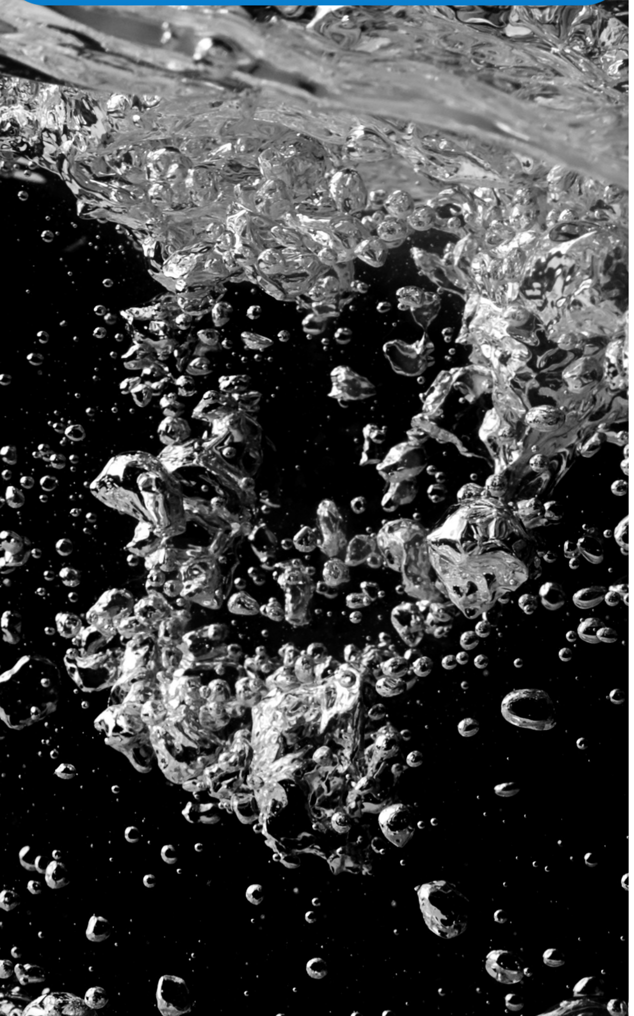
hydro action®

green from the ground up

www.hydro-action.com

DECEMBER 14TH, 2021 NEWEA Task Force

hydro action®
green from the ground up



Patent Year **Years in production**	Est. 1988 Beaumont, TX 2004 -- Plymouth, IN 2012 -- AN Series 2012 2017; US10414678B2
Category	ATU with Pre-Tank and Recirculation
Applications	Residential, Commercial, High-Strength
Capacity (GPD)	450 to 1100 Modular to 20,000+
Performance	
TN Range	NSF 15 mg/l, 2013 MD 20.3 mg/l, 2015 NY 11.1 mg/l, 2021

US010414678B2

(12) **United States Patent**
Sabo et al.

(10) **Patent No.: US 10,414,678 B2**
(45) **Date of Patent: Sep. 17, 2019**

(54) **NITROGEN-REDUCING WASTEWATER TREATMENT SYSTEM**

(71) Applicant: **A.K. Industries, Inc.**, Plymouth, IN (US)

(72) Inventors: **Stephen Sabo**, Plymouth, IN (US); **Steven Davis**, Plymouth, IN (US); **James Conley**, Plymouth, IN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 3 days.

(21) Appl. No.: **15/629,206**

(22) Filed: **Jun. 21, 2017**

(65) **Prior Publication Data**

US 2017/0283291 A1 Oct. 5, 2017

Related U.S. Application Data

(63) Continuation of application No. 14/134,860, filed on Dec. 19, 2013.

(60) Provisional application No. 61/739,130, filed on Dec. 19, 2012.

(51) **Int. Cl.**
C02F 3/30 (2006.01)
C02F 3/12 (2006.01)

(52) **U.S. Cl.**
CPC ***C02F 3/302*** (2013.01); ***C02F 3/1242*** (2013.01); *C02F 2209/10* (2013.01); *C02F 2209/40* (2013.01); *Y02W 10/15* (2015.05)

(58) **Field of Classification Search**
CPC C02F 3/302; C02F 3/1242; C02F 3/30; C02F 2209/40; C02F 2209/10; C02F 2209/005; C02F 2209/11; Y02W 10/15; Y02W 10/10
USPC 210/142, 418, 739, 745, 605, 620–623, 210/630, 220
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,647,986 A *	7/1997	Nawathe	C02F 3/006	210/195.3
5,888,394 A *	3/1999	Jan	C02F 3/006	210/104
7,011,757 B1 *	3/2006	Reid	C02F 3/302	210/605

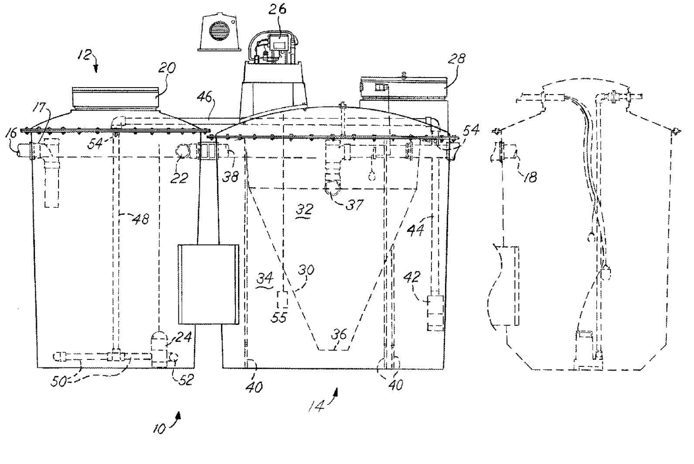
* cited by examiner

Primary Examiner — Nam X Nguyen
Assistant Examiner — Julia L. Wun
(74) *Attorney, Agent, or Firm* — Botkin & Hall, LLP

(57) **ABSTRACT**

A wastewater treatment system is provided having a pretreatment tank which receives wastewater from a wastewater source, and an aeration tank which is in fluid communication with the pretreatment tank. A recirculation pump is carried in the aeration tank and returns wastewater from the aeration tank to the pretreatment tank. The recirculation pump returns the wastewater according to a recirculation ratio R:I where R is the volumetric flow rate of wastewater through the recirculation pump and I is average volumetric flow rate of wastewater entering the pretreatment tank. A control panel cycles the recirculation pump on and off according to the recirculation ratio.

5 Claims, 2 Drawing Sheets



NITROGEN-REDUCING WASTEWATER TREATMENT SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part claiming the benefit of Utility application Ser. No. 14/134,860 filed Dec. 19, 2013, which claims the benefit of U.S. Provisional Application No. 61/739,130, filed Dec. 19, 2012, the disclosures of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Home wastewater treatment is an economical option for buildings which are located in areas without access to a city sewage system, or where the costs of hooking the building into a municipal sewage system are prohibitive. Home wastewater treatment systems perform similar functions as a sewage plant, but on a much smaller scale. These systems are typically located underground. After the wastewater has been treated it is typically discharged as waste on the property. It is essential that the wastewater is processed sufficiently so that the discharged water does not pose a threat to the environment.

In some geographical regions, wastewater discharged from a home wastewater treatment system—the wastewater effluent—must contain reduced nitrogen levels. When wastewater effluent contains excess amounts of nitrogen-based compounds, and when such wastewater effluent enters waterways, eutrophication, or hypertrophication can result. Eutrophication is the response of an ecosystem to excess artificial natural or artificial substances. One example of eutrophication is the increase of phytoplankton in a body of water, such increase can result in a "bloom" or bright green coloring of the water. Not only does eutrophication discolor the water, but it also disrupts the ecosystem, and can deplete the oxygen levels in the water, which in turn can cause natural species, such as fish, to reduce in numbers or die off.

There are several types of nitrogen which may be present in wastewater and which may need to be reduced, such as ammonia, nitrate, nitrite and organically-bound nitrogen. Total Kjeldahl Nitrogen (TKN) is a test method that measures the combination of organically-bound nitrogen and ammonia. Total Nitrogen (TN) is the sum of the TKN and nitrate and nitrite. To prevent eutrophication and other problems related to excess nitrogen, it is desired that the TN in the wastewater effluent is reduced. It is desired that the TN in the wastewater effluent be reduced by a minimum of 75% relative the TN of the wastewater influent.

One way to reduce nitrogen is through the use of a combination of aerobic and anaerobic bacteria. One suitable pathway of bacteria-aided nitrogen reduction is described as follows. The bacteria reduce ammonia to nitrite, and those or other bacteria reduce nitrite to nitrate, finally the nitrate is denitrified into molecular nitrogen, N_2 by bacteria. The molecular nitrogen bubbles out of the system, which results in an overall reduction in the nitrogen content in the wastewater. The final step of denitrification generally requires anaerobic conditions, while the other steps typically require aerobic conditions. As such, the wastewater treatment system must be designed to oscillate between aerobic and anaerobic conditions such that all phases of the nitrogen-reduction process may be achieved.

At the same time, the wastewater treatment system must be suitable for performing its primary function, which is to process the waste found in the wastewater. Typically, such waste is processed by bacteria which gasify nitrogen compounds into atmospheric nitrogen and carbon compounds into carbon dioxide.

As such, an improved home wastewater treatment system is needed which is suitable to both process the waste in the wastewater and to reduce the TN in the wastewater.

SUMMARY OF THE INVENTION

The present disclosure describes a wastewater treatment system which reduces both the waste content and the nitrogen levels in the wastewater effluent. The wastewater treatment system described herein includes a pretreatment tank and an aeration tank. The pretreatment tank provides an anaerobic environment which allows solids to settle out of the wastewater and encourages the growth of anaerobic bacteria which digest the waste in the wastewater. The aeration tank includes diffusers which add air to the wastewater therein, which air oxygenates the wastewater, thereby encouraging the growth of aerobic bacteria which aid in further digesting the waste contained in the wastewater. A recirculation pump is included in the aeration tank and pumps a portion of the wastewater from the aeration tank back to the pretreatment tank. As such, a portion of the wastewater in the aeration tank is returned to the pretreatment tank. The recirculation pump is activated by a controller such that the recirculation pump cycles on and off according to the flow rate of wastewater into the wastewater treatment system. The result is an environment that favors both wastewater treatment and nitrogen reduction.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of this invention has been chosen wherein:

FIG. **1** is side view of the wastewater treatment system showing internal components in dotted lines and an optional pump tank shown in dotted lines; and

FIG. **2** is a top view of the wastewater treatment system of FIG. **1** showing internal components in dotted lines and an optional pump tank shown in dotted lines.

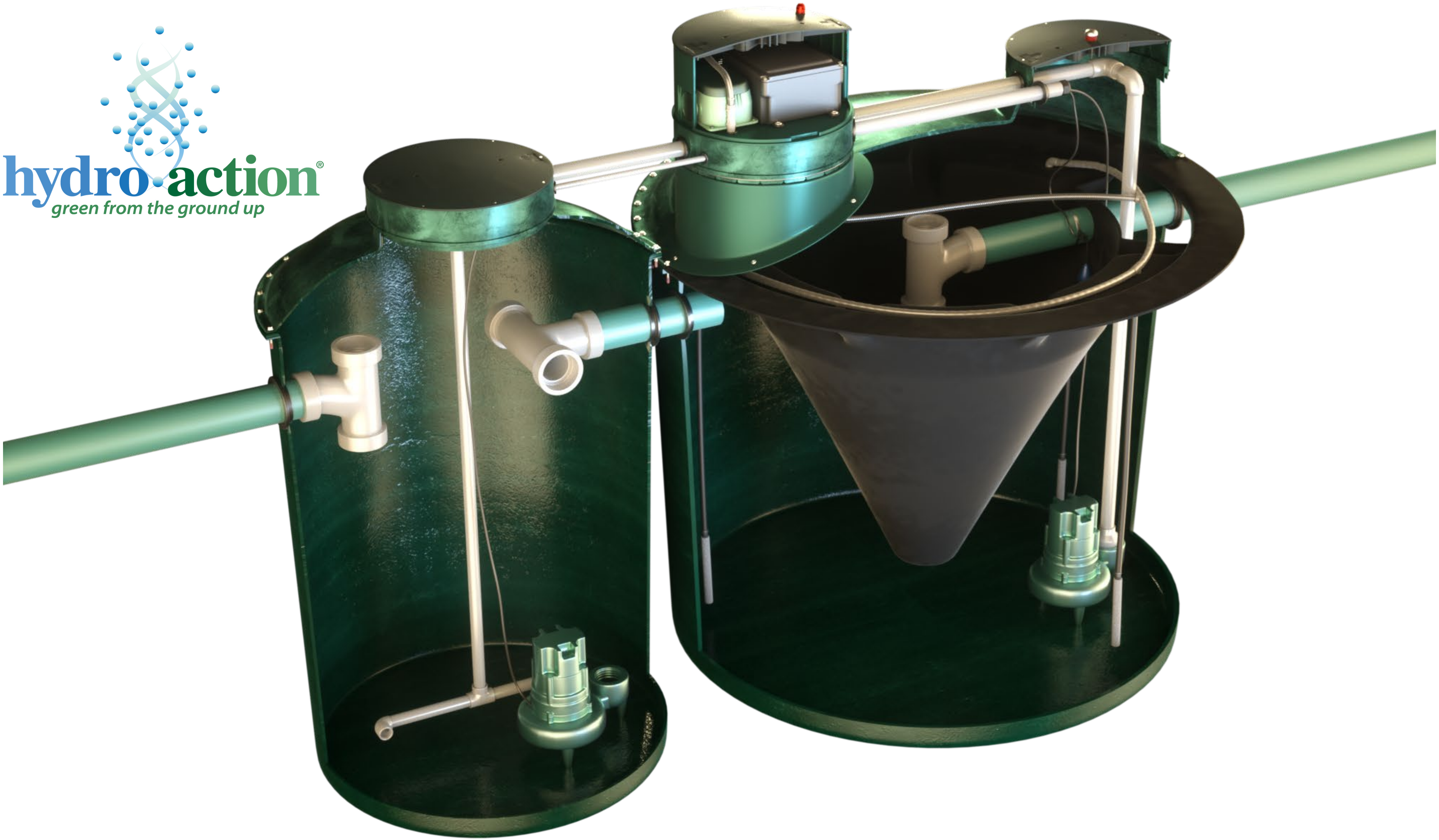
DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. **1**, the present disclosure describes a wastewater treatment system **10** which includes a pretreatment tank **12** and an aeration tank **14**. The pretreatment tank **12** and the aeration tank **14** are liquid holding vessels which are in fluid communication with one another and serve the purpose of treating wastewater. Pretreatment tank **12** includes an inlet **16** which accepts wastewater influent into the wastewater treatment system **10**. The inlet **16** is in fluid communication with a wastewater source, such as a residential home, though the application of the wastewater treatment system **10** is not limited to residential uses. The aeration tank **14** includes an outlet **18** which discharges wastewater effluent out of the wastewater treatment system **10**. The wastewater effluent discharged from the outlet **18** is typically dispersed into the ground through a drip field, though other discharge pathways are contemplated, and this description is not limited thereto. Further, in some instances a pump tank accepts the effluent from the outlet **18**, which pump tank doses the flow rate of the effluent, but again, the present description is not limited thereto.

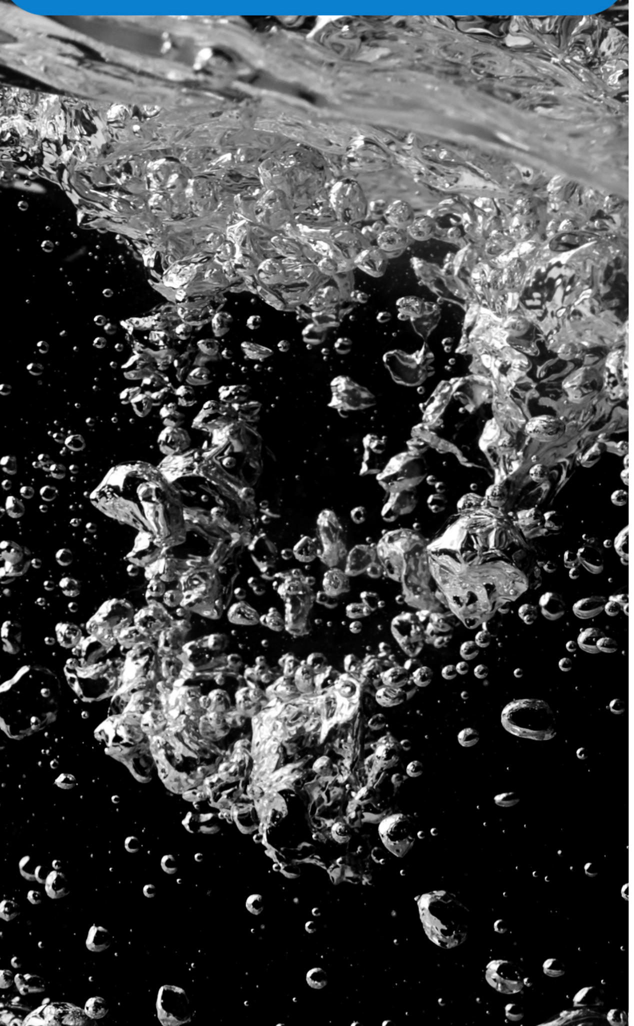
Referring now to the pretreatment tank **12**, the pretreatment tank **12** is a tank which preferably includes a riser **20**,

hydro action®

green from the ground up




hydro·action



HYDRO-ACTION PRODUCT SPECIFICATIONS

AEROBIC & NITROGEN REDUCTION ON-SITE WASTEWATER TREATMENT PLANTS

Model No.	AN400	LP-AN-400	AN500	AN500-C	AN600	AN800	AN1100	LP-500	AP-500	AP-600	AP-750	AP-1000G	AP-1500G
Treatment Capacity (Gallons Per Day)	450	450	550	550	660	800	1100	500	500	600	750	1000	1500
Volumetric Capacity (Gallons)	1217**	1216**	1504**	1507**	1895**	2465.91		954	836	1019	1275	1632	2413
Aeration Capacity (Gallons)	663	756	800	773	943	1261	1730	756	663	800	1000	1280	1895
Clarifier Capacity (Gallons)	173	198	219	219	224	387	362	198	173	219	275	352	518
BOD_5	1.25 lbs/day	1.25 lbs/day	1.50 lbs/day	1.50 lbs/day	1.50 lbs/day	1.85 lbs/day	3.0 lbs/day	1.25 lbs/day	1.25 lbs/day	1.50 lbs/day	1.85 lbs/day	2.50 lbs/day	3.75 lbs/day
HiBlow Linear Pump	HP 80	HP 80	HP 100	HP 100	HP120	HP150	HP200	HP 80	HP 80	HP 100	HP 120	HP 120	HP 200
NSF Std.	245	245	245	245	245	245	245	40	40	40	40	40	40

DESIGN COMPONENTS AND MATERIALS

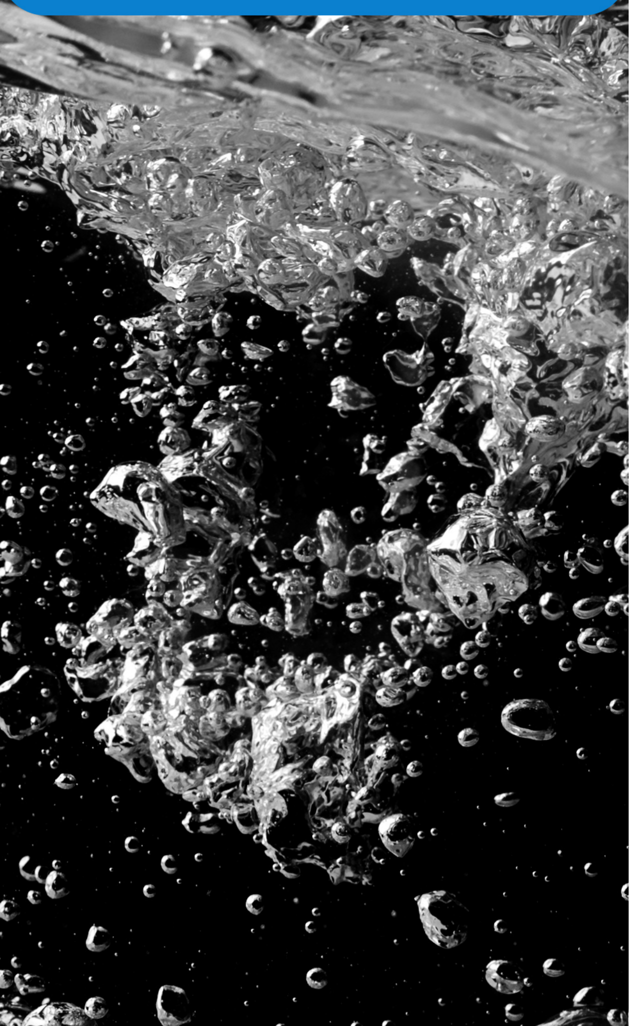
	AN400	LP-AN-400	AN500	AN500-C	AN600	AN800	AN1100	LP-500	AP-500	AP-600	AP-750	AP-1000G	AP-1500G
Tank & Cover	Fiberglass	Fiberglass	Fiberglass	Concrete	Fiberglass	Fiberglass	Fiberglass	Fiberglass	Fiberglass	Fiberglass	Fiberglass	Fiberglass	Fiberglass
Clarifier	Polyethylene	Polyethylene	Polyethylene	Fiberglass	Fiberglass	Fiberglass	Fiberglass	Fiberglass	Polyethylene	Fiberglass	Fiberglass	Fiberglass	Fiberglass
Pump Housing	Polyethylene	Polyethylene	Polyethylene	Polyethylene	Polyethylene	Polyethylene	Polyethylene	Polyethylene	Polyethylene	Polyethylene	Polyethylene	Polyethylene	Polyethylene

DIMENSIONS

	AN400	LP-AN-400	AN500	AN500-C	AN600	AN800	AN1100	LP-500	AP-500	AP-600	AP-750	AP-1000G	AP-1500G
Width	70"	82"	76"	76"	78"	94"	94"	82"	70"	76"	82"	85 5/8"	94"
Height	83 1/2"	64 1/4"	84 1/2"	84"	111"	118"	118"	64 1/4"	83 1/2"	84 1/2"	85 1/2"	89 1/2"	99 1/2"
Length	118"	164"	132"	129"	152"	176"	176"	82"	70"	76"	82"	85 5/8"	94"

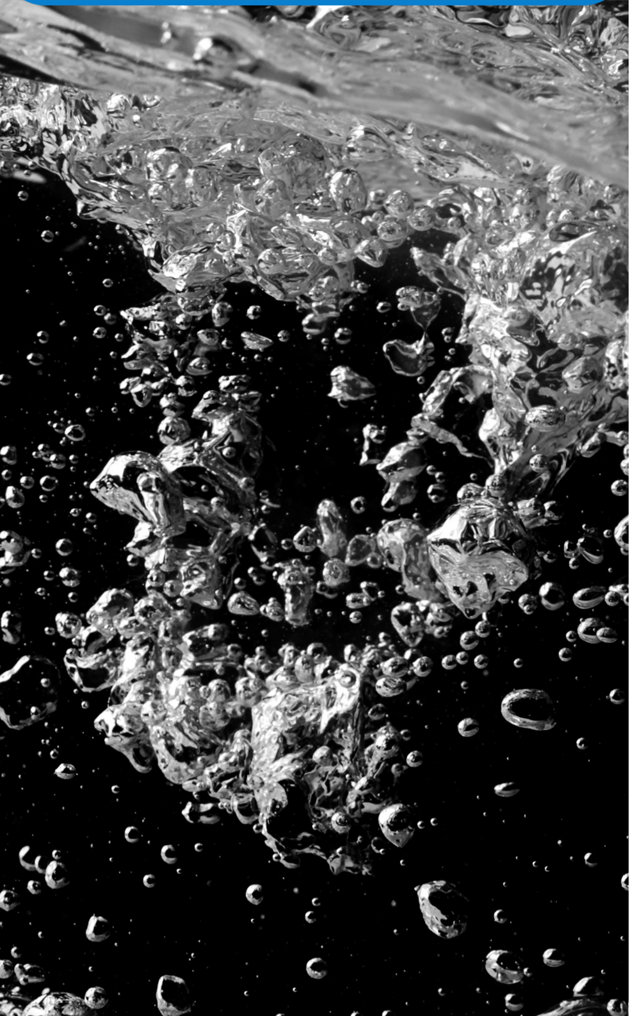
** INCLUDES PRE-TANK

REV.2016.05



Cost	
Monthly operating costs (electricity etc.)	740.33 kWh/year 2.02 kwh/day $11.10/month
Yearly O&M requirements	6 months
Yearly O&M costs (without sampling)	$125 Contract $133 Electrical $258 Total
Yearly O&M costs (with sampling)	$500 per sample
Expected system lifespan (range)	Pump Out @ 5 years
Total Cost of system over 20 years (design + install + operation + maintenance + repairs)	**Design** @ $2500 **Install** @ $5000 **Operation** @ $258 $8,000 to $25,000 **Pump Outs** @ 4 x $500 = $2000 **Replacements** @ $3000

hydro action®
green from the ground up



NSF®

BOD	4 mg/l
TSS	9 mg/l
TN	15 mg/l