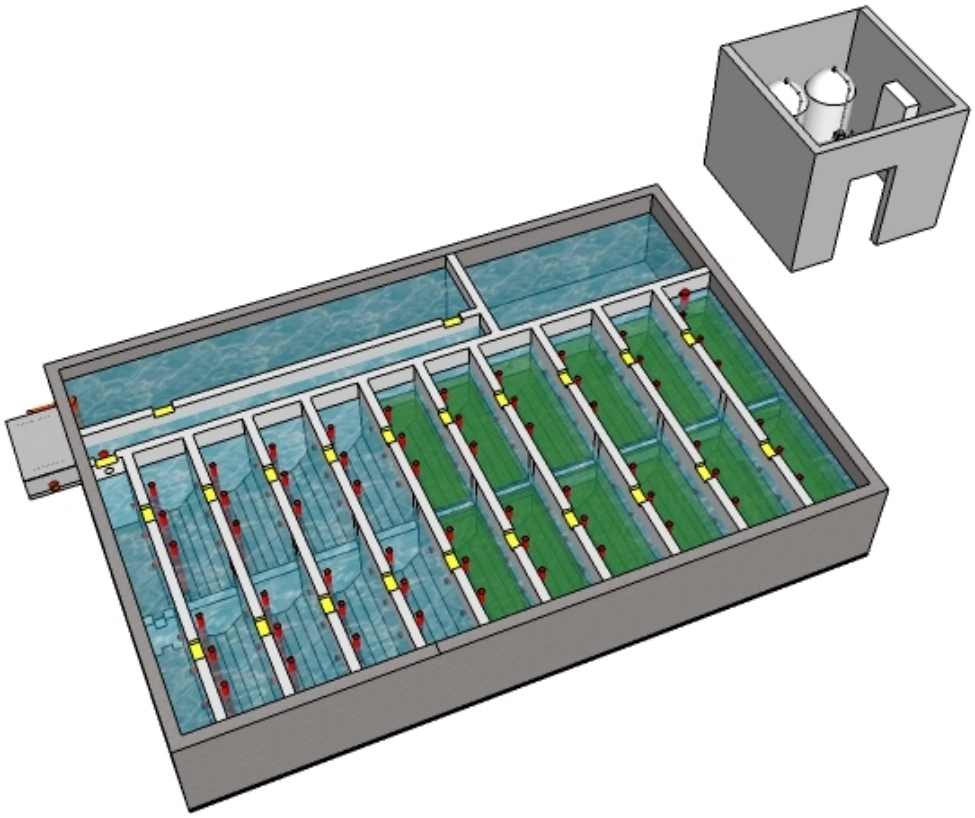
Client : First & Foremost Hotels & Resort - Maldives

Technology – "Green STP AD+"



Green STP AD+

Zero Discharge Sewage Treatment Plant

Reuse of treated water for Landscape & Irrigation

Date: 08th April 2017 – Mumbai [INDIA]

Preamble

The environment of Maldives comprises of a delicate and complex series of ecosystems which is unique to the tropical world and many have found it a pleasure to gaze upon. Current issues included beach erosion, coral mining, fresh water resources, waste disposal and sewage disposal.

One of the major threats to environment is disposal of sewage. Sewage poses a series of potential problems depending on the mode of disposal, discharges of raw and untreated sewage into the marine environment which tends to cause nutrient enrichment algal blooms, sea-grass, de-oxygenation. Such conditions adversely affect coral growth. Sewage related problems are a major concern around the densely populated islands and some tourist resorts.

Waste water (domestic sewage water) reuse is emerging as an alternative resource. It allows increase in the supply of water resources and reduces pollution problems because it prevents the discharge of waste water into the environment. Feasibility of Water Reuse project is currently subjected to economic assessment.

Maldives islands does not have natural source of water, so all potable water demand is catered by sea water, using desalination plant. Also, to operate desalination plant electricity is produced from diesel generators. The "GREEN STP AD+" converts domestic sewage water into nutrient rich irrigation water. So, using this treated water the fresh (desalination) water demand significantly goes down, saving capital & operating cost of the desalination.

Considering the remote location of the site, we have proposed self-sustained, scientifically developed, natural recycling treatment plant, with least operation & maintenance compared to any technology in the world.

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Project Proponent

Name of the project	:	First & Foremost Hotels & Resort at Maldives
Requirement	:	Sewage Treatment Plant
Type of project	:	Resort Villas & Staff quarters
Application of Treated Water	:	Land irrigation, WC flushing in staff quarters & any other non-potable applications
Location of the project	:	Maldives.

Objective

- ✓ Natural Self-Sustained design
- ✓ Least possible Operation & Maintenance
- ✓ Most Energy efficient technology
- ✓ Maximum recovery of water
- ✓ Lower Footprint
- ✓ Environmental Friendly
- ✓ No foul odor
- ✓ Long life span
- ✓ Economical – Capital Cost
- ✓ Simple to operate
- ✓ Meets International Pollution Standards

Water Balance/ Budget

The plant is designed to treat sewage generated of having following details.

Client Data

Source of Waste Water	:	Domestic Waste Water generated from Resort, Kitchen, Laundry, Swimming Pool Backwash Water, Bathroom, Staff Quarters, WC, Wash basin, etc.
Number of Guest Rooms	:	76 nos.
Number of Staff	:	_____ nos.
Application of Treated Water	:	Land irrigation & Gardening

Design Consideration & Estimation

Water require per person	:	_____ liters per day
Total Sewage Water Capacity	:	90 KLD (as per client 90 KLD is produced per day)
Plant Operating Hrs	:	22 – 24 HRs
Plant Flow Rate	:	4.5 m3/hr
Treatment	:	Anaerobic Digestion [AD] + Polishing + Ozonation
Green STP/AD+ Model No.	:	AD+/STP-90

Water Quality – Raw Sewage & Treated / Recycled

Parameters	Raw Sewage Water Quality	Treated Water Quality For Reuse
Color	Slightly brownish	Clear
Odor	Characteristic	Unobjectionable
pH	5.0 – 8.0	5.5 – 8.0
TSS	100 – 150 ppm	≤1 ppm
BOD (3 days 28 ^{0}C)	150 – 200 ppm	≤10 ppm
COD	300 – 450 ppm	≤100 ppm
Oil & Grease	20 – 25 ppm	≤ 10 ppm

Treatment Technology

Concept - Green STP AD+

Green STP AD+ combines state of the art High Rate Anaerobic Reactor (HRAR) technology with a selection of adequate tertiary treatment methods of filtration & disinfection. This full-blown decentralized wastewater treatment and reuse systems is aligned with the project specific conditions and requirements. We provide our clients custom and tailored wastewater solutions with outstanding economic and ecologic performances while making maximal benefit out of on-site reuse of products out of wastewater treatment. Our STPs are engineered to comply with the respective regulations and norms.

AD+ [Anaerobic Digestion +] is a waste water treatment, particularly suited to organic material & is commonly used for effluent, sewage & grey water treatment. Anaerobic waste water treatment is a biological treatment without the use of air or elemental oxygen. Many groups of anaerobic bacteria work together in absence of oxygen to degrade complex organic pollutants into methane / bio gas and carbon dioxide. In anaerobic digestion the micro-organisms responsible for the conversion of the organic matter or the other constituents in the waste water to gases & cell tissues are maintained in-suspension within the liquid. Anaerobic digestion is a simple process that can greatly reduce the organic matter without using any other resource & any form of energy.

Core Treatment - High Rate Anaerobic Reactor Technology

High Rate Anaerobic Reactors (HRAR) refers to bioreactors which can retain active biomass in the reactor independently of the incoming wastewater (Hydraulic Residence Time HRT). Slow growing anaerobes can be maintained in the reactors at high concentrations, enabling high reaction rate per unit reactor volume and high resistance of organic or hydraulic shock loads. HRAR can be used to treat wastewater from various sources and strengths like waste water from domestic sources, hospitals and industries like distilleries or food-processing.

The HRAR we use are cascaded in series to multi-step anaerobic systems, enabling separation of the anaerobic treatment steps (Hydrolysis/Acidogenesis/Acetogenesis/Methanogenesis) without difficult process controlling. With respect to sustainability and cost- effectiveness, anaerobic treatment has the core advantage of avoiding the loss of energy for destruction of organic matter, while energy is reclaimed from the organic waste constituents in the form of methane in biogas.

Salient Features:

* Overall Organic & Inorganic content reduction (BOD, COD & TSS) with color & odor.
* **Treated Sewage Water Quality - Most suited for Irrigation & Landscape.**
* **Energy Efficiency - Highest – 50 – 90 % less consumption**
* **Sustainability - Self Sustained [Autark]**
* **Reusable Output - Highest – more than 99 %**
* **Operation & Maintenance - Least – Operator not required**
* **Sludge Management - Least – Once in a Year**
* **Consumables - Minimum**
* **Life Span - Very High – 100 Years [Core Technology]**
* **Foot Print - Minimum 60 – 80 % less**
* **Nutrients - Rich**
* **Process & Technology/R & D - GREEN STP AD+ from Switzerland**

Advantages – HRAR [AD] :

* Low Process Control
* Low Process Energy
* No Chemicals
* Low Sludge Production
* MLSS and SVI monitoring not required
* Energy Generation in the form of Biogas
* Minimum Mechanical & Electrical Parts
* Under Ground Structure (Can be above ground)
* High Shock Load Resistance [Organic & Hydraulic]
* High Treatment Performance In Terms Of COD, BOD & TSS
* Self-Sustained
* Reclaimed Water more than 99.0 %
* Innovative still natural treatment process
* Energy efficient. 60 – 90% lesser power
* Extremely stable to hydraulic shock loads
* High treatment performance
* Low operating cost
* Low space required – being subsoil
* No foul odour
* Long life – at least 50 years

Process Description

Primary Treatment

Screening: - This is the first unit of the Green STP AD+. Sewage water from sewage collection chamber is collected into an AD tank through a bar screen by gravity. Bar screen is provided to trap floating materials like leaf, flowers, cottons, plastic, half eaten food, papers, etc.
Oil & Grease Chamber: - Sewage water from the kitchen which contains free oil, if not removed creates scum accumulation and affects the functioning of microbes. To avoid this, oil & grease, a chamber is provided after the bar screen where free floating material oil is arrested prior to entry in the AD Tank. Accumulated oil will be removed periodically and disposed of properly.

Secondary Treatment

Biological Treatment: -

Sewage from Oil & Grease chamber will pass through the AD Tank. The AD Tank is a cascade of three major treatments steps i.e. Settler, High Rate Anaerobic Reactor [HRAR]/Anaerobic Baffle Reactor [ABR] and up flow Anaerobic Filter which is constructed below ground level. These three different phases are built together in a single AD Tank with interconnecting compartments. The AD Tank performs the core treatment of the sewage water oxidization & decomposition of organic pollutant with the help of anaerobic microorganism to provide higher surface area for micro – organisms, floating random media is provided, on which micro- organisms growth takes place. Generally activation of AD tank with full sewage load can take 40 to 50 days and come to its optimum efficiency.

1. **Settler**

The first compartment of AD Tank is a settler. The settler has two treatment processes. First is a sedimentation in which the liquid part is separated from the solid matter and second is stabilization, which settles out most of the solids in the waste water.

2. **High Rate Anaerobic Reactor /Anaerobic Baffle Reactor (HRAR/ABR)**

In this treatment phase, biological and natural chemical processes are used to digest and remove most of the organic matter. In this high rate anaerobic reactor, without oxygen mechanical mixing is applied. Treatment is achieved by anaerobic digestion by naturally selected anaerobic microbial. This gives good retention time to waste water and development of a thick sludge blanket in the bottom of compartment.

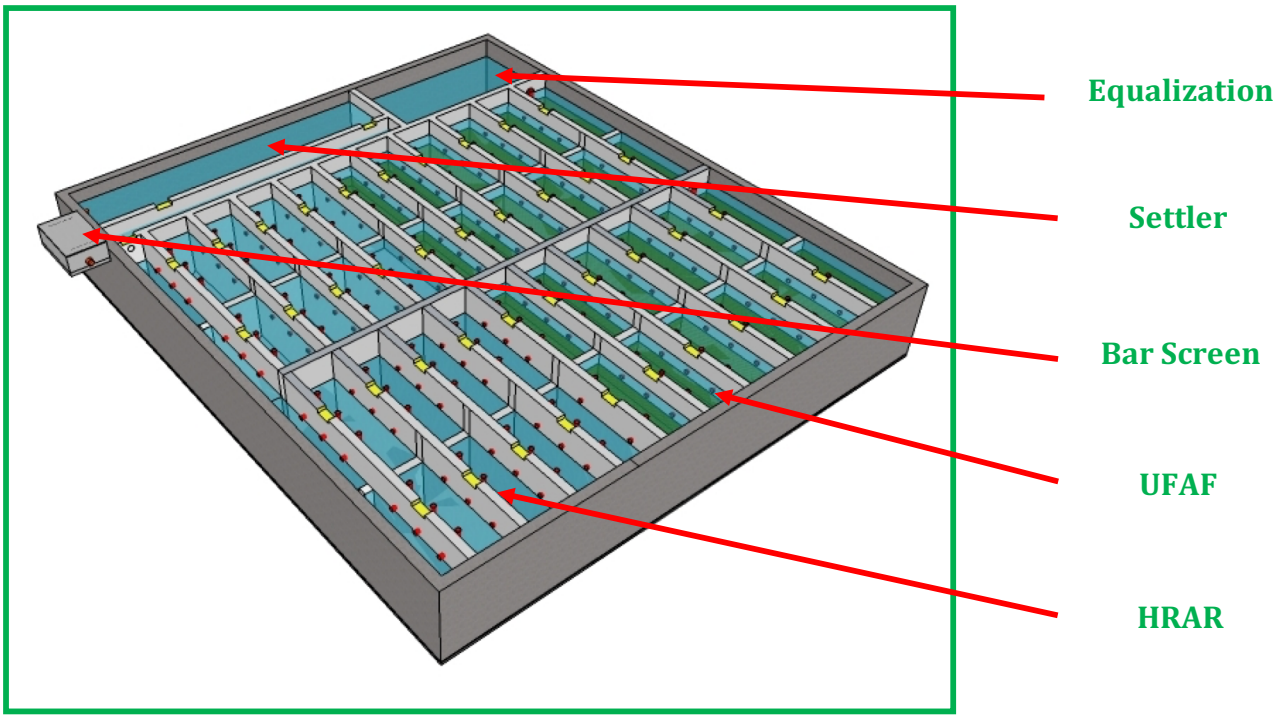


Fig. 1, Anaerobic Digester [AD] Tank – Civil On Site Construction

3. Up flow Anaerobic Filter

After the HRAR/ABR Treatment sewage water is transferred into up flow Anaerobic Filter compartment in order to improve further treatment efficiency, a filter media allowing widespread contact with the waste water stream is used which is very efficient in retaining and digesting the left over pollutants. The process works with fixed plastic bio media. The waste water passing out of the anaerobic filters has 90% of the original pollution load removal.

Polishing Tertiary Treatment

Secondary (biological) treated water from AD Tank will be collected in a equalization tank. This treated water is ozonated for pathogen disinfection. Ozonation also reduces foul odor & tint of color, if present in treated water. Post Ozonation water is filtered by **"Charged Activated Media Filter [CAMF]"** through a filter feed pump to trap tiny suspended particles from water. Ozonation of treated sewage water reduce tiny organic and inorganic impurities from water.

From backwash cum Treated Water Tank water is used for backwashing of filters. From this tank water will be further collected in main treated water tank.

Fig. 2, Tertiary Treatment: Charged Activated Pressure Filtration + Online Ozonation

Process Flow Diagram

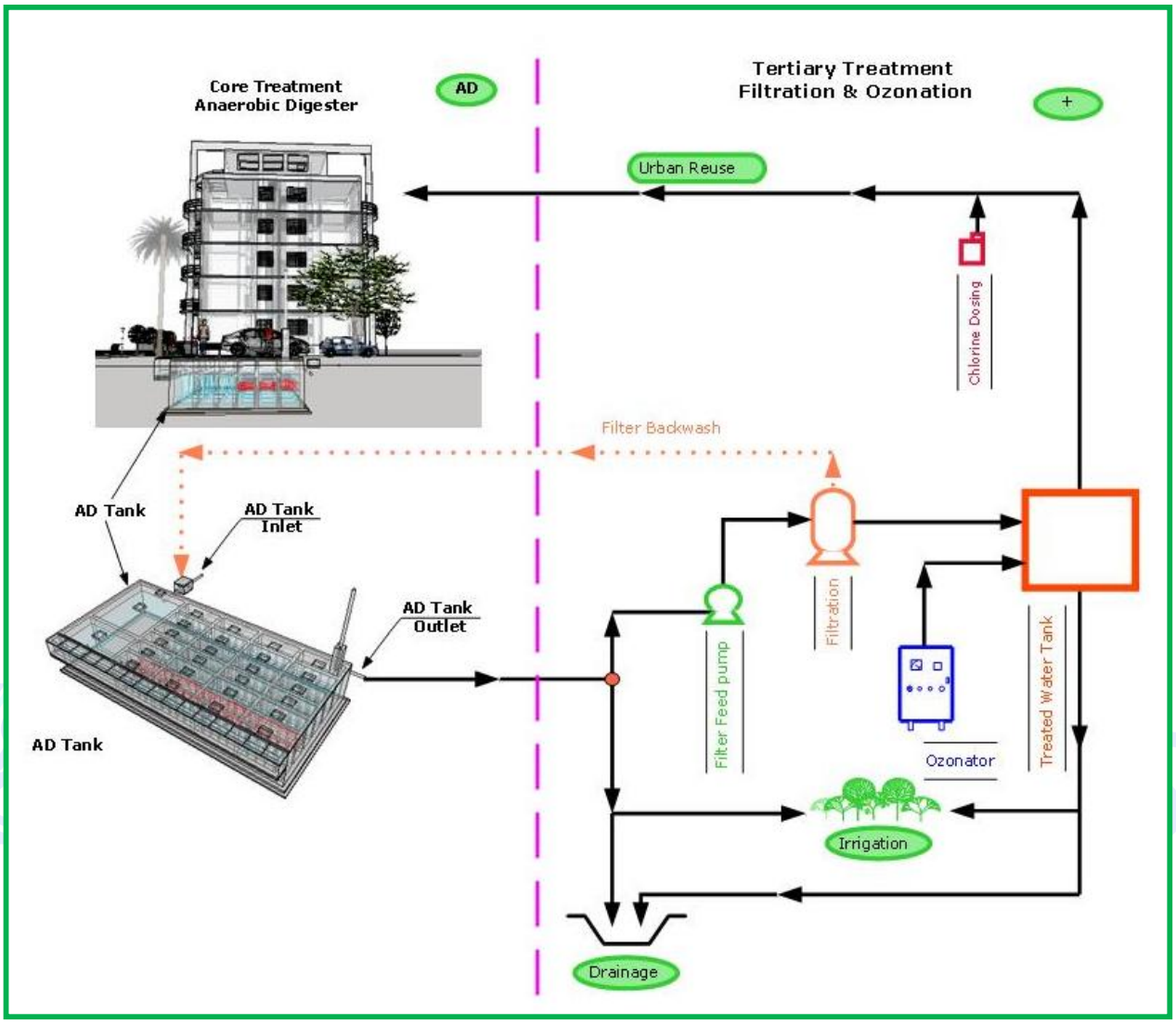


Fig. 3, Process Flow Diagram of "Green STP AD+"

Technical Specification

There are four options for anaerobic tank construction:

Option 1 [A] – Civil Tank Construction Under Ground

Option 1 [B] – Civil Tank Construction Above Ground

Option 2 [A] – Pre-Fabricated HDPE Tanks Under Ground

Option 2 [B] – Pre-Fabricated HDPE Tanks Above Ground

In option 1 [A] or 1 [B], the construction of the sewage collection cum treatment tank & treated water tanks are to be constructed on site by your civil contractor & we will give you the dimensional drawings. The bio-media & pipe grid will be installed by our team, after the tank is constructed & before the construction of top slab. Also, the tertiary treatment plant will be supplied & installed by our team.

In option 2 [A] or 2 [B], the sewage collection cum treatment tank & treated water tank will be pre-fabricated in our factory & along with tertiary treatment plant will be delivered to your site.

In any of the opted option, once the tanks are ready, they will be inoculated for anaerobic bacteria at the site.

Option 1 – Civil Construction

Foot Print – AD Tank

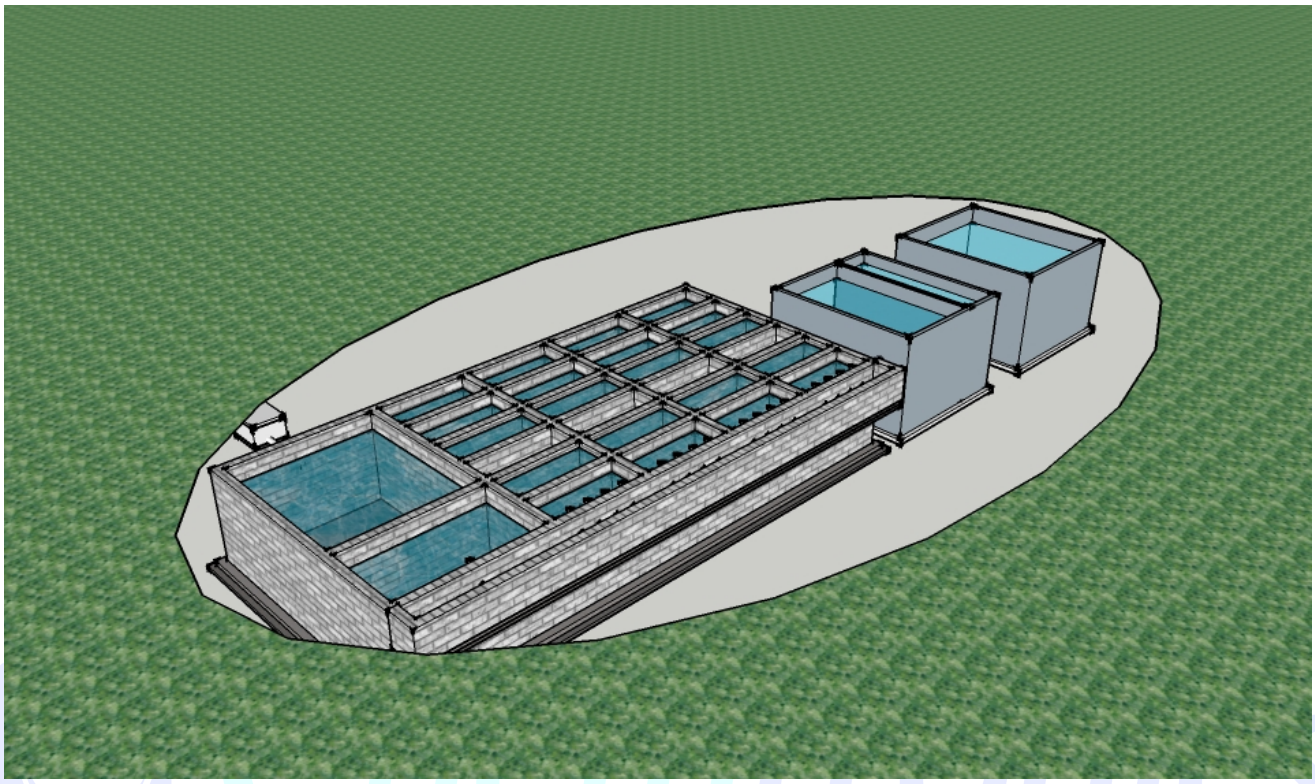


Fig. 4, AD Tank, Oxidation Tank & Final Treated Water Tank can be located below landscape

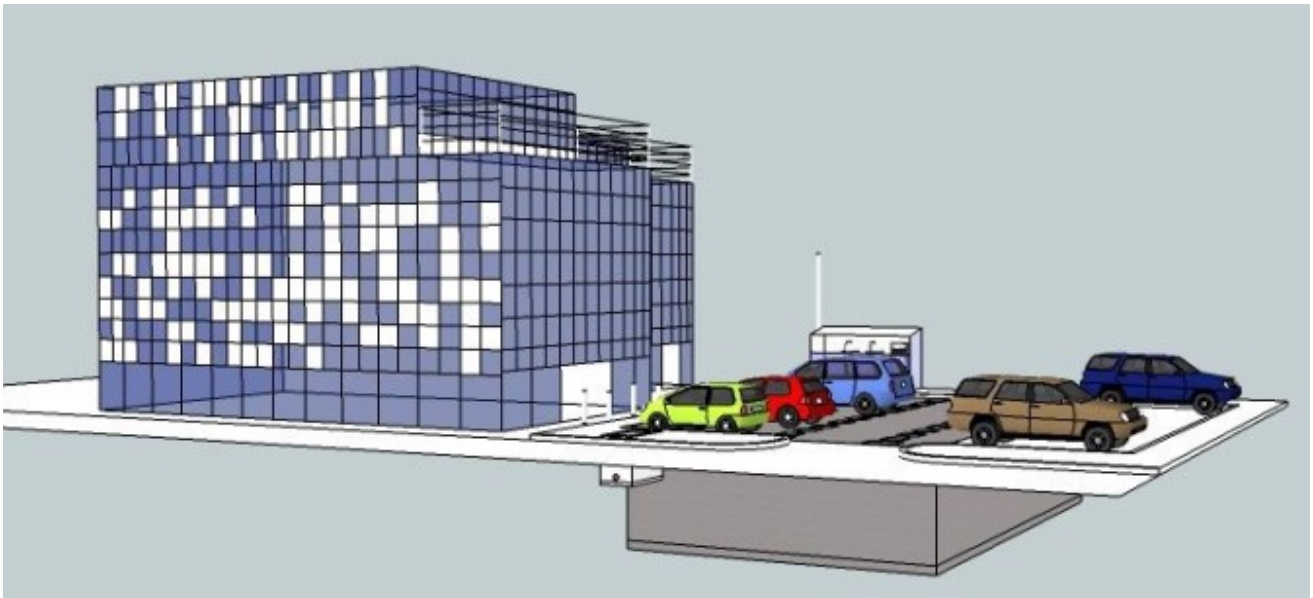


Fig. 5, AD Tank, Oxidation Tank & Final Treated Water Tank can be located below car park.

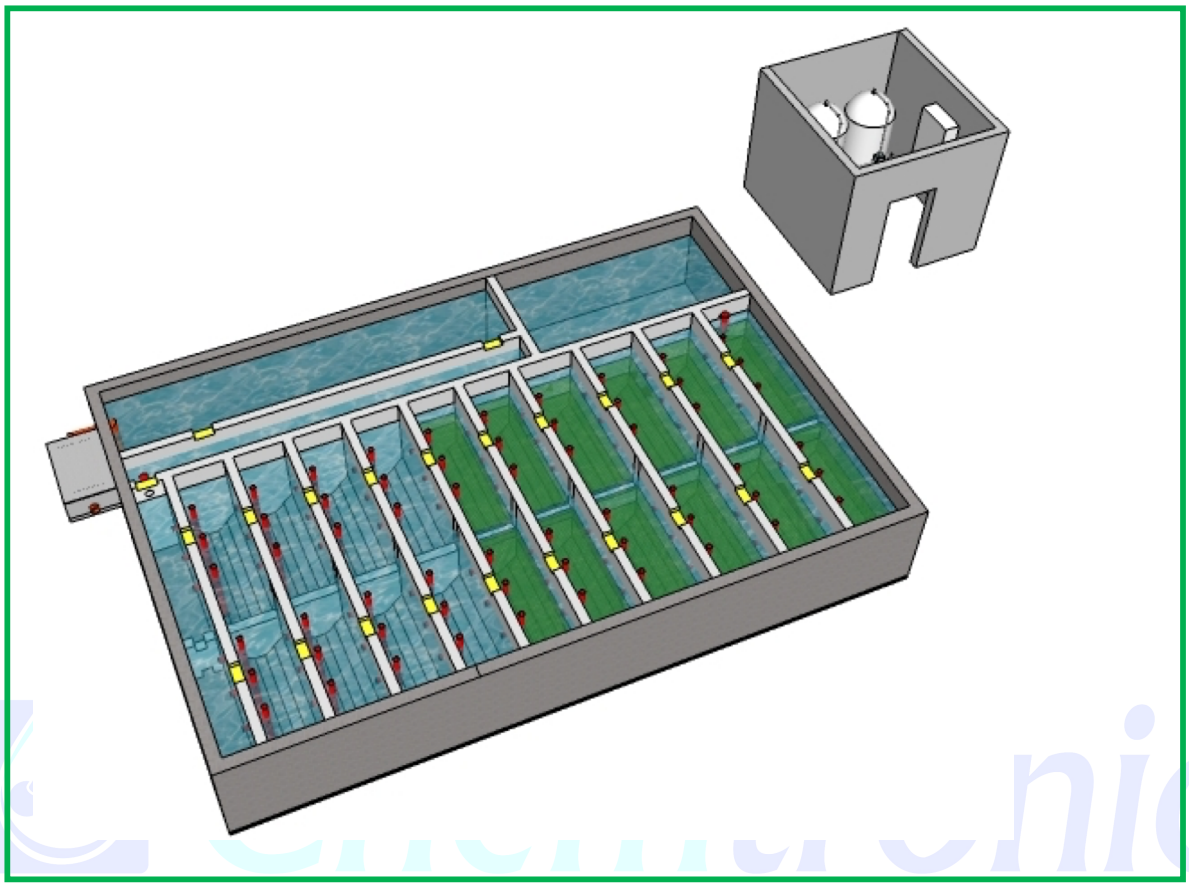
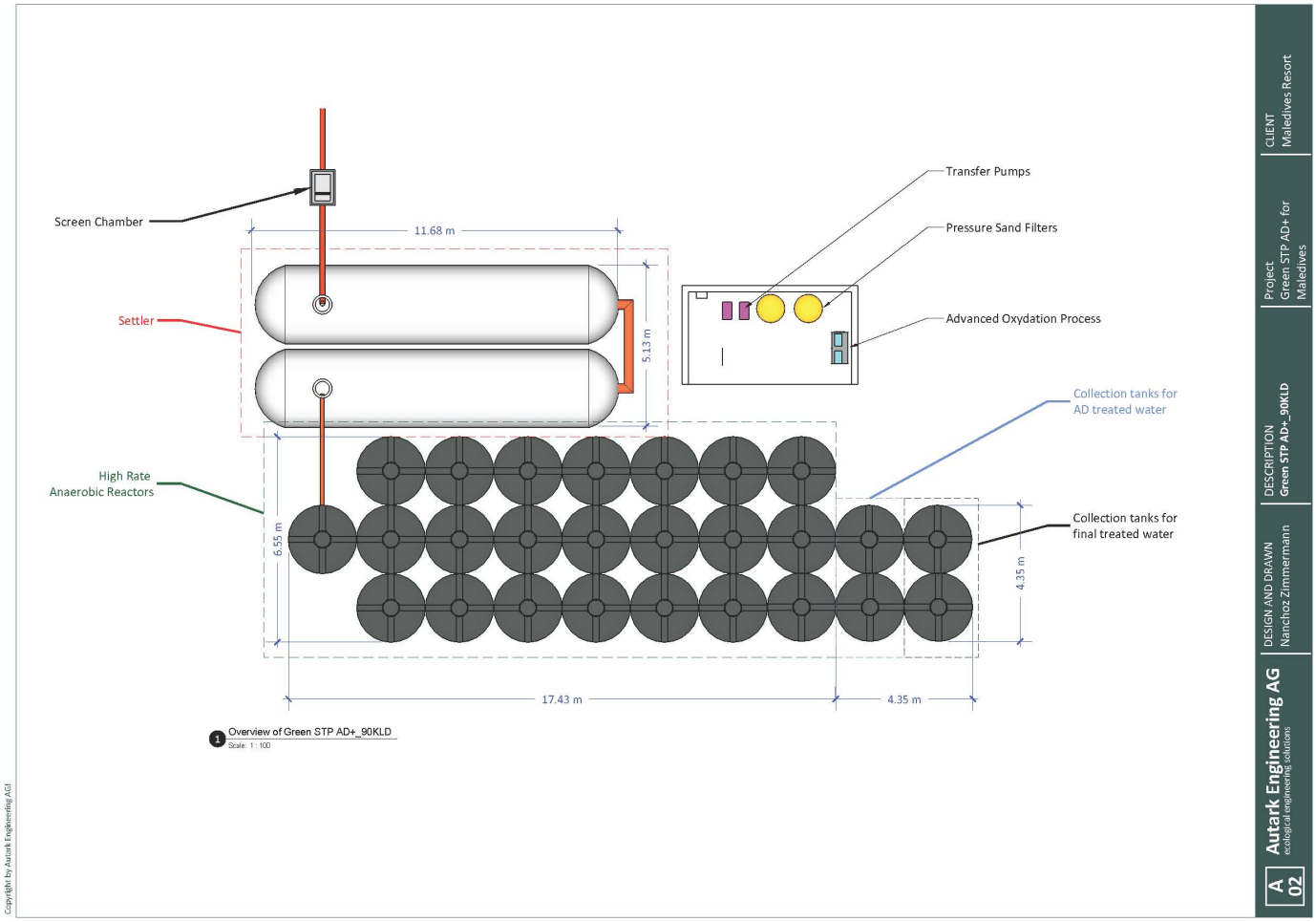


Fig. 6, AD Tank, Oxidation Tank, Final Treated Water Tank & Plant Room.

AD Tank	:	Under Ground / Above Ground	:	250 m2 [Area] X 3.0 m [Depth]
Oxidation Tank	:	Under Ground / Above Ground	:	10 m2 [Area] X 3.0 m [Depth]
Treated Water Tank	:	Under Ground / Above Ground	:	10 m2 [Area] X 3.0 m [Depth]
Plant Room	:	Above Ground	:	15 m2 [Area] X 3.0 m [Depth]
Total Area Required:		**Under Ground / Above Ground**	:	**285 m2 [Area] x 3.0 m [Depth]**

Option 2 – Pre-fabricated Construction



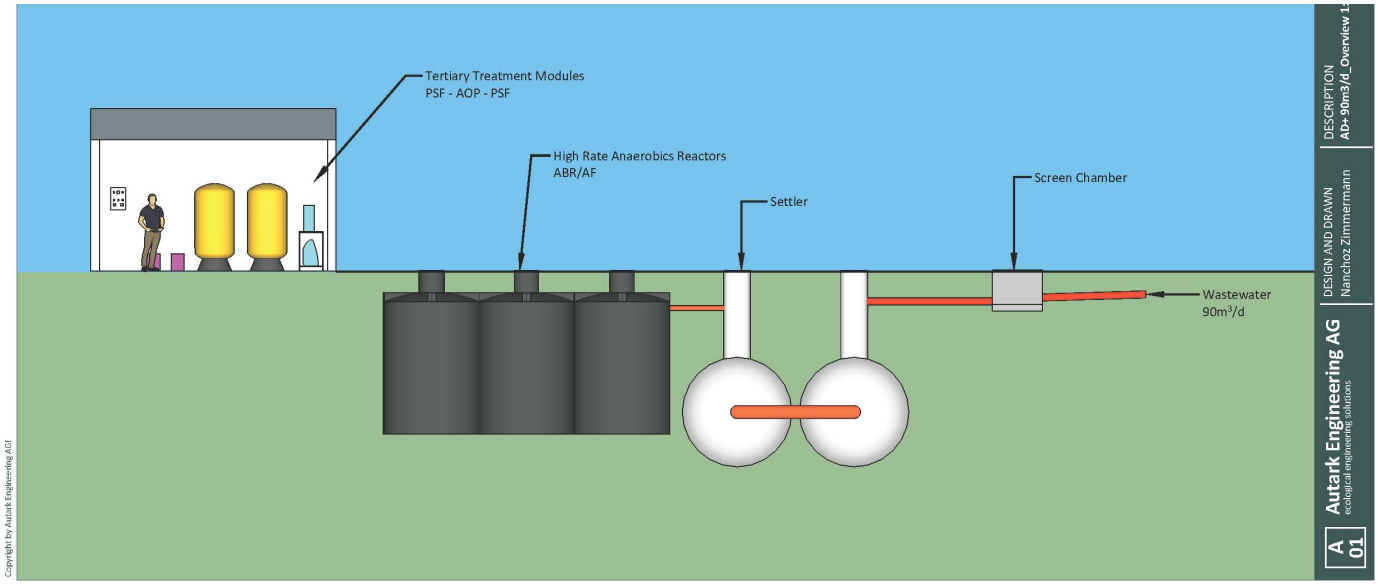


Fig. 7, Pre-fabricated AD Tank, Oxidation Tank, Final Treated Water Tank & Plant Room.

Foot Print – Equipment

AD Tank	**:**	**Above or Below Ground**	**:**	**285 – 300 m2 x 3.0 m [Ht/depth]**
Plant Room	**:**	**Above Ground**	**:**	**15 – 18 m2 x 3.0 m [Height]**

Power Rating

ABR + AF	:	0.0 Kw
Tertiary Treatment	:	1.0 Kw
Ozonation	:	1.6 Kw
Total Power Rating	**:**	**2.6 Kw**

Reclaim Efficiency

Treated Water Quantity	:	90 KLD	:	95 – 97 % Recovery
Biogas Production	:	5.0 m3/day	:	Electricity of 10 kw/day *

*at 50 % efficiency.

Life spane

AD Tank – Core Treatment	:	50 Years
Tertiary Treatment	:	50 Years
Ozonation Plant	:	20 Years

Operation & Maintenance

In AD tank waste water flows naturally by gravity. Tertiary treatment & disinfection process is automatic and does not require any operator. Only a part time non-technical operator is required for general supervision & log keeping. Sludge management is also minimal & does not demand for frequent sludge handling.

Maintenance & Replacement Frequency

Sludge Monitoring	:	Once in 6 Months		
Sludge inspection	:	Once in 6 Months		
Sludge Maintenance	:	Settler	:	Once in a Year
		ABR/AF	:	Once in 3-4 Years

Consumables

Chemicals

No Consumable chemicals are required.

Man Power

Non-technical operator is required for part time. : 1 hr/day

Electricity

Basic Sewage treatment plant	: 24 units/day	: 0.27 Kw/m3
Ozonation	: 38 units/day	: 0.42 Kw/m3
Total	: 62 units/day	: 0.69 Kw/m3

Spares

ABR & AF	:	No spares		
Tertiary Treatment	:	Filtering Media	:	50 Years
Ozone Generator	:	Ozone Cell	:	2 Years
Oxygen Generator	:	Molecular Selves	:	2 Years

Annual Maintenance Contract

Annual maintenance contract is available post hand over during warranty period & post warranty, for rest of plant life.

Capital Cost

Option 1 – Civic Construction

Civil Tank Construction	**:**	**Clients Scope – Chemtronics will provide dimensional drawing**
Equipment Supply	**:**	**USD 30,000**
Installation & Commissioning	**:**	**USD 500 per day per person** + To & fro Air fare + Local Conveyance + Food + Accommodation
Estimated time for I & C	:	Ad Tank - 2 persons - 10 days Equipment - 2 persons - 6 days Inoculation – 2 persons - 6 days **Total - 2 persons – 22 – 25 days**
Equipment delivery	**:**	**8 – 10 weeks**

Option 2 – Pre-fabricated Construction

Prefabricated tanks & Equipment Supply	**:**	**USD 150,000**
Installation & Commissioning	**:**	**USD 500 per day per person** + To & fro Air fare + Local Conveyance + Food + Accommodation
Estimated time for I & C	:	- 2 persons - 10 - 15 days
Tanks & Equipment delivery	**:**	**10 – 12 weeks**