Sustainable Living Inc

ANUBOSE INSTITUTE OF TECHNOLOGY
New Paloncha, Telangana
Approved by AICTE, Affiliated to JNTUH

Environmental Audit (Water and Waste Management)

Acknowledgment

Sustainable Living Inc

Hiran Prashanth
Environmental Sustainability Auditor

02 September 2022

Environmental Audit at AnuBose Institute of Technology (ABIT)

The Sustainable Living Inc acknowledges with thanks the cooperation extended to our team for completing the study at AnuBose Institute of Technology (ABIT).

The interactions and deliberations with ABIT team were exemplary and the whole exercise was thoroughly a rewarding experience for us. We deeply appreciate the interest, enthusiasm, and commitment of ABIT team towards environmental sustainability.

We are sure that the recommendations presented in this report will be implemented and the ABIT team will further improve their environmental performance.

Kind regards,

Yours sincerely,

Hiran Prashanth
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About Auditor

Hiran Prashanth is a sustainability consultant based in London. He has over 15 years of experience in climate change and environmental sustainability. He was working with the Confederation of Indian Industry (CII) before moving to London to pursue a master's degree at King's College, London. He currently advises companies to reach net zero carbon emissions. He works with companies in 12 countries around the world.

Hiran Prashanth has helped more than 150 organizations around the world the achieve carbon neutrality. Apart from carbon neutrality, Hiran Prashanth has also facilitated organizations to achieve net-zero energy, water neutrality, and zero waste to landfill. He has audited more than 500 companies for their sustainability performance.

Hiran Prashanth was awarded the 'Best Sustainability Assessor' by the Honorable Minister for HRD, Mr. Prakash Javadekar. Hiran Prashanth is a CII certified carbon footprint expert and a resource efficiency expert. He has trained more than 1000 industry personnel across the world on climate change and sustainability. He is a guest a faculty at IIM Lucknow and SIBM, Pune. His credentials can be found on Hiran Prashanth | LinkedIn. Sustainable Living Inc provides services on carbon footprint, energy audit, resource management and embodied carbon.

Executive Summary

The growth of countries across the world is leading to increased consumption of natural resources. There is an urgent need to establish environmental sustainability in every activity we do. In a modern economy, environmental sustainability will play a critical role in the very existence of an organization.

An educational institution is no different. Built environment, especially an educational institution, has a considerable footprint on the environment. Impact on the environment due to energy consumption, water usage and waste generation in an educational institute is prominent. Therefore, there is an imminent need to reduce the overall environmental footprint of the institution.

As an Institution of higher learning, AnuBose Institute of Technology(ABIT) firmly believes that there is an urgent need to address the environmental challenges and improve their environmental footprint.

True to its belief, ABIT has implemented rainwater harvesting in the campus. Continuing with rainwater harvesting, the college can also investigate the following recommendations:

- **Attain water positive status:** ABIT should focus on capturing the harvested rainwater to substitute freshwater consumption, work on sustainable groundwater beyond the fence and create a framework towards attaining water positive status over a period. Presently, ABIT is consuming nearly 50 KL of fresh water per day. Since metering is not available, the water consumption is calculated rather than measured value.

The first step is to increase the water conservation activities in the campus to reduce water consumption at source. The next step is to increase the rainwater harvesting capacity to completely offset the freshwater requirements of the plant. ABIT can also explore adopting lakes, desilting of ponds and restoration of water bodies in localities surrounding the campus. Water getting harvested in those structures can offset the freshwater consumption of the college.

- **Install water efficient fixtures**: The best way to conserve water is at the source. Therefore, ABIT will have to install water efficient fixtures to reduce water consumption. Some of the water efficient fixtures are:
    - Waterless urinals
    - Electronic taps (e-taps)
    - Electronic flush urinals (e-flush)
    - Foam taps
    - Spring loaded push taps
    - Low flush cistern
- **Install water flow meters**: Water flow meters are vital in understating the water consumption patterns of the campus. Presently, the water consumption is calculated rather than being measured. Water flow meters gives an accurate status if water consumption in the campus and from the water consumption values, the roadmap for water conservation activities can be prepared.
- **Segregate waste at source**: ABIT has provided bins for waste collection. ABIT must embark on awareness creation methods to increase the effectiveness of collection and provide more bins for proper waste segregation.
- **Maintenance of waste management yard**: The waste management yard is to be maintained just like raw materials storage room. Waste is nothing but a resource in wrong place. Therefore, by maintaining the waste management yard, quality of wastes can be maintained.

Environmental Audit

ABIT and Sustainable Living Inc are working together to identify opportunities for improvement in water management, and waste management. This report highlights all the potential proposals for improvement through the audit and analysis of the data provided by ABIT for water consumption and waste management. The report details the process conducted for the analysis such as on ground surveys performed for listing the type of water consumers with consumption per year, types of waste generated and disposal mechanisms.

Submission of Documents

Environmental audit at ABIT was carried out with the help data submitted by ABIT team. ABIT team was responsible for collecting all the necessary data and submitting the relevant documents to Sustainable Living Inc for the study.

Preliminary Study

After the receipt of documents, a desktop review of the data for quality check, followed by preliminary study was carried out by Sustainable Living Inc. In case of discrepancy/inadequacy/non-clarity of data, Sustainable Living Inc team got in touch with the ABIT team for clarification/additional information.

Environmental Audit

Data submitted and collected during the visit was used to assess the water and waste management practices of the campus and finally provide necessary recommendation for environmental improvement.

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Note

Environmental audit is based on the data provided by ABIT team. The scope of the study does not include the exclusive verification of various regulatory requirements related to environmental sustainability.

Sustainable Living Inc has the right to recall the study, if it finds (a) major violation in meeting the environmental regulatory requirements by the location and (b) occurrence of major accidents, leading to significant damage to ecology and environment.

Introduction

In addition to energy efficiency, water efficiency and waste management are also critical aspects for educational institutions to consider. Colleges and universities are known for their large-scale operations, which include a significant water and waste output. Therefore, it is essential for institutions to implement water-efficient practices and manage waste effectively to minimize their environmental impact. This report discusses the reasons why water efficiency and waste management are essential for an educational institution.

Water Scarcity and Conservation

Water scarcity is a growing concern, and many regions across the globe are facing water shortages due to climate change and population growth. Educational institutions, as large consumers of water, must take measures to reduce water usage and conserve water. This can include the implementation of low-flow plumbing fixtures, such as faucets, showers, and toilets, which can reduce water usage significantly. Additionally, colleges can promote water conservation by educating their students, faculty, and staff on the importance of water conservation and adopting sustainable practices such as xeriscaping.

Cost Savings

Water costs can represent a significant expense for colleges, and as water prices increase, institutions are facing an increasingly challenging financial landscape. By implementing water-efficient measures, colleges can reduce water consumption and save money. For instance, installing low-flow plumbing fixtures and repairing leaks can significantly reduce water usage in buildings. Additionally, water-efficient landscaping practices, such as using native plants that require less water, can also contribute to water savings.

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Waste Reduction and Recycling

Waste reduction and recycling are critical aspects of waste management that colleges must consider to minimize their environmental impact. Educational institutions generate a significant amount of waste, including paper, plastics, and other materials, which can contribute to greenhouse gas emissions and environmental degradation. By implementing waste reduction and recycling practices, colleges can minimize their waste output and promote sustainability. This can include implementing recycling programs, using composting, and reducing paper usage.

Cost Savings

Waste disposal costs can represent a significant expense for colleges, and as waste disposal prices increase, institutions are facing an increasingly challenging financial landscape. By implementing waste reduction and recycling measures, colleges can reduce waste output and save money on waste disposal costs. For instance, implementing a recycling program can reduce the amount of waste that requires disposal, reducing waste disposal costs.

Sustainability

Sustainability is a critical aspect that colleges must consider to reduce their environmental impact and promote environmental conservation. By promoting water efficiency and waste reduction, colleges can minimize their impact on the environment and contribute towards a sustainable future. Additionally, colleges can adopt sustainable practices such as using recycled materials and reducing waste to reduce their environmental impact. Sustainability has become a significant issue for students, and it can play a critical role in attracting prospective students to colleges.

Education and Awareness

Colleges are responsible for educating and raising awareness among their students, faculty, and staff on water conservation and waste reduction. By promoting water efficiency and waste reduction, colleges can educate individuals on the importance of conserving water, reducing waste, and promoting sustainable practices. Additionally, colleges can encourage students and faculty to adopt sustainable practices such as using reusable water bottles and reducing paper

usage.

Community Engagement

Colleges are an integral part of their communities, and by promoting water efficiency and waste reduction, they can engage with their communities and promote sustainability. This can include implementing community outreach programs, educating the public on the importance of water conservation and waste reduction, and partnering with local organizations to promote sustainable and reduce the environmental footprint of their communities.

Water Conservation

To achieve a water positive status by continuous reduction of freshwater consumption should be the ultimate focus of ABIT. Increased and focused attention should be given to attain water sustainability in future by inculcating the discipline of water conservation.

Fresh water consumption of ABIT : 50 KL per day (KLD) (calculated)

Rainwater harvesting : carried out for roof area

According to the report, 'Water in India: Situation & Prospects', India is the largest consumer of groundwater in the world with an estimated usage of 230 km3 per year. Approximately 60 per cent of the demand from agriculture and irrigation, and about 80 per cent of the domestic water demand, is met through groundwater. As per the Department of Drinking Water and Sanitation nearly 90 per cent of the rural water supply is from groundwater sources. This has led to an increased pressure on aquifers and the resulting hydrological imbalance.

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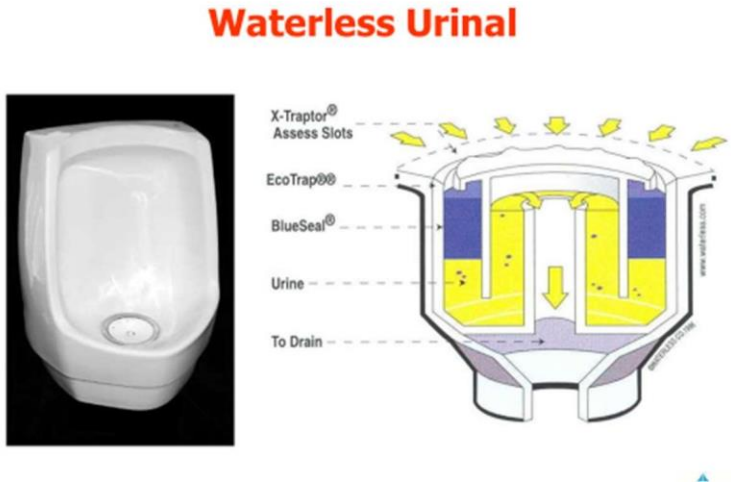
Recommendations for water conservation:

1) Waterless urinals: Waterless urinals look like regular urinals without a pipe for water intake. Men use them normally, but the urinals don't flush. Instead, they drain by gravity. Their outflow pipes conABITt to a building's conventional plumbing system. In other words, unlike a composting toilet, which leaves you to deal with your waste, these urinals send the urine to a water treatment plant.

a. Urine flows into the drain insert of the EcoTrap.
b. Inside of the EcoTrap the urine moves through a floating layer of proprietary immiscible BlueSeal liquid, which creates a barrier, preventing sewer gases and urine odors from entering the restroom area.
c. The urine below the BlueSeal barrier overspills into the central tube and travels down into the drain line.



d. Approximately 1500 sanitary uses are possible with just 3 ounces of BlueSeal. When the BlueSeal liquid is gone, it is simply replenished. This only takes about 20 seconds to perform and the EcoTrap is not touched.

e. Urine sediments are retained within the EcoTrap. Replacement is easy and need only be done 2 to 4 times per year depending on traffic to the urinal. As tool called the X-Traptor must be used to remove the EcoTrap. The use of the sABITial tool helps to minimize vandalism. The entire process of replacement only takes 3 to 4 minutes.

f. Waterless urinals are available for women. Indian manufacturers are supplying waterless urinals technology. Ekameco is one such company providing solution for women waterless urinals. You may visit www.ekameco.com and mail info@ekameco.com for more details on waterless urinals for women.

2) Volume reduction in flush tanks: One simple method is to add a one-liter equivalent water bottle in the flush tank thereby reducing its consumption majorly. One-liter savings in the tank will help to save approximately by 20% and doesn't require any investment.

3) Rainwater harvesting: Water harvesting or more precisely rainwater harvesting is the technique of collection and storage of rainwater at surface or in subsurface aquifer, before it is lost as surface run off. In artificial recharge, the ground water reservoirs are recharged at a rate higher than natural conditions of replenishment.

According to a report by the Central Groundwater Board published in 2007, the selection of a suitable technique for artificial recharge of ground water depends on various factors. They include:

a) Quantum of non-committed surface runoff available

b) Rainfall pattern

c) Land use and vegetation

c) Topography and terrain profile

d) Soil type and soil depth

e) Thickness of weathered / granular zones

f) Hydrological and hydrogeological characteristics

g) Socio-economic conditions and infrastructural facilities available

h) Environmental and ecological impacts of artificial recharge scheme proposed

Rainwater Harvesting Techniques in Urban Area

In urban areas rainwater is available from roof tops of buildings, paved and unpaved areas. This water could be stored and used to replace freshwater as well as used for recharging the aquifer.

4) Display water balance/conservation status at entrance of all blocks for overall involvement of all students & staff

It is suggested to display sABITific water consumption numbers in terms of domestic use at the entrance of each blocks to create awareness among all students and stakeholders visiting the facility. This daily/continuous awareness creation will ultimately help in reduction of water consumption by students.

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Water Saving Gadgets

It is suggested to display sABITific water consumption numbers in terms of domestic use at the entrance of each blocks to create awareness among all students and stakeholders visiting the facility. This

Electronic Taps (e-taps)

The latest trend in industries is to install electronic taps (e-taps). The advantages of using e-taps are as mentioned below:

- Unlike conventional taps, there is no twisting or turning in e-taps. They have a sensor, which cuts off water supply completely when not in use. This helps in saving up to 70% water during hand wash.
- E-taps enable hands free operation. No fear of cross contamination or contact with germs. E taps score very high on hygiene. It is the most ideal choice for multipurpose and multi-user washrooms.
- E-taps can work efficiently up to raw water TDS of 1,800 ppm.
- The touch free electronic taps, available in AC and DC models consume minimal power only. The AC model has an efficient battery back-up, while the DC model runs on just 4 alkaline batteries.

Operation of Electronic Taps

This has been successfully implemented in several hotels & restaurants. Of late, several industries have also started implementing this proposal. Thus, there is a good potential to optimize the freshwater consumption by replacing the existing taps with e-taps.

Electronic flush (e-flush) urinals

The latest trend in industries is to install e-flush urinals. The advantages of using e-flush urinals are as mentioned below:

- E-flush urinals are fitted with a sensor, which senses the usage and flush with water for few seconds after use. This helps in saving 70% water during urinal flush.
- E-flush urinals enable hands-free operation and score very high on hygiene. It is the most ideal choice for multipurpose and multi-user washrooms.
- E-flush urinals can work efficiently up to raw water TDS of 1,800 ppm.
- The touch free e-flush urinals available in AC and DC models consume minimal power only. The AC model has an efficient battery back-up, while the DC model runs on just 4 alkaline batteries.

Photographs: Electronic flush urinals

Hand wash

Foam taps

Conventional taps are used in the hand wash areas which results in wastage of large quantities of fresh water. Foam taps are a better fit in these high consumption areas. They consume 25-30% less water than conventional taps.

Photographs: Foam taps

Spring loaded Push taps

Spring loaded push type tap is an alternate device for minimizing hand wash water. The spring-loaded push taps operate with the simple mechanism of pressing the knob for water. The knob is automatically released back to close position in 5-7 seconds. This saves about 30-40% of water compared to the conventional taps.

Photographs: Spring loaded push taps

Low flush cistern

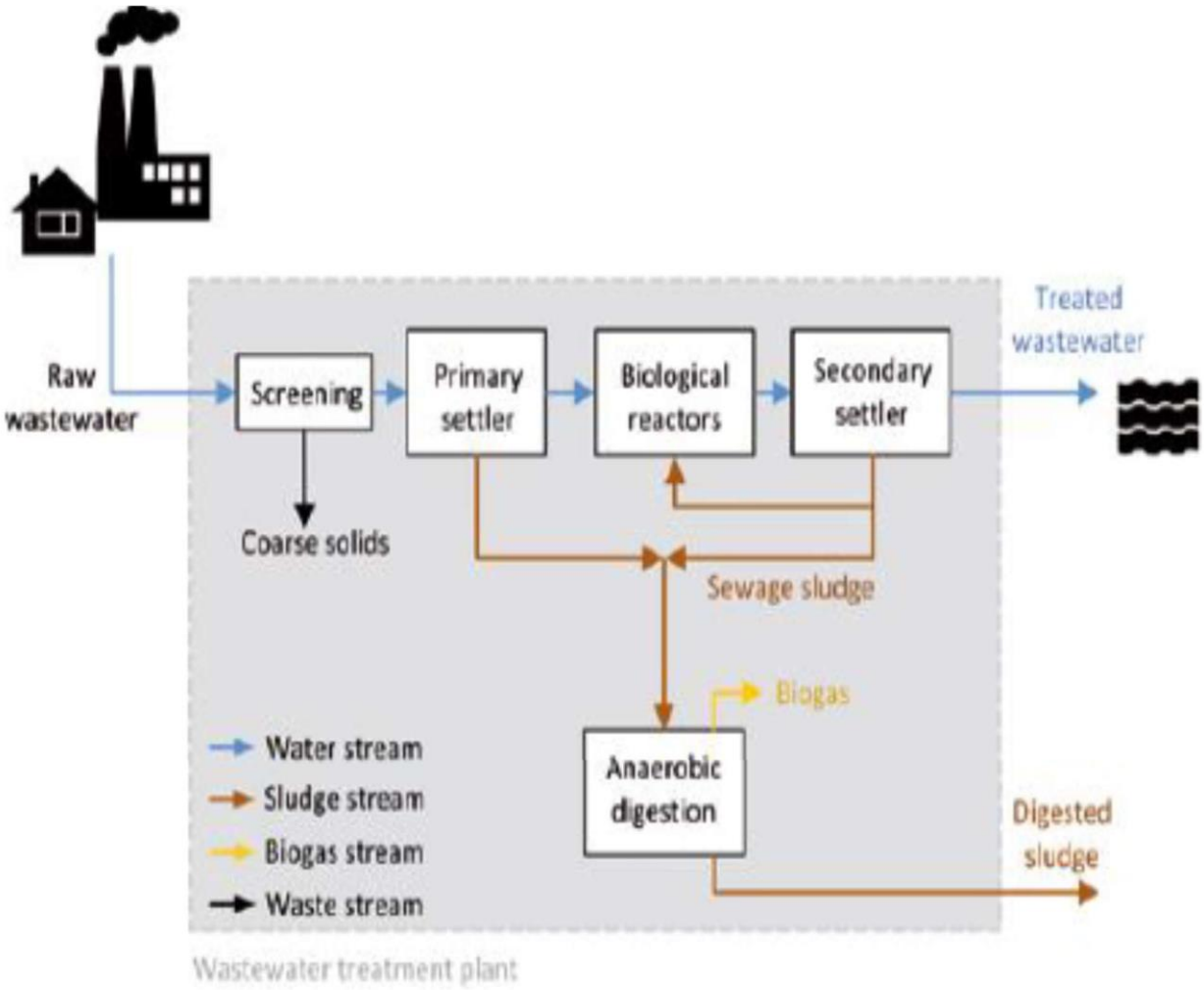
The latest model closets are water efficient and operate in dual mode, with a single flush releasing 2 litres of water and the dual flush releasing 4 litres per flush. This results in excellent water savings.

Photographs: Low flush cisterns

Biogas Production Potential of Wastewater

The sewage water is a useful waster as 1% of it in any quantity is a sludge which when subjected to anaerobic digestion will produce biogas. Wastewater is the effluent from household, commercial establishments and institutions, hospitals, industries and so on. Sewage water source contains large amount of organic material which can be efficiently recovered in as sludge which and when subjected to anaerobic digestion, the sludge produces methane gas (biogas).

Biogas is a mixture of gases containing 50-75% Methane, and 25-50%Carbon dioxide while 0-10% Nitrogen, 0-3% Hydrogen disulphide and 0-2% Hydrogen may be present as impurities which is produced by anaerobic digestion of organic material i.e. a sequential enzymatic breakdown of biodegradable organic material (Biomass) in the absence of oxygen. The process is usually carried out in a digester tank known as biodigester. Biogas is an important energy source used as cooking gas, to generate electricity, etc. thus producing biogas from wastewater is an efficient and sustainable waste management and renewable energy technique. One of the major environmental problems of the world today is waste management and wastewater constitutes a huge environmental problem to the society thus the need for wastewater treatment to recover and also recycle the recovered water for usage.



The physical process: this is the mechanical treatment of the water that involves removal of debris from the raw wastewater right from the point it enters the plant. The screening and primary settling of debris. Wastewater enters the treatment plant through the inlet chamber from where it is channeled to the coarse screen that removes solid waste.

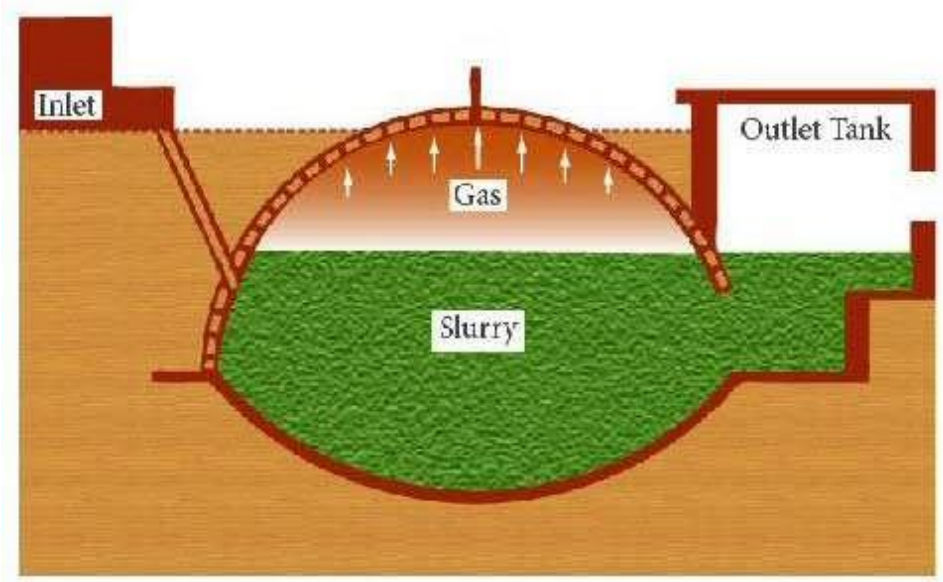
The biological process: this involve the biotreatment of the sewage in the bioreactors. It is the heart of the treatment plant where a biological process takes place. The bioreactors of a treatment plant are usually large tanks consisting of several mammoth rotors and submersible mixers. While the rotor introduces atmospheric oxygen into the sewage, the submersible mixers keep the biomass in suspension thus several reactions takes place in the bioreactors.

From the bioreactor, the sewage enters the sedimentation tank. Here the biological process ends and sludge is separated from water such that the clean water is passed to the disinfection tank for

disinfection and onward discharge for use while the sludge is removed by the returned activation sludge (RAS) pump that removes and sends part to the anaerobic digestion chamber while some are return to the anaerobic bioreactor for reactivation.

Production of biogas is an anaerobic digestion whereby microorganisms break down biodegradable material in the absence of oxygen to produce methane/carbon dioxide used to generate electricity and heat. Sludge from the treatment plant (primary and activated sludge) is the main feedstock (biodegradable organic matter) in the biogas production plant of a wastewater treatment plant and the biogas production process involves series of steps. The combine sludge resulting from primary and secondary water treatment is gathered, sieved and thickened to a dry solids content of up to 7% before entering the digesters. Optionally, the sludge can be pretreated by disintegration technologies with the aim to improve the gas yield. In the anaerobic digestion process, the sludge is pumped into the anaerobic continuously stirred tank reactors where digestion takes place.

In the process, microorganisms break down part of the organic matter that is contained in the sludge and produce biogas, which is composed of methane, carbon dioxide and trace gases. The raw biogas produced is dried and hydrogen sulphide and other trace substances removed and burned in burners after treatment. The digested sludge is dewatered, and the water reintroduce into the treatment plant while the remaining undigested matter used for organic fertilizer.



Rootzone treatment:

Root Zone' is a scientific term used to cover all the biological activity among different types of microbes, the roots of plants, water soil and the sun. It consists planted filter-beds containing gravel, sand and soil. The RZWT system utilises nature's way of biologically processing domestic & industrial effluents. This effective technology called Decentralised Wastewater Systems (DEWATS) was developed in 1970s in Germany and has been successfully implemented in different countries mainly in Europe and America.

The root zone wastewater treatment system makes use of biological and physical-treatment processes to remove pollutants from wastewater. Due to its natural process, there is no need to add any input such as chemicals, mechanical pumps or external energy. This reduces both the maintenance and energy costs.

- To accomplish this, the root zone wastewater treatment undertakes the following steps:
- Pre-treatment done in a Settler – a device that separates the liquid from the solid First treatment takes place in a Anaerobic Baffled Reactor – a device with several identical chambers through which the effluent moves from top to bottom.
- Second treatment happens in an Anaerobic Filter – a device filled with a filter material (cinder), through which the effluent moves from top to bottom.
- Third treatment takes place in a Planted Gravel Filter – a structure filled with gravel material and planted with water-resistant reed plants, which provide oxygen to the passing effluent.

The Root Zone Wastewater Treatment system takes into account the natural slope of the ground, so that water flows from one device to another without any external energy input such

as motor pump. Once the reed plants create an established stand, usually after the first growing season, the reed bed requires little or no maintenance. The plant foliage will soon blend naturally into the landscape, ever changing with the seasons and creating a pleasing sight as well!

Install water flow meter:

Water flow meters are vital in understating the water consumption patterns of the campus. Presently, the water consumption is calculated rather than being measured. Water flow meters gives an accurate status if water consumption in the campus and from the water consumption values, the roadmap for water conservation activities can be prepared.

Water Meters would have many advantages:

- Encourage water conservation – important given strain on water resources
- Encourage allocatively efficient distribution. People would consume to where the marginal cost = marginal utility
- In long term lower overall water consumption would reduce leading to even lower water bills.

Waste Management

Waste management is a critical aspect of environmental conservation, and colleges play a significant role in reducing waste and promoting sustainability. Colleges generate a significant amount of waste, including paper, plastics, and other materials, which can contribute to greenhouse gas emissions and environmental degradation. Therefore, it is essential for colleges to implement waste management practices to reduce waste output and minimize their environmental impact. This report discusses the importance of waste management in colleges.

Environmental Impact

Colleges are responsible for minimizing their environmental impact and promoting environmental conservation. Waste management is a critical aspect of this responsibility, as colleges generate a significant amount of waste that can contribute to environmental degradation. By implementing waste management practices such as recycling, composting, and reducing waste output, colleges can minimize their environmental impact and promote sustainability.

Recycling

Recycling is one of the most effective waste management practices that colleges can implement to minimize their environmental impact. Colleges generate a significant amount of paper, plastics, and other materials, which can be recycled and used again. By implementing a recycling program, colleges can reduce the amount of waste that requires disposal and promote sustainable practices. Additionally, recycling can reduce the energy required to produce new materials, reducing greenhouse gas emissions and contributing to environmental conservation.

Composting

Composting is another effective waste management practice that colleges can implement to minimize their environmental impact. Composting involves the breakdown of organic materials such as food waste and yard waste, resulting in a nutrient-rich soil amendment. By implementing a composting program, colleges can reduce the amount of organic waste that requires disposal and promote sustainable

practices. Additionally, composting can reduce the energy required to produce fertilizers, reducing greenhouse gas emissions and contributing to environmental conservation.

Cost Savings

Waste disposal costs can represent a significant expense for colleges, and as waste disposal prices increase, institutions are facing an increasingly challenging financial landscape. By implementing waste management practices such as recycling and composting, colleges can reduce waste output and save money on waste disposal costs. For instance, implementing a recycling program can reduce the amount of waste that requires disposal, reducing waste disposal costs. Additionally, composting can reduce the amount of organic waste that requires disposal, reducing waste disposal costs further.

Sustainability

Sustainability is a critical asABITt that colleges must consider to reduce their environmental impact and promote environmental conservation. By promoting waste management practices such as recycling and composting, colleges can minimize their impact on the environment and contribute towards a sustainable future. Additionally, colleges can adopt sustainable practices such as using recycled materials and reducing waste to reduce their environmental impact. Sustainability has become a significant issue for students, and it can play a critical role in attracting prosABITtive students to colleges.

Education and Awareness

Colleges are responsible for educating and raising awareness among their students, faculty, and staff on waste reduction and promoting sustainable practices. By promoting waste management practices such as recycling and composting, colleges can educate individuals on the importance of waste reduction and promoting sustainable practices. Additionally, colleges can encourage students and faculty to adopt sustainable practices such as using reusable water bottles and reducing paper usage.

Regulations and Policies

Government regulations and policies are critical in promoting waste management and environmental conservation. Colleges are required to comply with government regulations and policies such as the

Resource Conservation and Recovery Act (RCRA), which regulates the management of hazardous waste. Additionally, the Environmental Protection Agency (EPA) provides guidelines and resources to promote waste reduction and environmental conservation. By complying with these regulations and policies, colleges can reduce their environmental impact and contribute towards a sustainable future.

Community Engagement

Colleges are an integral part of their communities, and by promoting waste management and environmental conservation, they can engage with their communities and promote sustainability. This can include implementing community outreach programs, educating the public on the importance of waste reduction and promoting sustainable practices, and partnering with local organizations to promote sustainable practices.

India has drawn world's attention with its high paced urbanization and industrialization. Over the last decade, India has emerged as the fastest growing country with rapid economic growth. A renewed focus on sustainable growth and development is imperative as India strives to maintain its high GDP growth rate in its pursuit of achieving developed country status by the year 2022. However, the flip side of higher economic growth has resulted in increased consumption of the natural resources, increased waste generation and hence ecological degradation.

Present status: ABIT has initiated waste management activities inside its facility. Separate bins have been provided for different types of wastes. Waste bins are provided throughout the campus and students are being urged to use the bins effectively.

Recommendation: The waste management yard must be maintained in a similar fashion as that of a raw material storage room. Therefore, a total revamp of the waste storage yard is to be carried out. By doing so, the quality of the materials stored in the yard will not deteriorate and can be used a raw material for a subsequent process.

Enhance awareness creation, training and capacity building

ABIT should focus on implementing sustainable waste management practices. ABIT should regularly interact with Pollution Control Board and TSDF operators to enhance knowledge on waste management. The team should also take efforts to communicate the waste management and other policies and activities to all students in the college.

Achieve zero liquid discharge status

ABIT may install a STP to treat and recycle water. The treated water from STP can be used to substitute freshwater by utilizing the treated water in both high end and low-end applications.

Conclusion

Environmental sustainability is a continuous process and there is always a scope for improvement. ABIT has displayed itself as an advocate of environmental sustainability by getting environmental audit carried out. The organization has implemented several initiatives and measures to enhance efficiency and to optimize resource intensity. The journey ahead in the path towards environmental excellence has immense scope for improvement as brought out by this report.

ABIT needs to focus and work on areas efficiency levels needs to be enhanced. For example: waste management. The observations and suggestions put forth by the report would help the facility in improving its environmental performance and pave way for ecologically sustainable growth.

This report may be taken as a guide and roadmap for achieving higher performance rating in environmental stewardship. As one of the pioneers and leaders ABIT shoulder the task of further 'learning – teaching – learning' to improve, excel, and continue the innovative efforts for success of their students and associates.

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Green Landscape Audit

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About Auditor

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The growth of countries across the world is leading to increased consumption of natural resources. There is an urgent need to establish environmental sustainability in every activity we do. In a modern economy, environmental sustainability will play a critical role in the very existence of an organization.

An educational institution is no different. Built environment, especially an educational institution, has a considerable footprint on the environment. Impact on the environment due to energy consumption, water usage and waste generation in an educational institute is prominent. Therefore, there is an imminent need to reduce the overall environmental footprint of the institution.

As an Institution of higher learning, AnuBose Institute of Technology (ABIT) firmly believes that there is an urgent need to address the environmental challenges and improve their environmental footprint.

True to its belief, ABIT maintains an excellent landscaping in its campus. The whole campus is lush green, and trees are seen everywhere around the campus. Sustainable Living Inc congratulates the ABIT team for their wonderful efforts to create a truly green campus.

Based on the data submitted by ABIT team, following improvement opportunities have been identified in the campus in terms of landscaping:

- Implement ecosystem restoration by development of theme gardens in unused areas of the campus
- Develop green corridors between existing areas in the campus
- Develop natural areas to encourage bird roosting and nesting in built-up areas
- Increase tree density and canopy cover in the built-up areas by planting more fruit yielding tree

- Conduct regular flora surveys for improving the existing data
- Develop strategies for regular monitoring & prevention of invasive plant species

By addressing the improvement opportunities, the campus would be able to achieve the following benefits:

- Identifying & implementation of proper measure for conservation of endangered floral species in the campus
- Reduce the microclimate temperature of the campus by 1-2 degrees which is quite significant
- As many of the species have the capability to absorb contaminants in the air and therefore this would lead to better air quality in the campus
- This can evolve as an excellent educational campus for spreading awareness on biodiversity and benefit the nation at large

Introduction

Urbanisation and its effect on loss of biodiversity

Urbanization causes biodiversity to decline. As cities grow vital habitat is destroyed or fragmented into patches not big enough to support complex ecological communities. In the city, species may become endangered or even locally extinct as natural areas are swallowed up by the urban jungle.

Ironically, it is urban growth that is often responsible for the introduction of non-native species, either accidentally or deliberately, for food, pets or for aesthetic reasons.

Documentation of Flora

Knowledge on biodiversity of any geographical region is of paramount importance for sustainable management and conservation plans. The foremost task in the conservation process is to prepare an inventory of species. It is necessary to have full knowledge regarding the habit, habitat, distribution and phenology of various plants for their proper conservation.

The documentation of flora will help in identifying, documenting and promoting the conservation of native flora in India. This in turn will help in promoting native species for landscapes as they suit the growing interest in "low-maintenance" gardening and landscaping.

Many species are vigorous & hard and can survive winter, cold and summer heat. These species, once established, can flourish without irrigation or fertilization and are resistant to most pests & diseases.

Need for Documentation of Flora

The knowledge building on significance and importance of various flora existing around us is the need of the hour. Loss of the biodiversity is likely to result in loss of various other taxonomic groups.

Serve as a ready reckoner:

Most of the campuses have huge landscape with diverse floral species. Nevertheless, the availability of information on these species is minimal. Hence, the documentation of the species would serve as an educational material on the details of species existing within the campus

Public Visibility:

Despite having various Biodiversity initiatives in place within the campus most of the campuses lack the visibility of the measures taken in conservation. The study will create awareness & visibility of the campus on various conservation measures implemented to the occupants as well as to the visitors.

Also, the organization will gain visibility globally amongst its shareholders for the positive steps taken towards protecting biodiversity.

Conservation of species:

Due to urbanization most of the floral species are under tremendous pressure. The need of the hour is to conserve and protect these species. The study would help in identifying such species in the campus which need to be conserved.

ABIT carbon sequestration through plantation

Carbon sequestration through plantation is one of the important steps towards achieving carbon neutrality. In carbon footprint calculation of ABIT, carbon sequestration through plantation is considered and due credit has been given.

No. of trees considered for carbon footprint calculation	:	2000 trees
CO_2 absorbed by a tree in one year	:	18 KG
Total CO_2 sequestrated	:	2000 trees x 18 KG of CO_2 / year
	:	36000 KGs of CO_2

Plantation & Maintenance techniques

Selection of species

- Native species like *Azadirachta indica* (Neem), *Pongamia pinnata* (Pongam tree), *Cassia fistula* (Indian shower tree), *Butea monosperma* (Flame of the forest) and also fruit bearing species like *Mangifera indica* (Mango), *Manilkara sapota* (Chikoo), *Syzygium cumini* (Jamun Tree), *Psidium guajva* (Guava), *Annona squamosal* (Custard apple), *Punica granatum* (Pomegranate), *Phyllanthus emblica* (Indian Gooseberry), *Citrus sinensis* (Sweet lime) and *Citrus limon* (Lime) to be selected for plantation
- Saplings of 2-3 ft height to be considered for plantation in public areas
- Plantation can be taken up as avenues (roadside plantation) and green belts (thick plantation in one area)
- Fruit plantation can be taken up in protected areas, institutions with large areas. Special care to be taken in maintenance since these plants also generate revenue

Digging of pits

Pits to be dug about one month prior to the plantation date and it should be exposed to sunlight. This will help in killing of harmful disease-causing bacteria and virus.

1. In places of no availability of proper sunlight, dry trash to be filled in the pit and burnt.
2. Pit size should be normally $2ft^3$ or $3ft^3$and in soils which are very hard $4ft^3$ or above to be dug.
3. Further to the digging of pit, the bottom of the pit should be loosened up to 6-9 inches.
4. While digging, we can observe different soil profiles. Topsoil will be soft and contains enough nutrients for nourishing the plant. The topsoil should be deposited on one end and hard soil on the other end. While filling the pit with soil, the topsoil only should be used. The topsoil from the non-plantation area around the pit to be collected and mixed with manure and used for filling of the pit.

Transportation

- Visit to the nurseries and enquire about plant species like availability, size, age and girth prior to the plantation. Also, the size of the packet in which the plant is existing to be enquired.
- Ensure that the material is available in the nursery and allotted to pick up
- The saplings to be watered one or two days prior to the movement of plants to plantation area.
- The plants to be procured at least 15 days prior to plantation.
    - The saplings to be watered as soon as they reach the plantation area and regularly thereafter.
    - They should be kept in shade, non-windy & protected areas.

The above said steps to be followed for movement of plants near to the pits within the plantation area. Enough water to be stored for watering the plants after plantation. Also, tools and manpower to be kept in place to ensure proper plantation of saplings. If the sapling is bushy with many branches, then the branches are to be trimmed before plantation.

Plantation

- The poly bag around the root ball to be carefully cut with a knife / sickle / scissors without disturbing the roots
- Rope and stakes are to be kept ready to support the plant after plantation.
- Regular watering to be done to the plants followed by mulching (loosening of top 3 – 4 inches of soil)
- Mulching will help in conservation of moisture, aeration of roots and control of weeds.
- Note: At least 5% of extra plants to be procured for timely gap filling and to ensure 100% survival. Care to be taken for these plants like other plants.

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Recommendations for Enhancing Flora in Campus

1. **Implement Ecosystem Restoration**
    - Develop naturalised areas in the Open Area segments
        - Wastelands in the campus can be converted to a Park
    - 'Theme Gardens' can be developed in unused areas of the campus to increase proportion of natural area
2. **Enhance Ecosystem Protection**
    - Protect and maintain the existing Open Area segments
3. **Planting more fruit yielding trees**
    - Increase tree density and canopy cover in the built-up areas
4. **Increase number of Native Plants in the Landscape area**
    - Increase native plants to boost native biodiversity
        - Bees, butterflies and other insects
    - Healthy native plant growth will help in easy identification of invasive alien species
5. **Introduce more native species in Open Areas**
6. **Preventing/ Decreasing Invasive Alien Species Spread**
    - Identify potential threatening species in advance and implement quarantine measures
        - Mass Eradication techniques for larger spreads
    - Commitment to complete eradication
    - Manual Uprooting of small populations
7. **Develop natural areas to encourage bird roosting and nesting in built-up areas**
8. **Introduce features to attract birds in the built-up areas**
    - Bird feeders
    - Water troughs/ Bird baths
    - Nesting material
9. **Improve measures for rainwater harvesting in paved and un-paved areas**

- Open fields, parks, pavement landscapes, etc.
- Develop outdoor parks in open areas

Conclusion

As seen in the carbon sequestration calculation, tree plantations lead to a tremendous reduction in net emissions of the campus. Therefore, ABIT needs to develop a roadmap to include tree plantation as a strategy to reduce overall carbon emissions of the campus.

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