

Compact Wastewater Treatment System for Domestic and Commercial Operations System Design and Field Experience

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Small domestic, commercial and recreational developments have primarily been using a conventional septic tank and disposal field system for disposal of domestic wastewater in rural areas.

The systems have applications for single and multiple dwellings, small subdivisions, golf courses, campgrounds and small industrial operations.

The capacity of the systems range from approximately 1.0 m³/day for a single family dwelling to approximately 50 m³/day for a golf course or 50 unit condominium or 50 lot subdivision.

The treatment system consists of a primary treatment which takes place in the septic tank and a secondary treatment which takes place in the disposal field.

The conventional septic tank and disposal field wastewater treatment system is simple, economical and efficient domestic wastewater treatment system if it is designed and operated properly.

However, a proper operation of the system is contingent on a number of factors which include ground topography, soil characteristics and low groundwater and bedrock levels.

Other factors which restrict use of the system include setbacks to water bodies, water wells, buildings and land area requirements. Typically, the minimum lot size required is two acres, sandy or silty loam soil and a minimum groundwater and bedrock level of 1.5 meters below the disposal field. Flat or moderately sloping ground surfaces are preferred.

The systems lifespan varies widely from a few years to approximately 20 years and it depends on the system design and construction, and the soil characteristics.

Smaller systems operate with a gravity wastewater flow between the septic tank and the disposal field while larger systems use pumps to deliver under pressure the wastewater from the septic tank to the disposal field.

Improper system operation may result in soil, surface and groundwater pollution and health hazards.

An alternative to the conventional septic tank and field system is a mechanical-biological treatment system with a simple, economical and reliable design and operation. It can provide a wider range of wastewater treatment levels to suit the local environmental conditions which may require a secondary or tertiary (or higher) treatment levels - including the treated effluent filtration, and/or disinfection.

A novel mechanical-biological treatment system developed employs an activated sludge treatment process to provide a secondary or a tertiary treatment level and ozonation to provide the treated effluent disinfection. Filtration of the secondary or tertiary treatment effluent can be added for reuse of the effluent for recreational, commercial or industrial purposes, and in a near future, it may be permitted for flushing toilets.

The treatment system consists of a settling tank, an aeration tank and a clarifier tank in the secondary treatment process. Additional tanks are added to provide a tertiary treatment level and disinfection and filtration.

The key components of a secondary and a tertiary treatment system is an aeration and recirculation pump and an air aspirator-mixer which supplies air to the aeration tank.

The pump provides several functions:

- to pump the wastewater to the air aspirator-mixer
- to recirculate activated sludge from the clarifier to the aeration tank through the air aspirator-mixer
- to waste excess activated sludge to the sludge holding tank
- and to recirculate the aerated wastewater and sludge to the inlet raw wastewater for removal of phosphorous and nitrogen.

The multifunction aeration and recirculation pump minimizes the number of pumping units required and the air aspirator-mixer replaces an air blower.

The aeration pump and air aspirator-mixer system allows for the aeration system and the bio-reactor to operate in several different modes:

- Continuous aeration and mixing.
- Intermittent (cyclic) aeration without mixing between the aeration cycles.
- Intermittent (cyclic) aeration with mixing between the aeration cycles.

The flexibility in the design of the aeration system can provide energy savings and extend the life span of the aeration equipment. An essential feature of the aeration system is the system ability to re-suspend the bio-mass in the bio-reactor after the aeration system is stopped for a considerable time of 0.5 to 2.0 hours or longer. This allows the system operation in “on” and “off” mode which can be used throughout the day and night or during the night hours when the wastewater supply rate is low.

Two wastewater treatment systems with capacity of 1.5 m³/day and 35 m³/day have been in operation since June 2007. The systems operate in a secondary treatment process without disinfection and filtration. A third system with a secondary treatment process and ozone disinfection has been approved by Alberta Environment for installation in 2010 at a golf course.

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