



ENVIRONMENT

Technological Innovation

ABSTRACT

Water contamination is becoming an important issue. Bionest Technologies Inc. has developed an advanced secondary treatment system that is remarkably effective in dealing with domestic wastewater.

The BIONEST treatment system uses a biological filtration process based on a microbial culture fixed to a non-biodegradable media, combined with alternating aerobic and anaerobic treatments.

This technology is distinctive owing to its unique proprietary media, allowing biofilm bacteria to attach effectively and providing a greater active surface for nitrification-denitrification reactions.

With the BIONEST system, the quality of the effluent leaving the bioreactor significantly exceeds government standards, regardless of the season.



**BIONEST™: AN ADVANCED
SECONDARY TREATMENT
SYSTEM FOR
DOMESTIC WASTEWATER**

HIGHLIGHTS

Technology

- Medium with a very large active surface area and texture promoting rapid growth of micro-organisms
- Easily withstands hydraulic shock loading temperature and influent load variations

Environment

- Non-toxic, non-biodegradable media
- Over 99% reduction in fecal coliform bacteria
- Over 98% removal of BOD₅ and over 96% of TSS

Cost-effectiveness

- On a per-square-meter basis, one of the most inexpensive synthetic media on the market
- Minimal maintenance costs
- Low operating costs

PROJECT OBJECTIVES AND PHASES

Since 1997, Bionest Technologies has focused on developing and marketing a domestic wastewater treatment system that is economical, requires little maintenance and is of higher quality than conventional systems.

Advised by experts at the University of Guelph in Ontario (Alfred site), Bionest Technologies inc. developed their system under different conditions. The objective was to submit a proposed system for a four-bedroom house to the Comité sur les nouvelles technologies de traitement des eaux usées (New Wastewater Treatment Technologies Committee) for evaluation. The committee is composed of representatives of the ministère des Affaires municipales, du Sport et du Loisir et le ministère de l'Environnement du Québec.

The committee deemed that sufficient data was provided on the system to meet the requirements of the Regulation respecting waste water disposal systems for isolated dwellings Q-2, r. 8, for advanced secondary treatment. In addition, the system was classified as a standard technology for applications involving isolated dwellings and commercial, institutional and community wastewater treatment systems comparable to domestic wastewater systems.

The last step is to receive certification from the Bureau de normalisation du Québec (BNQ) (Quebec Standards Bureau) and NSF.

BACKGROUND

Conventional septic systems, typically consisting of a septic tank and leaching fields with absorption trenches or a seepage bed, are the most commonly used systems for the in-situ treatment of domestic wastewater from isolated dwellings.

The main problem with conventional septic systems is soil variability. In many regions, the soil does not have the appropriate characteristics to treat effluent from these systems. In addition, the soil type or lot size simply may not allow the installation of a conventional system.

Finally, new government standards require more efficient management of domestic wastewater.

TECHNOLOGY

The BIONEST treatment system is a biological treatment process using a fixed biofilm reactor and alternating aerobic and anaerobic environments.

The primary treatment takes place in the septic tank. The BIONEST media is placed in the second compartment with a sludge extraction unit and effluent filter.

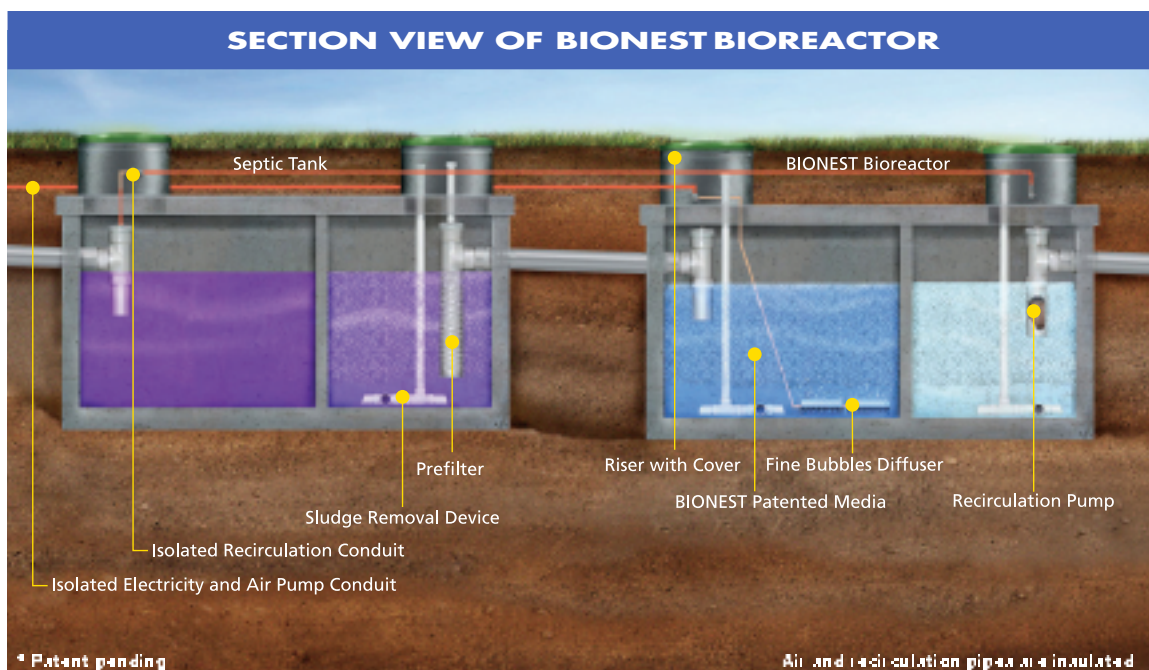
The advanced secondary treatment takes place in a tank similar to a septic tank: the BIONEST reactor. The BIONEST media is placed inside the two compartments tank.

The first compartment is continuously aerated by two fine bubble diffusers, which initiate nitrification

reactions. The oxidation of the ammonia to nitrates is completed in the second compartment, which is anaerobic.

Part of the effluent is routed back to the septic tank to improve nitrogen removal through the release of nitrogen gas. After leaving the bioreactor (the retention time is over 48 hours), the effluent can be allowed to percolate into the soil through a polishing field (or sand leach field), discharged directly into a continuous stream under the appropriate conditions or recycled for use in irrigation after treatment in a tertiary disinfection system.

The system is designed to permit sludge removal, if necessary, without removing the media.



RESULTS

To demonstrate the performance of the BIONEST advanced secondary treatment system, samples from an actual system were taken and analyzed over 12 months.

The system in question was used to treat wastewater from two residences, each equipped with two bedrooms. Several parameters, including CBOD₅ and TSS, were analyzed using 16 samples taken from the influent and effluent.

The study found that effluent from the BIONEST system has remarkable physical and chemical properties: CBOD₅ below 4.4 mg/L, TSS below 3.5 mg/L and a mean fecal coliform count of 1,670 UFC/100 mL. These results correspond to average reductions of 98%, 96% and 99% in CBOD₅, TSS and fecal coliform bacteria respectively. Significant reductions were also found for other parameters such as COD, turbidity and total nitrogen.

During sampling, flow rates and loads at the inlet were greater than normal, showing that the BIONEST system can easily satisfy all requirements, even during shock loading.

The experience proves that the BIONEST wastewater treatment system is able to produce effluent of a higher quality than that required in Regulation Q-2, r. 8.

The system provides CBOD₅ and TSS concentrations in effluent that are 3-4 times lower than required and fecal coliform concentrations that are 30 times lower.

WASTEWATER TREATMENT EFFICIENCY OF BIONEST BIOREACTOR

Parameters ¹	Typical mean concentrations ² Inlet	Typical mean concentrations ² Outlet	Standard for effluent from isolated dwellings	Mean treatment efficiency (%) ²
Total coliform count (UFC/100 mL)	34,9 x 10 ⁶	130 000	-	99,6
Fecal coliform count (UFC/100 mL)	235 400	1 670	50 000 ³	99,3
Ammonia nitrogen (mg/L)	38	6,5	10 ⁴	83,1
Five-day carbonaceous biochemical oxygen demand (CBOD ₅) (mg/L)	175	4,4	15 ³ 10 ⁴ 25 ⁵	97,5
Chemical oxygen demand (mg/L)	439	38	-	91,3
Suspended solids (mg/L) (SS)	84	3,5	15 ³ 10 ⁴ 30 ⁵	95,8
Total phosphorous (mg/L)	2,75	2,0	-	27,3
Turbidity (NTUs)	66	2,0	-	97,0
Total nitrogen (mg/L)	44	7,1	-	83,9
Nitrites-nitrates (mg/L)	-	5,7	-	-
Colour (ACU)	394	32	-	94,2

¹ Typical flow rates at inlet to BIONEST bioreactor ranged from 1400 to 2200 L/d.

² Results based on analyses carried out by Consultants S.M. of 16 samples taken from an actual septic system operating under typical conditions over a 12 month period.

³ Regulation respecting waste water disposal systems for isolated dwellings, Q-2, r. 8, Québec Department of the Environment

⁴ Standards set in the State of California and British Columbia.

⁵ ANSI/NSF standard for efficiency.

NSF = National Sanitation Fondation · ANSI = American National Standard Institute

POTENTIAL AND LIMITATIONS

Potential

- Media can be used for the full range of scalable BIONEST bioreactors
- Highly resistant to hydraulic and organic shock loading
- Outdoor temperature has little effect on the efficiency
- Possibility of discharging the effluent directly into a continuous stream
- Possibility of adding a tertiary ultraviolet (UV) treatment system, thus allowing treated effluent to be used for irrigation or to be discharged in a ditch or lake

- The BIONEST system can also be used for community applications such as groups of dwellings and holiday resorts.

Limitations

- The current model can only be used for domestic wastewater
- An electrical power source is required
- Septic tanks located upstream of the system must have their sludges pumped out periodically in accordance with provincial and municipal regulations.

- Since a biological treatment process is used, the BIONEST system cannot tolerate some household cleansers and other chemical products that kill bacteria, which is also true for conventional septic systems and leaching fields as well as other biological treatments.

INFORMATION

This data sheet is based on the results of a study of an actual system, as well as information from the technical evaluation sheet published by the ministère de l'Environnement du Québec. The development and marketing of the technology were made possible by funding from Canada Economic Development Agency and by the ministère du Développement économique et régional.

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