Containerized Wastewater Treatment Plant

Decentralized and Onsite Treatment of Municipal and Industrial Wastewater and Landfill Leachate

With the continued exponential increase of the world population, meeting the global needs for potable and industrial-quality water production and wastewater treatment is increasingly more challenging with every passing year. Although according to the USGS 71% of the earth's surface is covered by water, only 3.5% is fresh water. The remainder is saline and requires substantial investment and energy to convert it to useable water for industrial, agricultural, or human consumption. Similarly, large quantities of wastewater generated by developing and developed communities worldwide, create costly and often monumental collection, treatment, disposal infrastructure, and related growth challenges. In contrast to saline water treatment, wastewater treatment for the purposes of reuse often requires much less energy and capital, thereby providing a more sustainable and economically viable solution to address the water scarcity dilemma. As a result, municipalities and industries are trending more toward decentralized and onsite treatment, with a focus on recovery and reuse of water and wastewater from municipal and industrial wastewater sources.

Current, conventional wastewater treatment plants often utilize biological and/or chemical treatment technologies, which require or cause substantial amounts of land, utilities, permitting, environmental impacts, aesthetics, noise, odor and air pollution, as well as, rising and unsustainable capital, operation and maintenance costs. Conventional treatment plants also require substantial amount of monitoring, controls, and highly skilled operators. Furthermore, conventional plants are not a practical choice for meeting smaller scale wastewater needs, due to their often inherent fixed and sizeable capital costs for land area, infrastructure needs, such as for example tank, piping, significant equipment, building, chemical, power, laboratory, road, utility, permitting, and zoning needs, and requirements to achieve similar results to a containerized wastewater treatment plant option.

A novel, innovative, and commercially available wastewater treatment system developed by Clark Technology, LLC, addresses most of the conventional wastewater treatment challenges, by providing communities, remote producers, landfills, and most industrial water users with the ability to treat, recover and reuse their wastewater with a more cost effective and sustainable approach. The economic and environmental benefits include savings on wastewater discharge and/or transportation, treatment, and freshwater purchase costs, in addition, to a reduced strain on diminishing and precious water resources and significant reduction of polluted surface water and groundwater sources.

Clark Containerized LeachBuster® System

In September 2019, after successfully installing and operating several LeachBuster systems in the United States (over 70 installations are operating internationally), Clark Technology designed, engineered, and commissioned its newly developed Containerized LeachBuster wastewater treatment plant (CLB WWTP) at a remote site in the Blue Ridge Mountains of the state of Virginia. Following a wastewater treatment study by the site's Owner and their consultant team, the Owner selected Clark's CLB WWTP for its wastewater treatment needs. The CLB met the discharge, financial, and other project goals, including an urgent need to replace an existing biological and already failing wastewater treatment

plant, after it was severely damaged by a significant windstorm. Following the start of the project, an application was submitted to the Virginia Department of Environmental Quality (VDEQ) for a National Pollutant Discharge Elimination System (NPDES) permit to replace their existing system with the new CLB system. Once approval for the permit was secured from VDEQ, Clark began design and construction of the treatment plant. Within months, after completing design and manufacture of the CLB, it was transported to the site for installation. In parallel to the containerized system construction, civil site preparations were completed that included concrete pad placement and installation of the necessary wastewater delivery and off-take lines, as well as the required power supply. Installation and commissioning of the CLB was completed over the span of two weeks.

System Specification

The system was designed for a population equivalent (PE) of about 300 people. The Owner chose to rehabilitate and reuse eight existing wastewater storage tanks to equalize and normalize the hourly and daily fluctuations in the incoming wastewater stream.

The CLB in Virginia is modular and upgradable to 50,000 gpd or 750 PE with minor modifications required to accommodate adequate future treatment and buffering capacity. As part of the CLB design, provisions such as additional treatment and power capacity were considered to accommodate future expansion needs. Table 1 below provides an overview of the CLB's capabilities and specifications.

Table 1. General CLB Wastewater Treatment Plant Specifications

Item	Description
LeachBuster® WWTP Description	US manufactured, containerized, stainless steel and/or GRP construction, LB-treatment levels 1-14 for industrial, municipal, landfill leachate, and water reuse treatment applications.
Treatment Levels	Produces up to 14 different levels of treated water quality covering the whole spectrum from UF to Ultra-pure and levels in between, such as NF and RO.
Average/Max Daily Flow	5,000to 500,000++ gallons per day (gpd)
Applications	Industrial, food production, agricultural, municipal, landfill leachate, hospitality, and commercial wastewaters. Potable water treatment and reuse.
Discharge Point	Protected trout and potable water streams, general surface waters, secondary treatment lagoons or ponds
System Housing	40 ft and 53 ft insulated high cube shipping container (5,000 to 50,000 gpd per container, dependent on treatment plant level and wastewater type.)
Wastewater Delivery System	Varies
Input Power	Varies, 480V, 3-phase power source (can be accomplished through VFD if 3-phase power is not available at site.)
Treated Wastewater Discharge Rate (effluent)	4,700 to 470,000 gpd (dependent on treatment plant level and wastewater type)
Design and Engineering	4-12 weeks (dependent on overall plant size, balance of plant and site work needs)
Construction	8-16 weeks (dependent on existing site conditions)
Installation and Commissioning	2-6 weeks

After running for several months, the specific CLB in Virginia achieved all performance and discharge criteria set forth in the VDEQ permit requirements, which is summarized below:

Table 2. Independent Third Party Laboratory Virginia CLB WWTP Analysis

Parameter	Influent	Effluent	Units
Biological Oxygen Demand, BOD	305	ND	mg/L
Total Suspended Solids, TSS	260	ND	mg/L
Total Kjeldahl Nitrogen (TKN)	81	6.2	mg/L
NO_2 plus NO_3 - Nitrogen	17	ND	mg/L
Phosphorus	10.2	0.051	mg/L
E.coli	$>10^7$	<1	MPN/100 ml

Photograph 1: Typical Containerized WWTP installation. Virginia CLB is shown.

Photograph 2: Standard interior view of the control panel, pumps, VFDs, and other equipment for a typical Containerized WWTP. Virginia CLB is shown.

System Summary

The Containerized LeachBuster® WWTP is a compact and ready-to-install, plug-and-play system with minimal onsite construction requirements. The following table highlights some of the important features and differences of the CLB WWTP, when compared with conventional and biological WWTPs.

Table 3. CLB WWTP Compared to Conventional WWTPs

Item	Clark Containerized LeachBuster® WWTP	Conventional WWTPs
Treatment Flexibility	Cleans wastewater and water streams to a desirable degree of purity required by the application/owner. Provides effluent with up to 14 different desired quality levels, covering a wide spectrum of purity levels from UF, NF, RO, and everything in between. Produces ultra-pure (pico meters) to agricultural quality water (leaving nutrients, but cleaning pathogens, heavy metals, and others).	Typically removes organics and often needs tertiary treatments to achieve a higher purity effluent. Typically produces only one level of purity. The plants typically require substantial re-design for removing new and emerging contaminants or to meet a more stringent level of output purity.
Footprint	Fits into one or two shipping containers with up to 1000 sq ft, plus some area for peripherals. Requires up to 80% less space than for a conventional WWTP of the same size and treatment type.	Several acres for primary, secondary, and often tertiary treatment.
Contaminant Agnostic	Removes most or all organics (BOD, COD, TSS, VOCs, SVOCs, PAHs, DRO, GRO), inorganics (metals, semi-metals, dissolved	Often requires several steps such as chemical, biological, and even post filtration

	solids such as sugars, chlorides, sulfides), and pathogens (bacteria, viruses, and fungi) typically in a single pass.	to remove metals, dissolved solids, and other contaminants
Removes PFAS	Removes per- and polyfluoroalkyl substances (PFAS) or the "forever chemicals" and concentrates them into a smaller volume for easy confinement or destruction.	Not effective in removing or destroying PFAS compounds, it accelerates its distribution in the environment by delivering into the aqueous conduit via effluent, sludge, and air.
Removes CECs	Removes contaminants of emerging concern (CECs), such as pharmaceuticals, health and beauty chemicals degradation by-products, micro plastics, dioxins, chlorides, and others.	Additional treatment technologies such as reverse osmosis needed to remove these compounds.
Infrastructure	Prefabricated, pre-wired, and plumbed within a container. ready to be connected to incoming wastewater and outgoing clean water, power source and concentrate discharge pipe. Requires minimal soil disturbance, foundation, and site preparation.	Often requires extensive excavations, ground disturbance to accommodate primary and secondary clarifiers, aeration tanks, return sludge pumps and pipes, and other equipment.
Pre-Treatment	Requires minimal pre-treatment and can handle substantial amounts of suspended and dissolved solids. Uses a simple strainer to remove large solids.	Requires substantial pre- and post-treatments, including primary and secondary clarifiers, fine screens, sedimentation/grit removal, and other equipment.
Permitting and zoning	Enclosed and closed loop with limited exposure of the wastewater to surrounding air, environment, or the operator. Requires less environmental, regulatory, zoning, and other permits.	Due to existence of odor, noise and substantial soil disturbance and excavation requirements, requires much more regulatory permits and review such as: environmental impact studies, zoning, air, discharge, and additional building permits.
Ease of Operation and monitoring	Fully automated and requires much less operator time and skill set then for a typical WWTP. Can be monitored and operated remotely from a smart phone or a laptop computer.	Often requires comprehensive and constant monitoring and significant operator time, training, and skills. Often requires monitoring and control of sophisticated parameters such as mixed liquor, suspended solids, MLSS, dissolved oxygen (DO), volatile solids (VS), and over 30 other parameters.
Pathogen Removal	Physically removes pathogens without the need for any disinfectant, such as chlorine or other disinfecting mechanisms such as UV or ozone treatment. The elimination of the use of chlorinated disinfectants eliminates the possibilities of formation of trihalomethanes (THMs), which are toxic to human, terrestrial, and marine life.	Requires chemical (chlorine) or physical (UV or ozone) disinfection mechanisms. Chemical disinfection generates THMs, which are typically toxic to human, terrestrial, and marine life.

For additional information regarding the Clark Containerized LeachBuster WWTP and how it can support or provide a solution to your wastewater treatment needs, please contact:

Mehdi Sarfaraz
Senior Project Manager

3401 Nevada Avenue North
Golden Valley, MN 55427
MSarfaraz@clark-technology.com
www.Clark-Technology.com

Vlad Scheglowski, PE
COO/Exec. Vice President

3401 Nevada Avenue North
Golden Valley, MN 55427
VladS@Clark-Technology.com
www.Clark-Technology.com