DETAILED PROJECT REPORT

ON

WASTEWATER TREATMENT FOR PURULIA SAINIK SCHOOL

AT PURULIA, WEST BENGAL

PREPARED AND SUBMITTED BY:

ALAKNANDA TECHNOLOGIES PVT. LTD

APRIL – 2022

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1.0 Introduction

A collective questionnaire based due diligence of the desired sites as mentioned above were carried out in order to obtain as much information regarding sites as possible along with existing secondary information provided by the respective authorized personnel of Purulia Sainik School in those areas. primary survey has been undertaken in order to discuss & review the site conditions and assess feasibility of implementation of technology including those of availability of land for project positioning, access potential, flow, invert levels, site options for technology implementation, dimensions of drains and surrounding localities, flow & hydraulics & finally ease of O&M, etc. The following sections attempts to discuss the above mentioned details that shall render an insight to the aspects of Phytorid technology STP implementation at Hostel and mess and the basic computation of dimensions for successful treatment of sewage generating in the campus.

2.0 Location:

Puruliya Sainik School is a residential school established in 1962 in Purulia District West Bengal, India. The Sainik School campus is located away from hustle & bustle of the city life on an area of about 280 acre on Purulia-Ranchi road. Sainik School Purulia is well connected with the different parts of the country both by Rail & Road. The school is 5 km from Purulia Bus Stand and 8 km from Purulia Junction railway station. The school has a helipad of its own. Presently Sainik School Purulia having 550 residential students and 50 teaching and supportive staff.

Key Indicators of Puruliya Sainik School	
Total population: 600 (Student+Staff) Distance from Ranchi: 115 kms	Distance from State Capital (West Bengal):186 Kms Distance from Delhi: 1345 Kms

3.0 Geography:

Purulia has a sub tropical climate nature and is characterized by high evaporation and low precipitation. Temperature is average in summer and low in winter which varies from 2 degrees in winter to 35 degrees in summer. Rainfall defines the climate of the district. South west monsoon is the principal source of rainfall in the district. Average annual rainfall varies between 1100 and 1500 mm. In Purulia, ground surface water contributes to a substantial quantity of water supply and largely being used as drinking water resources. Groundwater level is deep underground in the area.

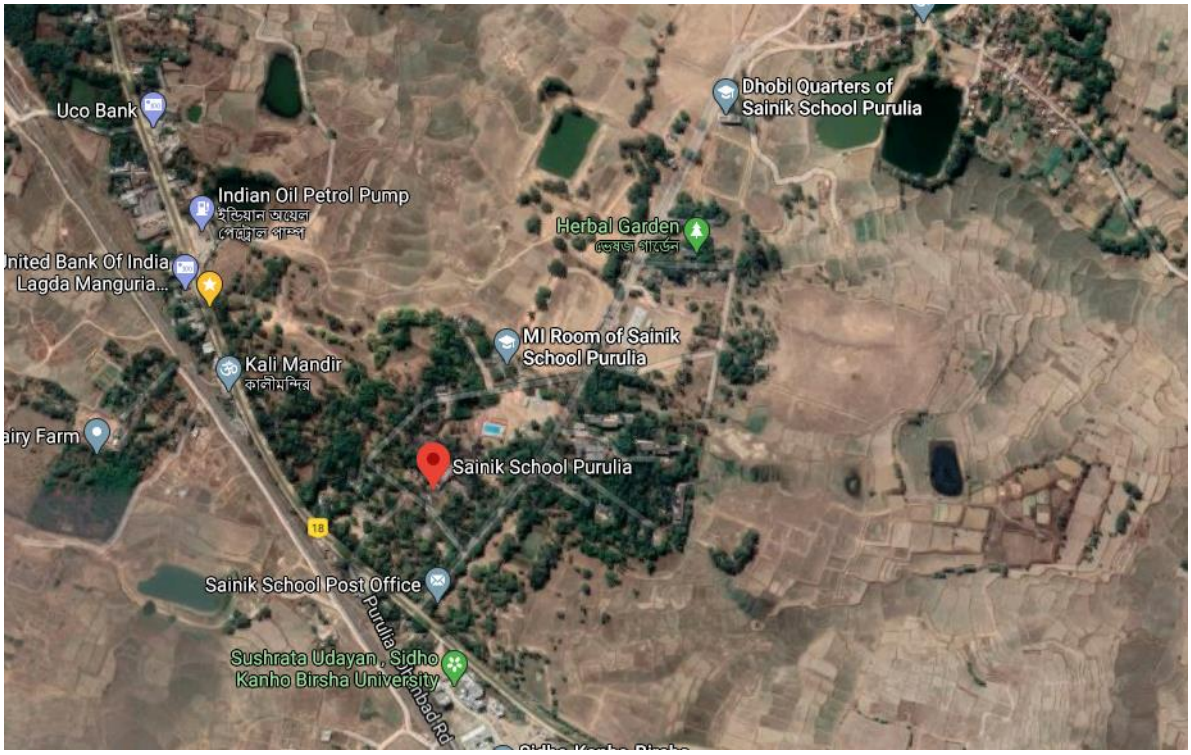


Fig.1 Map of Sainik School Purulia (Source:Google Map)

Latitude: 23°21'24.8"N Longitude: 86°20'26.7"E

2. Existing Liquid Waste Management System

At present, there is a very inconsistent drainage system present in the campus. A majority of the waste water from the buildings in premises to be partially treated with septic tank released onto open land. Due to flow of waste water into open areas, it has become a major source of bad odour, mosquito breeding and disease in the campus.

In the absence of systematic liquid waste handling methods, following issues are being faced:

• The discharges from the toilets/bathrooms are mostly let in the soak pit which are either broken or choked.

• The waste water System provided to treat kitchen and mess water is non-functioning and causing unpleasant smell at location.

The PSC lacks the basic infrastructure of sewage treatment across the whole value chain of LWM. Thus, there is an urgent need to bring in the improved, efficient and sustainable Liquid Waste Management system for clean and green campus as well as there is need to upgrade the waste water treatment system.

3. Proposed Liquid Waste Management System:

The solutions have been proposed based on the inputs given by the PSC and the baseline survey findings and existing situation assessment.
Ideally, domestic waste should be collected and treated within 12 hours‟ intervals every day. If kept beyond 24 hours, it generates unpleasant odours and attracts flies. Beyond 24 hours, foul smell generates and further beyond 48 hours ends up in bad odour and begins to stink and after 72 hours along with the bad odour formation of maggots take place which is the prime reason for nuisance of domestic flies in and outside homes. Treated sewage is to be used for gardening, toilet flushing and agriculture purpose.

a. Sewage generation Locations in Campus:

As listed below, the water is used mainly for WC and bathing purpose. Major of the water use in premises is for hostel buildings and in cadets mess and it is the main source of the sewage generation. Soak pit is provided for each building for Pre-settled effluent from septic tank is discharged to the underground chamber from where it infiltrates into the surrounding soil. There are Total 62 Soke pits available in the campus. Gray water and black water carried in separate lines. As suitable natural slope, gravity and space available for sewage Treatment plant installation, the sewage from the adjacent hostels can be treated combine.

1. Netaji Hostel
2. Tilak Hostel
3. Tagore Hostel
4. Chitranjan Hostel
5. Patel House
6. Mess
7. Office Building.
8. Laundry
9. Sevapuri Staff Quarter

b. Collection of Baseline data:

Fig.2 Sewage sample collection and Testing at site.

Fig.3 Soil sample collection at site.

c. Wastewater Characterization:

Sewage water samples are collected from different location for analysis and there results are as follow;

1) Raw sewage parameters before treatment:

Sr. No	Sample	pH	Temp	Conductivity (s/mm)	Total Solids Mg/l	BOD (5 Day@20 C) Mg/l	COD Mg/l
1	Netaji Hostel	7.68	29.32	395	6000	73	184
2	Chitranjan and Tilak Hostel	7.46	29.2	410	5000	75	164
3	Tagore and Patel house	7.63	29.8	370	5000	88	202
4	Cadets Mess	8.27	29.5	325.5	3500	90	220
5	Sevapuri Staff Quarters	6.77	-	516.8	7500	135	310

2) The average Effluent parameters considered for design STP are as follow:

Sr. No	Parameter	Standards
1	pH	5.5 – 9
2	Bio-chemical Oxygen Demand (BOD)	250-350 mg/l
3	Chemical Oxygen Demand (COD)	400-500 mg/l
4	Total Suspended solids (TSS)	200-430 mg/l
5	E-Coli	6x10^7

3) The Treated sewage parameters after Phytorid treatment:

Sr. No	Parameter	Standards
1	pH	6.5 – 9
2	Bio-chemical Oxygen Demand (BOD)	<10
3	Total Suspended solids (TSS)	<20
4	Chemical Oxygen Demand (COD)	<50
5	Nitrogen Total	<10
6	Phosphorus	1.0
7	Oil and grease	<10
8	F-Coli (MPN/100 ml)	10,000

d. Sewage Treatment Plant Capacity Calculation:

The flow of sewage generation is considered as per CPHEEO manual (GOI) guidelines and also verified with actual water supplied. The sewage quantity considered is 80% of the water supplied. The calculated STP capacities are as listed below;

Sr. No	Name of Hostel	Student's residing (Nos)	Flow (KLD)	Area Required (Approx)
1	Netaji Hostel	115	13 KLD	20 Sqm.
2	Chitranjan and Tilak Hostel*	100+104=204	22 KLD	30 Sqm.
3	Tagore and Patel house* (only for grey water)	104+225=329	21 KLD	30 Sqm.
4	Patel House (Only Black Water)	125	5 KLD	12 Sqm.
5	Cadet Mess	600	25 KLD	40 Sqm.
6	Sevapuri Staff Quarters	-	12 KLD	20 Sqm

*Note: *sewage to be treated in combine at nearby location.*

e. Proposed Locations for Treatment Plant:

1. **Netaji Hostel: (13 KLD)**

Fig.4 Proposed Location for treatment plant

Area required: 20 Sqm (Approx.)

Treatment unit Sizes:

Screen Chamber:0.8x0.6x0.8m

Sedimentation Tank: 1.6x2.5x2.5m

Phytorid Bed: 4.5x2.5x2.5m

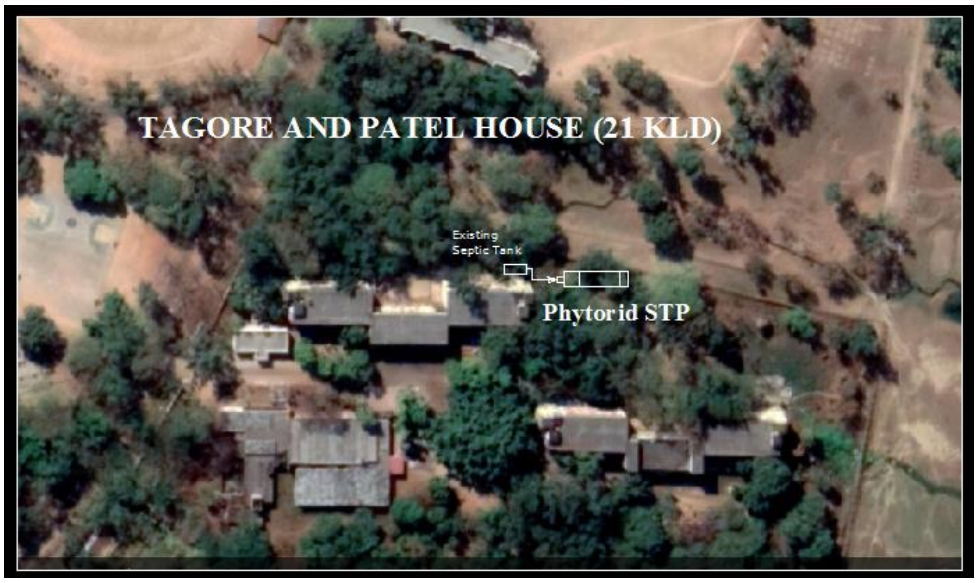
Treated water Tank: 1x2.5x2.5m2.

2. **Chitranjan and tilak Hostel (22 KLD)**

Area required: 30 Sqm (Approx.)

Treatment unit Sizes:
Screen Chamber:1.2x0.8x1.0 m
Sedimentation Tank: 2.6x2.5x2.7m
Phytorid Bed: 7x2.5x2.5m
Treated water Tank: 1.5x2.5x2.5m

3. Tagore and Patel house



Area required: 30 Sqm (Approx.)
Treatment unit Sizes:
Screen Chamber:1.2x0.8x1.0 m
Sedimentation Tank: 2.5x2.5x2.7m
Phytorid Bed: 6.5x2.5x2.5m
Treated water Tank: 1.5x2.5x2.5m

4. Patel House

Area required: 12 Sqm (Approx.)
Treatment unit Sizes:
Screen Chamber:0.8x0.6x0.8m
Sedimentation Tank: 1.8x2.0x2.25m
Phytorid Bed: 3x2x2m
Treated water Tank: 1x2x2m

5. Cadets Mess

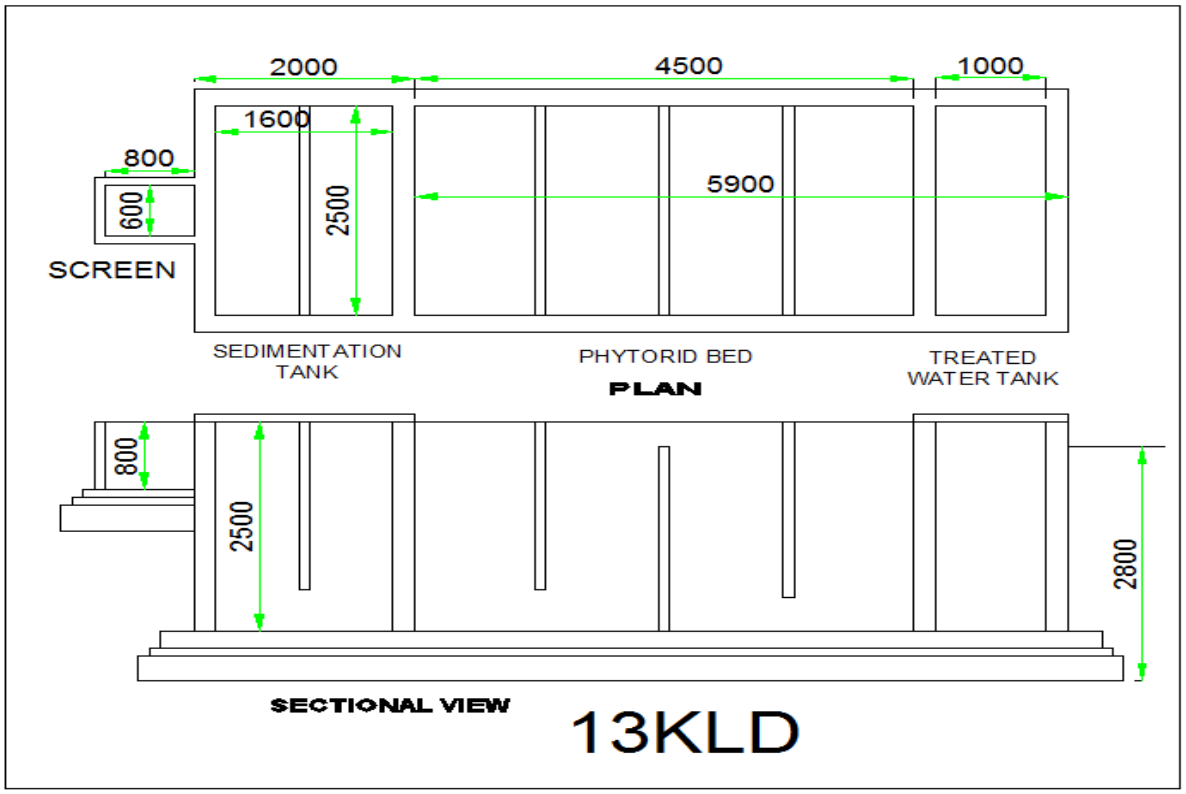
Area required: 40 Sqm (Approx.)
Treatment unit Sizes:
Screen Chamber:1.2x0.8x1.0m
Sump pit: 1.5x2.6x2.7m
Sedimentation Tank: 3.5x2.6x2.7
Phytorid Bed: 7.6x2.6x2.5m
Treated water Tank: 1.6x2.6x2.5m

6. Staff Quarters (12 KLD)

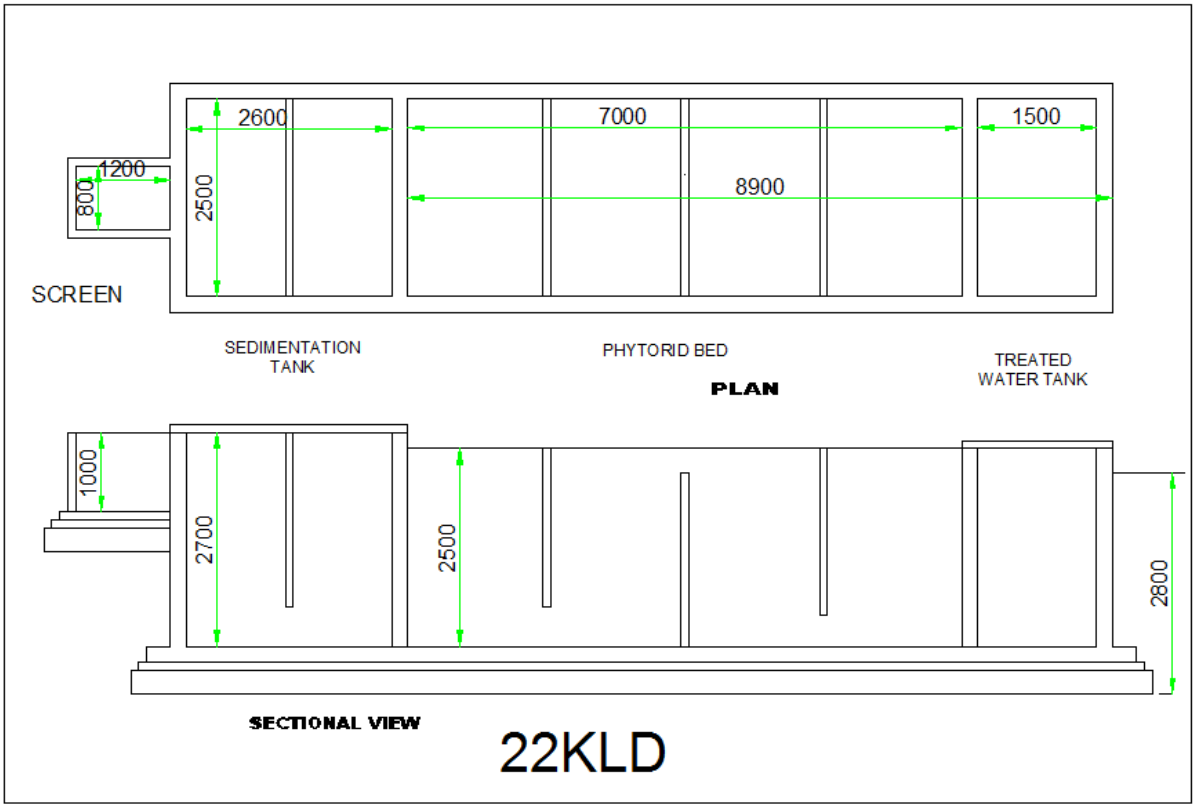
Area required: 20 Sqm (Approx.)
Treatment unit Sizes:
Screen Chamber:0.8x0.6x0.8m
Sedinentation Tank: 1.8x2.5x2.5m
Phytorid Bed: 4.5x2.5x2.5m
Treated water Tank: 1x2.5x2.5m2.

4. General Conceptual Layout of Phytorid STP plant:

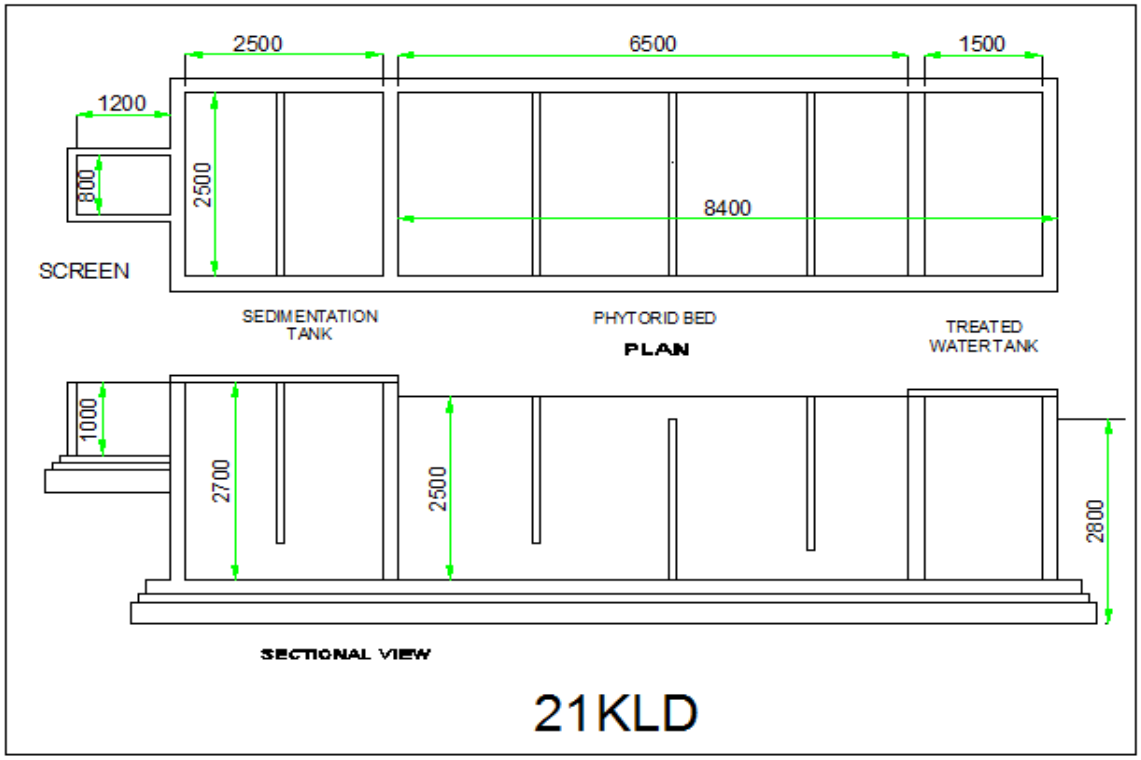
1.Netaji Hostel



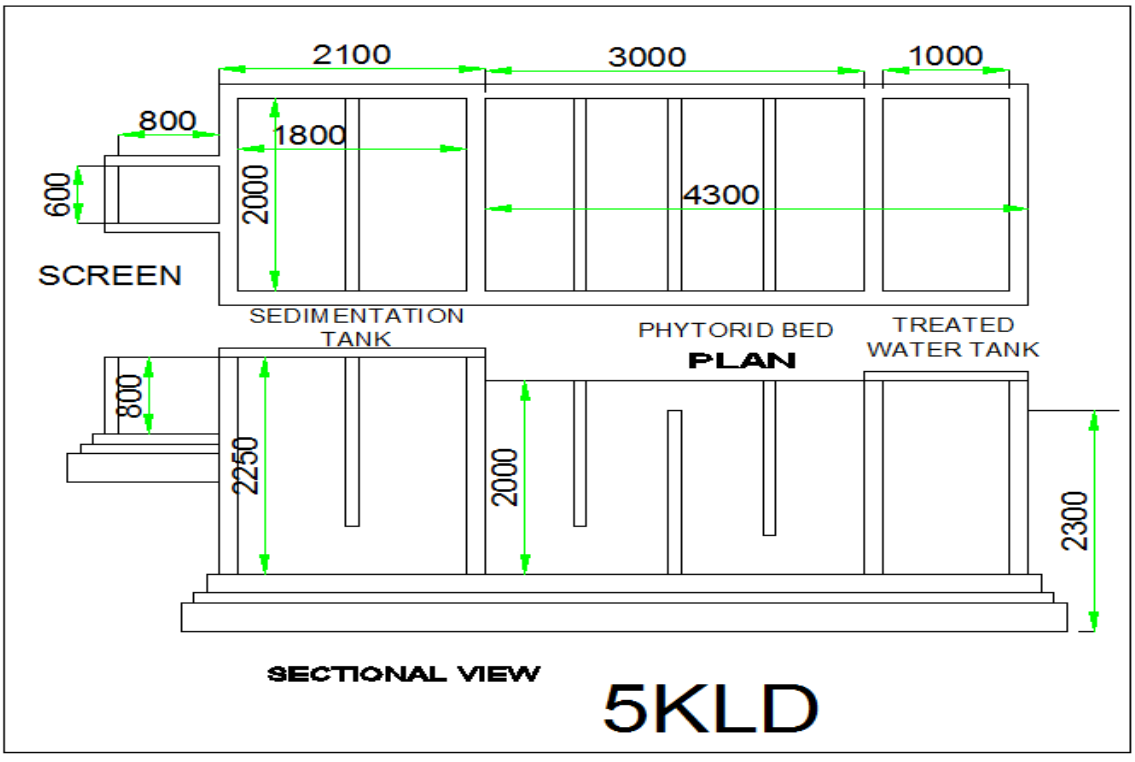
2. Chitranjan and tilak Hostel



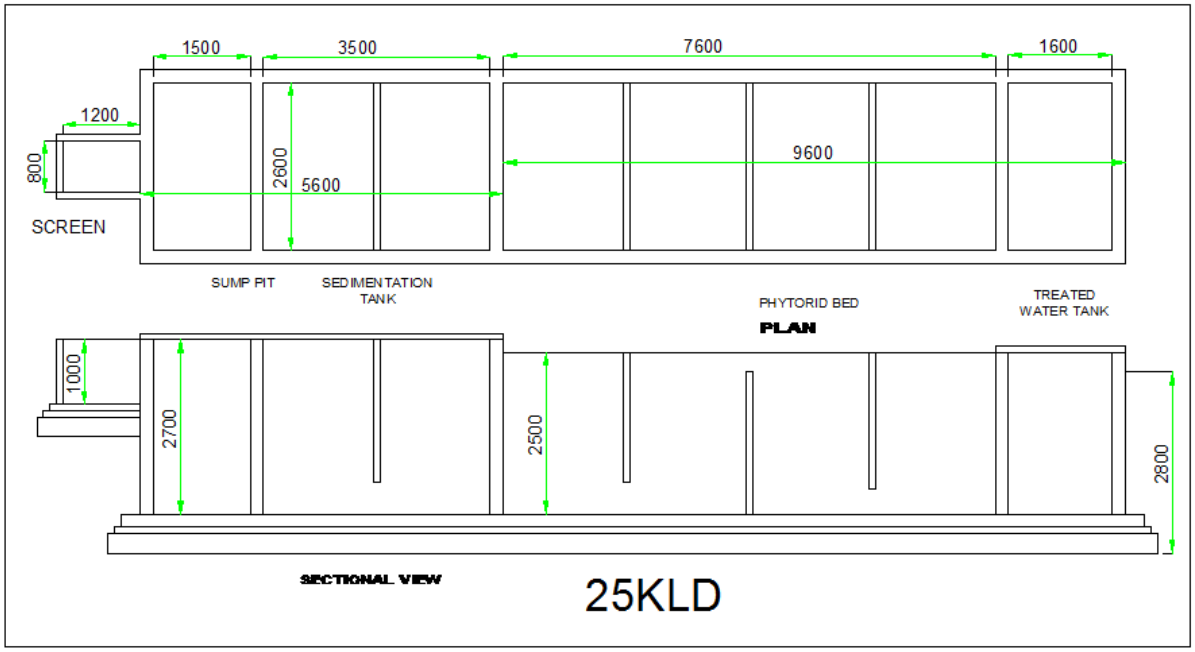
3. Tagore and Patel house



4. Patel House



5. Cadets Mess



6. Staff Quarter

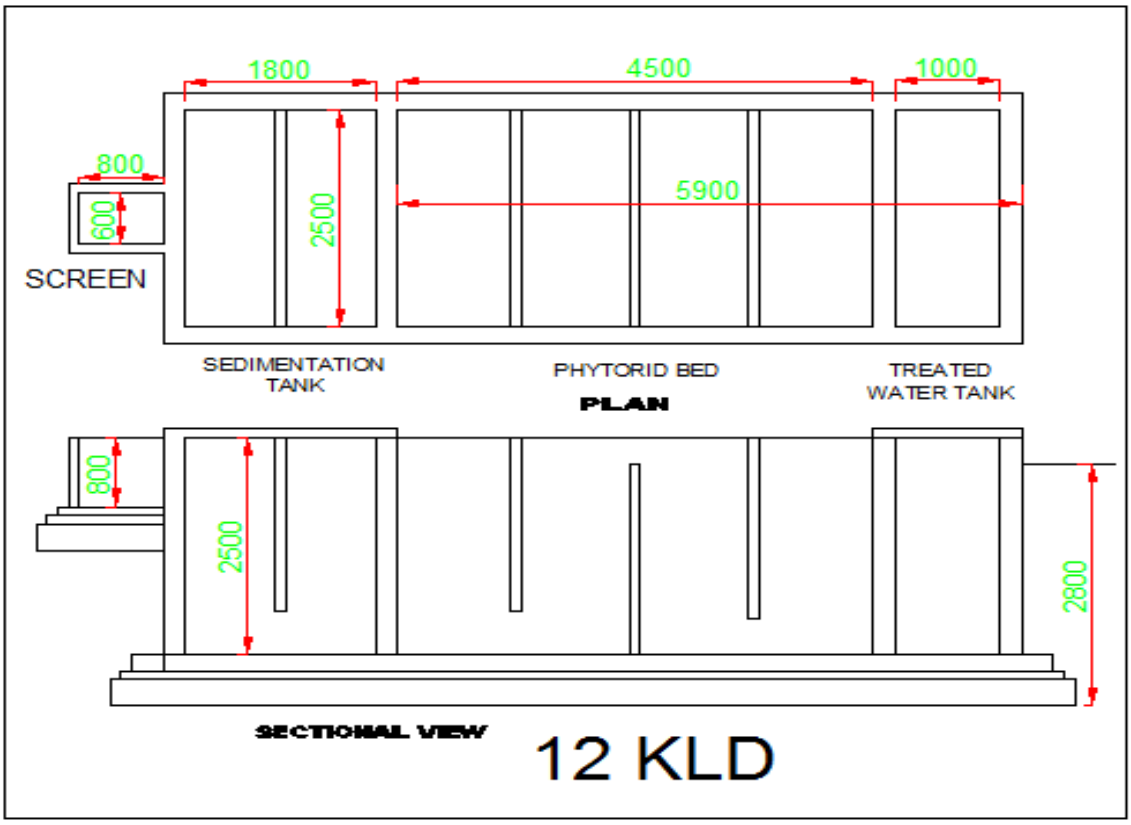


Fig.5 Conceptual layouts of phytorid treatment

5.0 About Phytorid Treatment Technology:

Introduction

Phytorid Technology is a self-sustaining technology developed by National Environmental Engineering Research Institute (NEERI), CSIR that works on the principles of **natural wetland**. It has been developed and **patented by CSIR-National Environmental Engineering Research Institute (CSIR-NEERI)**. The patent awarded is European Patent Office (EPO) Pub. No.: WO2004087584, Pub. Date: 14.10.2004, Australian Patent Office (APO) Pub. No.: AU2003223110, Pub. Date: 25.10.2004 and **Indian Patent Office (IPO) 0010NF2003/IN Pub. No.: 241523, Pub. Date: 09/07/2010**. This technology has obtained authorization from the Council of Scientific and Industrial Research.

The PHYTORID system based on natural treatment method has distinct advantages over conventional treatment plant. The technology is recommended for decentralized plants with varying capacities of m^3/day to MLD. In this technology, treatment occurs via natural methods such as filtration, sedimentation and nutrient uptake by plants and microbial action in a constructed system which is filled with gravel. Specifically identified different species of plants which are known to have good nutrient uptake rates are planted in the gravel bed.

The system includes screen chamber, collection cum sedimentation, Phytorid bed and treated water tank. The complete schematic is shown in Figure 1 and the cross-sectional view of Phytorid treatment system is shown in Figure 2. Wastewater from screening chamber flows into primary settling chamber by gravity. Solids are separated in the settling chamber by gravity and digested in anaerobic manner. Next bed is called Phytorid bed and is the heart of the system. Wastewater from primary settling chamber further flows into Phytorid bed by gravity. Phytorid bed is provided with different gradation of gravels/stone aggregate and hydrophytic plants. The Phytorid bed is divided into compartment with baffles provided in such a way that the flow of wastewater is in a sinusoidal manner. This unique design provides both the anaerobic and aerobic zones in the same Phytorid bed. Aerobic zone is near roots of the plants, as plants transport oxygen from air to the roots and in-turn into water for biochemical oxidation. A specially designed culture media helps in carrying biochemical oxidation in the Phytorid bed. The flow of sewage is 6 inch below the gravel top layer and therefore no sewage is exposed, thereby avoiding mosquito problems.

The plant species in the Phytorid system uptake nitrates and phosphates from the wastewater. Due to several passages through gravel beds with both aerobic and anaerobic zones, faecal coliform is also reduced by more than 95%. Treated water flows into a final storage tank by

gravity and the water quality meets the norms of reuse for irrigation, flushing etc.

Process Flow Diagram:

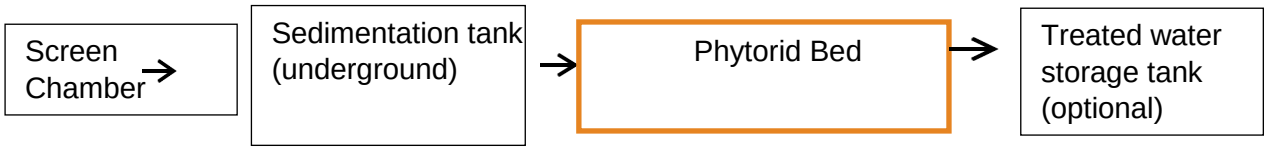


Figure 6: General Phytorid wastewater treatment plant layout

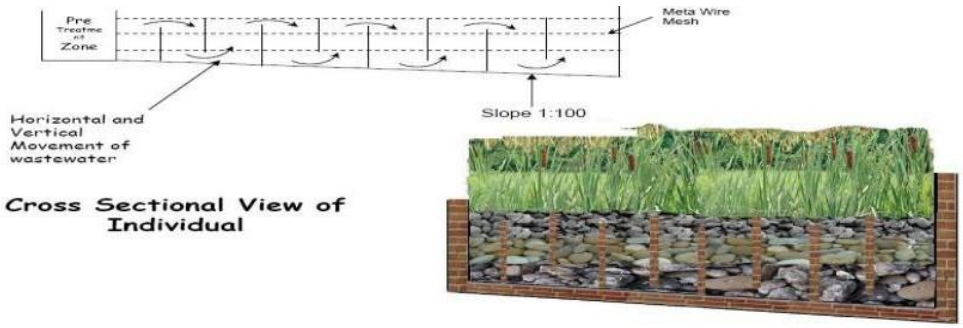


Figure 7 : Cross Sectional View of Phytorid Treatment System

Removal mechanisms in Phytorid system:

Constitution of wastewater	Removal mechanisms
BOD (Biodegradable Organics)	Bioconversion by facultative and anaerobic bacteria on plant and debris surface
Suspended solids	Filtration, Sedimentation
Nitrogen	Nitrification/de-nitrification, plant uptake, volatilization
Phosphorous	Filtration, media sorption, precipitation take place plant uptake
Heavy Metals	Adsorption of plant and debris surface sedimentation
Trace organics	Adsorption, Biodegradation
Pathogens	Natural decay, perdition, sedimentation, exertion of antibiotics from roots of plants

Objective:

The main objective of the proposed wastewater treatment is to provide a simple, feasible, eco-friendly and cost-effective technology. The proposed technology has negligible operation and maintenance costs.

The technology has following key features:

- Being based on natural treatment process, external source of aeration is not required, hence negligible consumption of electric power.
- The technology is very simple in design and operation therefore needs no skilled manpower for operation and maintenance.
- The system has an aesthetic aura because of plants (ornamental as well as flowering) and subsurface flow of water.
- The production of sludge is negligible with no odour issues.
- The Phytorid bed is custom designed as per the land availability.
- There is no any application of chemicals for treatment process.

Building and equipment components for Phytorid based wastewater treatment technology:

Phytorid unit is essentially a civil structure. It comprises of screen chambers, collection chamber, Phytorid bed, treated water tank.

a. **Screen Chamber:** Raw water consists of coarse and fine solid particles, to remove that by using bar screens of 5 mm and 3 mm aperture size for coarse and fine particles respectively.

b. **Collection cum Sedimentation Tank**: The collection cum sedimentation system is specified design allows suspended solids to settle down in the tank and simultaneous removal of BOD by more than fifty percent.

c. **Phytorid Treatment Unit:** The Phytorid bed works on the principle of aerobic treatment. In this unit the bed is filled with different size gravels and wetland plants such as *Colocasiaesculenta, Canna indica, Cyperusalternifolius*, etc.

d. **Treated Water Collection Tank:** It is the collection tank for water coming from the planted bed after treatment.

5. Cost Estimation:

Consultant's Scope of Work

Sr. No.	Scope	Specifications
1	Site Selection and Feasibility of Treatment Unit	• Site selection • Pre-Feasibility study
2	Designing	• Conceptual design • Architectural design • Detailed engineering structural drawing • Design approval from NEERI
3	Plant Species	• Selection and procuring plants based on availability of local wetland plants. • Transportation and labour requirement for plantation. • Acclimatisation of plants
4	Bio-media Application	• Bio-media application to provide growth Supplements for the proper growth and development of the plants on gravel bed.
5	Electro Mechanical Equipment	• Inlet Screen • Inlet Pump as per requirement • Tertiary Treatment (PSF, ACF and Chlorination units) in FRP. Feed pump, carbon sand media, interconnecting piping, with material and installation etc all.
6	Overall Supervision	• Overall supervision till the commissioning

A. Consultancy charges:

Sr. No.	Description	Service Charges*
1	**Patel House - 5 KLD**	**1,90,00**
2	**Sevapuri Staff Quarter – 12 KLD**	**4,50,000**
3	**Netaji Hostel -13 KLD**	**4,70,000**
4	**Tagore and Patel house – 21 KLD**	**5,40,000**
5	**Chitranjan and Tilak Hostel – 22 KLD**	**5,60,000**
6	**Cadets Mess – 25 KLD**	**6,25,000**
	GRAND TOTAL (Rs):	**28,35,000**

*Excluding all applicable taxes

B. Construction/Civil Work Charges:

Sr. No.	Item	Specifications	Service Charge*
1	Civil Work	Construction of RCC tanks for Phytorid system as per NEERI approved design inclusive of carriage, labour and material (Civil cost may vary as per site condition) RCC work of following STP Plants for locations:-	
	1	**Patel House - 5 KLD**	**3,70,000**
	2	**Sevapuri Staff Quarter – 12 KLD**	**9,00,000**
	3	**Netaji Hostel -13 KLD**	**9,20,000**
	4	**Tagore and Patel house – 21 KLD**	**11,50,000**
	5	**Chitranjan and Tilak Hostel – 22 KLD**	**11,80,000**
	6	**Cadets Mess – 25 KLD**	**13,10,000**
		TOTAL	**58,30,000**

*Excluding all applicable taxes

GRAND TOTAL:

Sr. No.	Items	Service Charge*
1	**A. Consultancy charges**	**28,35,000**
2	**B. Construction/Civil Work Charges**	**58,30,000**
	TOTAL (Rs):	**86,65,000**

*Excluding all applicable taxes

Note: Price may vary as per site condition.