Design and development of an energy efficient continuous flow bio kill system for inactivating bio-waste

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Abstract:

Objectives:

Design and build an economic, energy efficient and environment friendly continuous flow bio kill system to rapidly inactivate microbes present in bio-waste without using corrosive chemicals.

Methods:

We have designed and build a fully automated continuous bio kill system for thermal inactivation of industrial bio-waste. The system is composed of three spiral heat exchangers that play a pivotal role in heating the bio-waste and recycling excess heat (**Fig. 1**). These units have two Spiral channels in which the heating and cooling liquids counter current direction enabling efficient heat transfer. Unlike the conventional batch tank system, heat transfer in these configurations is instantaneous requiring less input energy thereby minimizing operational cost. The heated bio-waste is circulated through a heat retention coil where the temperature is maintained at 134°C to 142°C for a fixed time period. On the basis of input temperature the hold-up time, based on Log reduction value, can be 2 min for 142°C to 3.5 min for 134°C. The system is linked to the bio-waste collection tank and is capable of treating up to 5000 l/h.

Results:

Thermal sterilization employing heat is a highly efficient method to inactivate vegetative and spore forming microorganisms routinely present in industrial bio-waste. However, it is highly energy and resource intensive making it less attractive for industrial application. The energy required to sterilize a 1000 L bio-waste contained in a stainless steel tank is approximately 106 kWh. On the other hand the continuous bio kill system illustrated in **Fig 1** achieves same end result with 40 kWh energy. This is achieved using: a) energy efficient spiral heat exchangers, b) heat retention coil and c) innovative engineering design to capture and recycle excess heat. The key highlight of BiOZEEN's continuous bio kill system is the ability to capture excess heat from the treated bio-waste and recycle back into the system. The heated bio-waste exiting at 134°C from the retention coil is circulated through heat exchanger (HE-02) where the excess heat is transferred to untreated biowaste flowing in opposite direction. Thus, less energy is required in heat

exchanger (HE-01) to heat the bio-waste to requisite temperature. Due to reduced hold time and continuous circulation, large volumes of bio-waste can be inactivated in a fraction of time than those required by batch tank method. This facilitates rapid disposal of bio-waste eliminating need for large storage tanks that may possess significant threat to environmental contamination. Heat Exchangers are Spiral type, having counter current flow, imparts high turbulence and does not allow deposition of cell mass present in Biowaste. The system is designed to have flexible in capacity operation, PLC based fully automated incorporating auto displacement and washing after operation is over.

Conclusions:

We have designed and build an eco-friendly continuous flow bio kill system to inactivate microorganisms and reduce environmental contamination. Our system eliminates usage of highly polluting toxic chemicals for sterilization and consumes up to 65 percent less energy than conventional batch tank system.

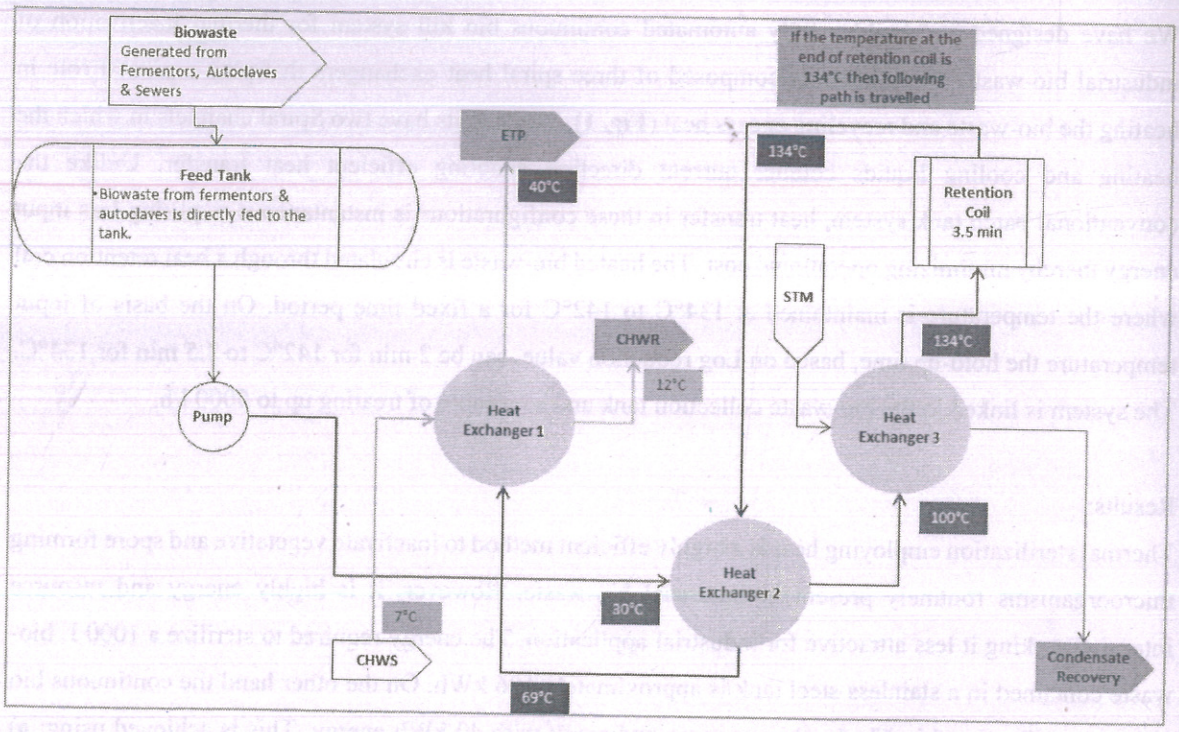

Figure 1 – Process flow diagram of continuous flow bio kill system developed at BiOZEEN for inactivating bio-waste.