given the contaminants generated, biological treatment is the appropriate method for slaughterhouse wastewater treatment. Systems such as SBR, a Moving Bed Biofilm Reactor (MBBR) or activated sludge systems are the typical options considered due to their effectiveness in removing the largest quantity of organic load on a small footprint.

Any of these treatment systems requires the extended time and high cost of new construction – design, acquisition and installation. The operations are complex and must be done regularly by well trained staff. The energy consumption is very high. Finally, sludge removal operations must be managed on a yearly basis. The maintenance operations are costly and may require a complete shutdown of the treatment system.

The ECOFIXE/BIOFIXE solution

ECOFIXE and BIOFIXE are biological wastewater treatment modules that increase the treatment capacity of biological reactors by 20 to 60%. ECOFIXE removes organic load; BIOFIXE removes ammonia, even under 4 degrees Celsius.

The unique advantage of the modules is that they are installed directly in the biological reactor, thus avoiding the need to construct new concrete tanks.

Each module has a stainless steel frame which is anchored to the bottom of the concrete tank, and contains fixed bed media which attracts, supports and maximizes biomass development. The fixed-bed media intensifies treatment capacity by increasing the surface area available to attached growth microorganisms. An increase in SRT means more processing is done without producing more sludge.

The underside of each module is equipped with a fine-bubble aeration system which ensures maximum oxygen transfer to the biomass. This aeration system is more efficient than standard coarse bubble aeration resulting in a net reduction of energy consumption.

Once installed, the ECOFIXE and BIOFIXE systems are self-sufficient, highly reliable, and do not require an operator to be present.

ADVANTAGES OF ECOFIXE/BIOFIXE

- No new construction;
- Fast and simple installation (within a week);
- Energy efficient (net energy reduction);
- Low maintenance and operating costs;
- Modular; over 50% locally manufactured
- No chemicals;
- Sturdy;
- 100% of the flow treated; no sludge increase
- Stable and constant performance.

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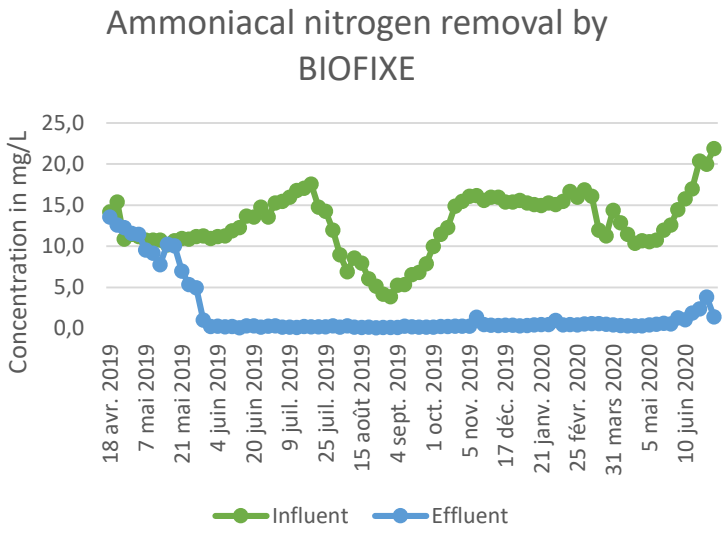
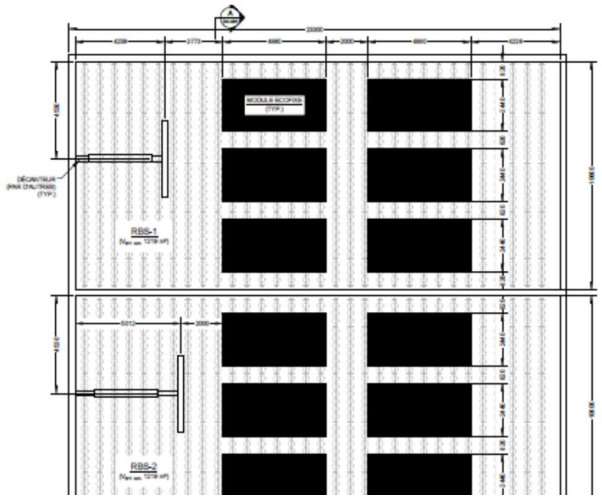
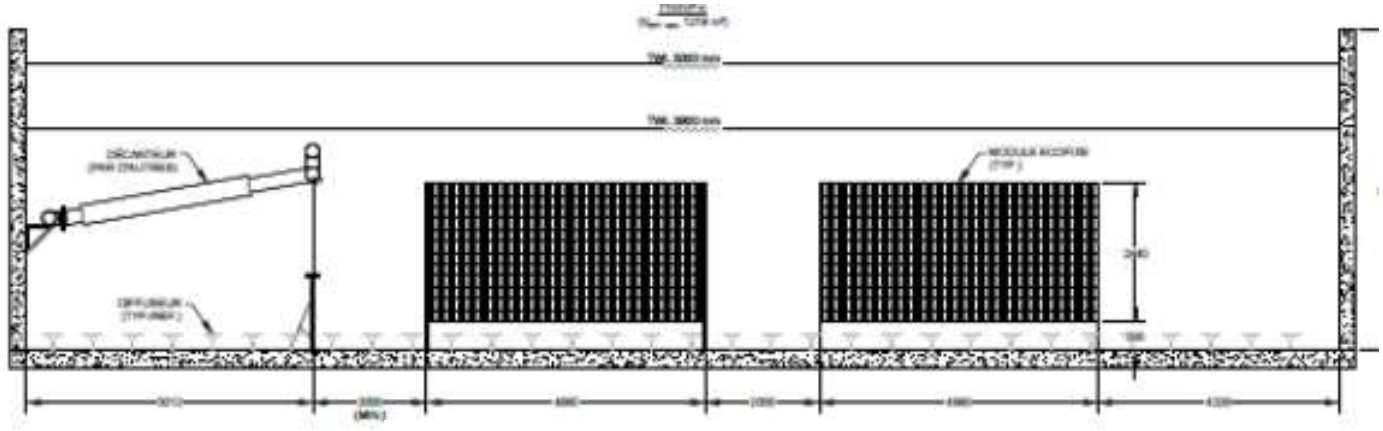
Performance





Plan view - SBR with 2 cells and 12 BIOFIXE modules



Profile view - SBR with BIOFIXE modules

DESIGN

To meet the slaughterhouse needs of increasing the ammonia removal by 2.4x, the Technologies Ecofixe engineers determined that 12 BIOFIXE modules were required. Ecofixe has developed a proprietary R&D modelling tool that provides a custom design for each project. The model evaluates the customer's parameters (organic load, ammoniacal nitrogen, flow, etc.) as well as the customer's needs in terms of additional treatment capacity.

INSTALLATION

The BIOFIXE components are prefabricated in the factory and then transported to the site for assembly. The twelve BIOFIXE modules took one week to assemble and two days to install in the SBR cells with no interruption to the treatment process or operations. The construction of a new cell would have taken 6 to 8 weeks before being operational.