CENTURION UNIVERSITY
Shaping Lives... Empowering Communities...

7.1.3. **Facilities in the institution for the management of the degradable andnon-degradable waste**

Centurion University of Technology and Management being a skilled University strives topractice the Swachhata mantra through each of its endeavors. It realizes the essentials of sustainable and holistic waste management in reducing its environmental footprint and providinga safe and healthy work environment for the University community.

- **Solid waste management:**

Solid wastes are collected in different bins placed at various locations in the campus. biodegradables wastes are used for composting while non-biodegradable wastes are handed over to the municipality for safe disposal.

Table-1 Different solid wastes generated inside CUTM campuses

Campus	Non-biodegradable waste (kg/day)	Biodegradable waste (kg/day)
Bhubaneswar	100	800
Paralakhemundi	70	600
Bolangir	10	100
Raygada	10	100

- **Liquid waste management:**

Daily about 6 lakh liters of waste water are treated by mechanical, chemical and biological processes in five sewage treatment plants (STP) working at different CUTM campuses.

Campus	Waste water generated (l/day)	Waste water Treated (l/day)
Bhubaneswar	4,00,000	3,00,000
Paralakhemundi	3,00,000	3,00,000

- **Biomedical waste management:**

The Biomedical wastes generated from the SoPAHS, Centurion University of Technology and Management, Bhubaneswar and Community Diagnostic Center (CDC) are liquid wastes, Solid wastes like hypodermic needles, syringes, scalpels and broken glass, dressing, bandages, material contaminated with blood, tubes and catheters. The amount of liquid wastes and solid wastes are generated from SoPAHS and CDC are **100-150ml and 300-500 mg per day** respectively.

The biomedical liquid wastes are treated with 1% Sodium Hypochlorite Solutions before drained in to the sewage connection and the hazardous chemicals are kept separately in the laboratory away from the reach of students. A lab-In Charge and Faculty member takes care of the liquid wastes and hazardous materials and the safety norms are strictly followed in the laboratory.

The biomedical solid wastes are segregated and stored in specified colored bins that are collected from the end user sites and stored at a central location, a restricted area within the campus before handing it over to the biomedical waste treatment facility. For the biomedical waste treatment facility, the University has signed a MoU with the **Saniclean Private Limited.** Saniclean collects the closed bags filled with BMW by their staff from the premises for the proper disposal of the wastes.

Apart from this, several incinerators are installed in each ladies' hostels for the safe disposal of used sanitary pads.

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- **E-waste management: policy, agreement and process?**

E-wastes are collected and segregated in the campus and are handed over to **Shree Ganesh Recycling Pvt. Limited for the proper recycling as per the MoU.**

- **Hazardous Chemicals and Radioactive Waste Management:**

Very less amount of hazardous chemical wastes like acids and alkalis are generated inside

the campus and are disposed in the drainage line after dilution. The University doesn't produce any radioactive wastes.

- **Waste recycling system:**

CUTM has different segments to recycle the waste to wealth.

1. Sewage Treatment Plant (STP)

Sources of wastewater generation

Waste water in campus is generated from different sources like domestic waste water from different hostels and staff quarters, administrative and academic buildings and canteens present in the Campuses. Some waste water is also generated from different cleaning activities. The waste water is collected and treated in the Sewage water Treatment plants (STPs).

Treatment Process:
Treatment process includes
Step-1: screening of bigger size waste particles like leaves, kitchen waste, straw etc.
Step-2: Removal of oil and grease from the oil and grease chamber.
Step-3: Settlement of sludge in the pretreatment tank and storage of the water in the buffer tank.
Step-4: Aeration of sewage water for 8 hours per each cycle in the presence of microorganism in the reaction tank.
Step-5: Decantation of treated water into the Chlorine contact tank where calculated amount of disinfectant is added and supplied for the irrigation purpose.

Process Description:
The wastewater treatment plant functions according to the activated sludge principle in the

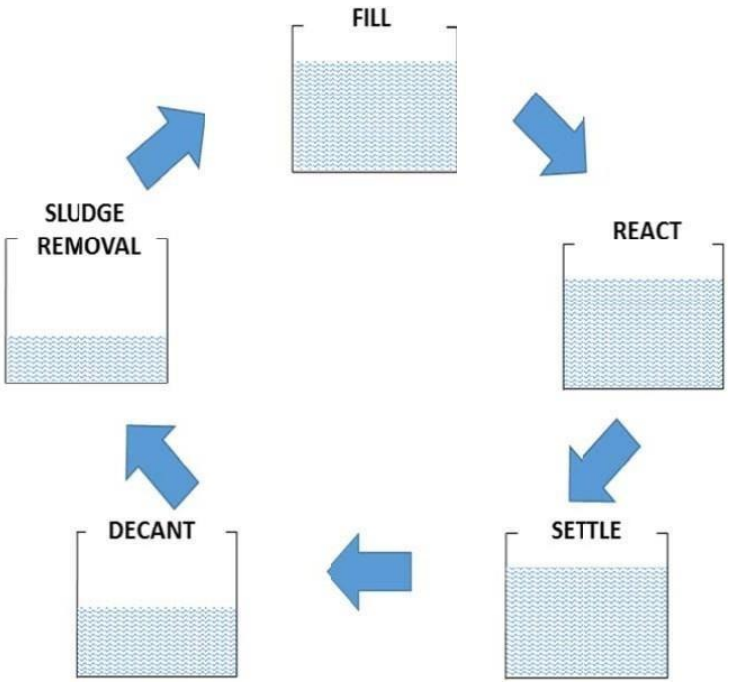
impounding process (SBR process). With this the pollutants are taken out of the wastewater by floating micro-organisms (activated sludge) and converted into biomass. The wastewater enters the pre-treatment chamber. This chamber is needed to allow sedimentation of coarse material. It is also known as mechanical pretreatment. Coarse materials sink to the bottom and the pre-treated effluent flows over into the next chamber with the help of a natural gradient. The second chamber is the buffer tank serving as storage until the effluent is being pumped into the reactor.

Reactor:

Within the Reactor the wastewater is being treated in three nos. eight-hour duration cycles per day. One cycle consists of following phase:

1. Filling/Loading Phase.
2. Reaction.
3. Settling phase
4. Decanting
5. Sludge Removal

Initially, the reactor will be filled with a certain amount of water with the help of the air lift pumps. To treat the effluent, microorganisms are required which are responsible for the decomposition of the organic waste within the effluent. Due to controlled infusion of air the microorganisms multiply, resulting in a rapid reduction of the organic substances in the effluent. The Control Unit controls a compressor (Blower) and four magnetic valves which control the plant based on the SBR- timing principle. The loading, sludge return and treated water disposal pipe works on the air lift principle. To initiate the transport of water respectively the aeration the corresponding valve opens. With a delay of two seconds the blower starts. Reversely, when switching off the blower will switch off first, then the valve will close with a two second delay.



There are four STPs working in the Paralakhemundi campus. Each STP having a treatment capacity of 75000 liters waste water per day. Thus, daily around 3 lakh liters of waste water is treated in Paralakhemundi campus. CUTM Bhubabaneswar campus has one STP which treats

about 3 lakh liters waste water per day. All the STPs treat the waste water throughout the year. Treated water is used for watering the campus gardens, lawns, playgrounds and agricultural fields. The dimensions of the STPs are given below.

Dimensions of STP at Paralakhemundi Campus				
Dimensions	Length (m)	Width (m)	Depth (m)	Tank Capacity (m^3)
Pretreatment Tank	7.37	2.17	3	40.00
Buffer Tank	7.37	1.63	3	30.00
Reaction Tank	4.1	4	3	41.00
Storage Tank	2.22	4	3	22.20
Dimensions of STP at Bhubaneswar Campus				
Particulars	**Length (m)**	**Width (m)**	**Depth (m)**	Tank Capacity (m^3)
Pretreatment tank	13.8	2.07	4	114.260
Reaction Tank	13.8	2.07	4	114.260
Storage Tank	7.50	4.94	4	148.200

The 6 lakh liters of treated water is used for watering the campus gardens, lawns, playgrounds and agricultural fields.

2. Bio-digester/Composter

Food wastes generated inside the campus including canteens and staff quarters are converted into bio-compost by means of biological decomposition in bio-composter.

Components of KWIK Bio-Composter:

i. Composting Chamber: where the kitchen waste and other organic wastes are mixed and biologically decomposed.
ii. Inlet Hopper: used to feed the raw organic wastes.
iii. Control Panel: which controls the machine operations.
iv. Leachate Trays to collect excess water Rollers
v. Power Transmission Unit Outlet.

Working Principle:

KWIK COMPOSTER is a fully automatic Bio-Mechanical Composter and a continuous organic waste converter. It offers a greener and a cleaner alternative to the problem of organic waste disposal. It works on sustainable micro-organism based technology. KWIK Composter converts the organic waste added to the machine into nitrogen rich compost by reducing its volume by almost 60%-70% of the original. Organic waste includes kitchen waste or anything that comes from plants or animals and is bio-degradable.

Approximately 7 quintals of kitchen waste are generated per day in Bhubaneswar campus. All the waste is converted to 170 kg of manure and is used in garden. Two composters/digesters are used to convert kitchen waste to manure. One digester's capacity is 5 quintals and the other one's capacity is 2 quintals. The bio-compost thus produced are used for gardening, nursery and mango orchards inside the campus.

Around 2 quintals of food waste are generated on daily basis in Paralakhemundi campus. Total food waste is collected in the drums provided in each mess, canteens, Restaurants and Dhabas inside the campus and transferred to the composting pits. These food wastes are laid layer wise by adding pusha organic decomposer mixture on each layer and are converted into compost. The pit is covered with soil when it is completely filled with the food wastes and allowed todecompose for 45 days. The compost thus produced is used in different agriculture farms of CUTM.

3. Vermicompost Unit:

Different kinds of organic wastes including vegetable wastes, grass cutting from lawns, leaves fallen on the ground, garden cuttings generated inside the campus are converted into vermicompost in the established vermicompost unit in different CUTM campuses. The vermicompost thus

produced are used in different farms, nurseries, gardens and orchards present inside the University campuses. Some vermicompost are also sold to different organizations andfarmers.

Process for the production of vermicompost:

- **Raw materials:**

Cattle dung, Dry leaves, Kitchen waste, Farm waste, Paddy straw, Cattle Shed waste, Banana tree

- **Bed preparation steps:**

Layers from bottom are filled in the following order:

1. Big gravels: 5cm thickness
2. Small gravels: 5cm thickness
3. Sand; 5cm thickness Soil: 5cm Thickness
4. Decomposed farm residue: 5cm Thickness
5. Cattle and Residue: 5cm Thickness
6. Paddy straw – 5cm Thickness
7. Pre-decomposed cattle dung slurry spray

After the preparation of the complete bed about 3kg of earthworms are uniformly released at the top of the bed. Finally, the pit should be covered with moist gunny bags for maintaininghumidity.

Different species of earthworms used:

Two types of earthworms are being used

1. Red worms – *Lumbricus rubellus*
2. Red wigglers – *Eisenia foeitidae*

Different types of vermicompost beds:

1. Cement pits
2. Cement Ring
3. HDPE

Vermicompost Production Process:

Collection of wastes and processing including shredding and separation of non – degradable material.
Preparation of earthworm bed a concrete base is required to put the water of Vermicompost preparation. Loose soil will allow the worms to go into soil while watering all the dissolvable go into along with water.
Collection of Earthworm after vermicompost collected, sieving the compost material to separate fully composted material. The partially composed material will be again put into the vermicompost bed.
Shifting the vermicompost in proper place to maintain moisture and allow the beneficial microorganisms to grow.

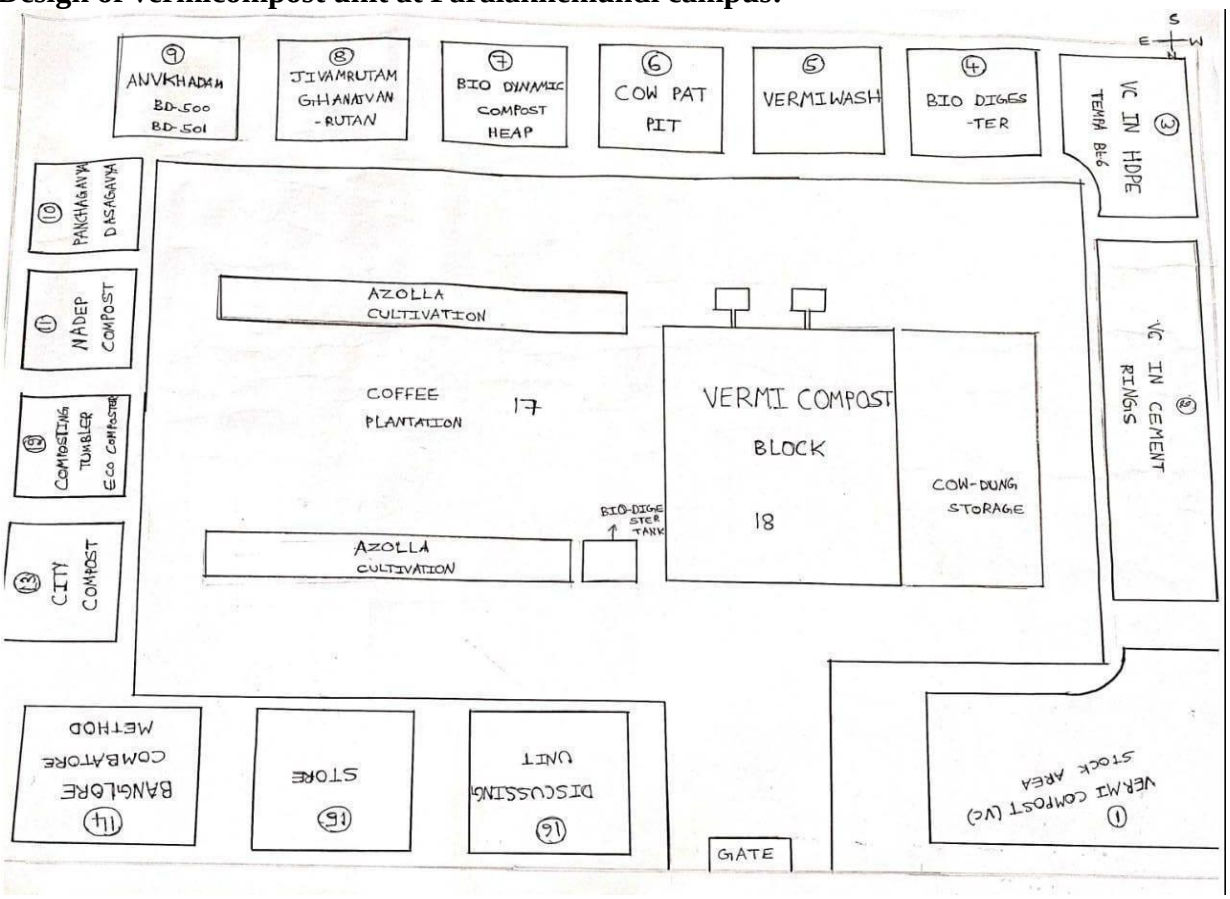
Harvesting of vermicompost:

1. The compost is ready when the material is moderately loose, grumbly and colour of the compost is dark brown.
2. The castings are formed at the top layer of the pit and needs to be collected periodically (once in a week)

Storage of vermicompost:

The harvested vermicompost needs to be stored in cool and dark place away from sunlight.

Design of vermicompost unit at Paralakhemundi campus:



Dimensions of Vermicompost bed:

Sl. NO.	SUB UNITS	DIMENSION (meter)			
		Length	Breadth	Height	No. of beds
1	Vermicompost Cement tanks	2.5	1.35	1	20
3	Vermicompost in cement ring	0.65	Dia-0.85	0.65	11
4	Vermicompost in HDPE Tetrabed	6.69	2.50	3.68	2
5	Vermicomposting unit	6.6	1.25	0.7	20

Materials and Cost Analysis for Vermicompost:

- **Cement Tanks:**

SI. NO.	PARTICULARS	QUANTITY	COST (per cycle)
1	Raw Cowdung	1500 kg	2300/load
2	Labour for loading tractor	2 labour	500 (250/labour)

3	Labour for filling tank	1 labour	600/day
4	Labour charge for maintainance		3500
5	Earthworms	3kg	600/kg - 1800
6	Other charge		2000
		TOTAL	10700

- **Cement Ring Pits:**

SL.NO.	PARTICULARS	QUANTITY	COST (per cycle)
1	Raw Cowdung	500kg	300
2	Labour cost	1	300
3	Earthworms	500gm	250
4	Cement ring	2	700
		TOTAL	1630

- **HDPE TETRABED METHOD**

SL.NO.	PARTICULARS	QUANTITY	COST (Per cycle)
1	Raw cowdung	1.5 ton	1,200
2	Labour cost	1	300
3	Earthworms	5 kg	3000
4	HDPE BAG	1bag	2500
		TOTAL	6,500

Production and Sales

Year	Item (s)	Quantity sold per year	Rate per unit	Sales realization
1st year	Vermicompost	18 tons	15000	
			Total	270000
2nd year	Vermicompost	21 tons	15000	
			Total	315000
3rd year	Vermicompost	27 tons	15000	
			Total	405000
4th year	Vermicompost	23 tons	15000	
			Total	345000
5th year	Vermicompost	28tons	15000	
			Total	420000

Customer details:

Generally, our production of vermicompost is being sold to

1. Farmers
2. Faculty members
3. Units in college
4. NGO's

From last 5 years to these 4 categories of people vermicompost is being sold

Types of wastes used for vermicompost production (in Paralakhemundi Campus:

SI.NO	Types of waste	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
1	Cow-dung from livestock	10 tractors/year	10tractors/year	10tractors/year	10tractors/year	10tractors/year
2	Top soil from unit	1ton/year	1ton/year	1ton/year	1ton/year	1ton/year
3	Dry leaves from Unit's mango leaves	10 ton/year	10ton/year	10ton/year	10ton/year	10ton/year
4	Pebbles	3ton/year	3ton/year	3ton/year	3ton/year	3ton/year

Campus wise vermicompost units with its production capacity present in the university are given below.

Campus	No. of Units (Tanks)	Production (tons/ year)
Paralakhemundi	3 (45)	180
Bolangir	1 (1)	3
Bhubaneswar	1 (2)	0.6
Rayagada	NA	NA

4. Biogas:

Centurion University has a 2 m^3 capacity Deenbandhu fixed dome biogas plant at Paralakhemundi campus and a $2m^3$ capacity FRP floating drum biogas plant each at Paralakhemundi and Bhubaneswar campus.

The biogas is produced by the anaerobic digestion of the organic waste material. The composition of the Biogas is given below:

Composition of gas	Content (%)
Methane	55-65
Carbon dioxide	35-45
Hydrogen	Trace
Hydrogen sulphide	Trace amount
Ammonia	Trace

Mechanism of Biogas Production:

The digestion of the organic waste matter is occurred in the absence of air i.e., the anaerobic condition. The degradation takes place in the four different stages:

i) **Hydrolysis:** Most of the organic waste materials subjected to bio-methanation contain the macromolecules like cellulose, hemi cellulose, lignin etc., which are insoluble in water. In the first step of gas production, these macromolecules are subjected to breakdown into micro-molecules with the help of some enzymes, which are secreted by the bacteria. So, the major end product of this step is the glucose.

ii) **Acidogenesis*:*** The components released during the hydrolytic breakdown become the substrate for the acid forming bacteria. The acid forming bacteria convert the water-soluble substances into volatile acid. The major component of the volatile acid is the acetic acid. Beside this some other acids like butyric acid, propionic acid etc. and gases like CO_2 and H_2 are also produced. The forming bacteria during the conversion process utilize the amount of oxygen remaining in the medium and make the environment anaerobic.

iii) **Acetogenesis**: In this step, the fermented products are oxidized into simpler forms. Substrates for acetogenesis consist of various fatty acids, alcohols, some amino acids and aromatics. In addition to hydrogen gas, these compounds primarily form acetate and carbon dioxide.

iv) **Methanogenesis*:*** This is the last stage of biogas generation. N this stage the methanogenic bacteria convert the volatile acids formed in the se4cond step by the acidogenic bacteria to methane and carbon dioxide. Some excess CO_2 in the medium is also converted to methane gas by reacting with the hydrogen present in the environment.

The reactions in the above four phases to go on simultaneously. In the first three stages the two groups of bacteria are very active. During their processes of conversion they utilize the amount of oxygen present in the environment and make the whole system almost oxygen free during their process of respiration. In the fourth step the methanogenic bacteria are active. These groupsof bacteria are highly sensitive to oxygen while the previous two groups are not so sensitive. This is the reason why the methanogenic bacteria are called obligate anaerobic bacteria. It hasbee also noticed that the microorganisms are very much dependent on each other. The amount of acetic acid formation is directly related to the methane generation. More the acetic acid formation more will be the amount of methane generation.

Components of biogas plants:

i) **Mixing tank -** The feed material (dung) is collected in the mixing tank. Sufficient water is added and the material is thoroughly mixed till a homogeneous slurry is formed.

ii) **Inlet tank -** The substrate is discharged into the digester through the inlet pipe/tank.

iii) **Digester -** The slurry is fermented inside the digester and biogas is produced through bacterial action.

iv) **Gas holder or gas storage dome -** The biogas gets collected in the gas holder, which holds the gas until the time of consumption.

v) **Outlet tank-** The digested slurry is discharged into the outlet tank either through the outlet pipe or the opening provided in the digester.

vi) **Gas pipeline -** The gas pipeline carries the gas to the point of utilization, such as a stove or lamp.

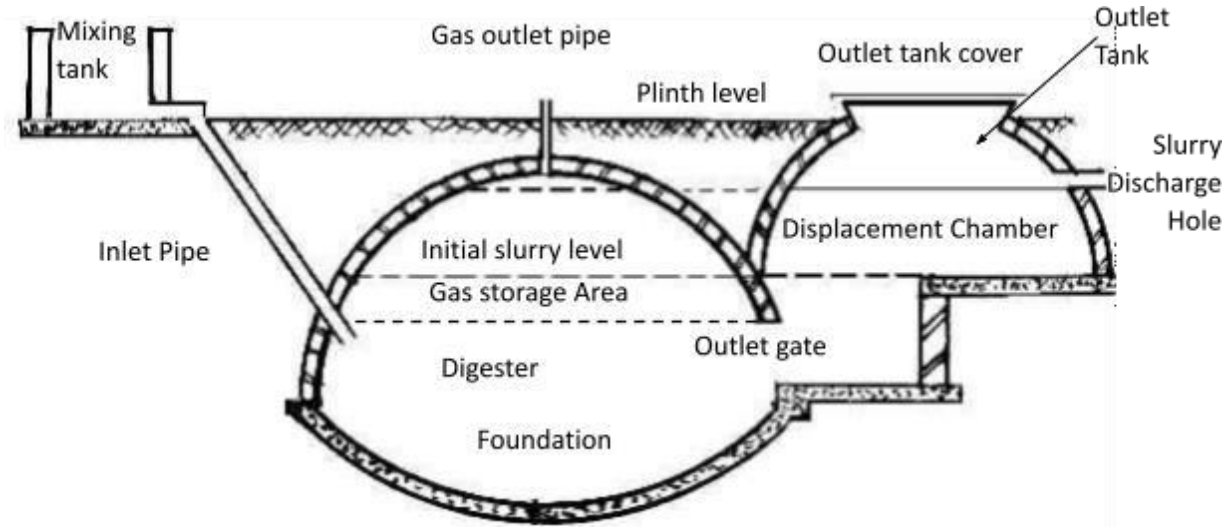


Fig.: Deenbandhu Biogas plant

Operation and Maintenance:

About 50 kgs of cattle dung is used for the generation of 2 m^3 gas per day. The acquired quantity of dung along with equal quantity of water is put into the mixing tank daily. After plugging the inlet pipe the contents are thoroughly mixed. Materials like straw, trash, etc. is removed and the slurry is then led into the digester by removing the plug at the opening of the inlet.

After feeding, the inlet opening is again closed by the plug. The inlet tank is cleared with the water and the washing is drained out through the hole provided at the lowest point of the floor of the inlet tank. Inorganic materials like sand, mud etc. will get washed away while cleaning the mixing tank. After digestion of slurry about 2 m^3 gas is produced daily and the digested slurry is get out through outlet tank automatically. Digested slurry is used as an organic manure for the plants in the garden.

The biogas thus produced is used by one of the families residing inside the Tribal village at CUTM, Paralakhemundi campus. The digested slurry is used to grow the vegetables in the gardens situated in the Tribal village.

5. Handmade paper and pen unit:

The handmade paper unit at CUTM, Bhubaneswar campus, Odisha is a solution to solve all environmental problems raised due to cloth and paper wastes generated inside the University campus.

A handmade paper that

- does not utilize wood for its manufacturing
- is free from all chemicals
- is dried using most eco-friendly means of energy
- is a bio-degradable product.
- is excellent for writing
- has greater tensile, bursting, tearing and double fold strength compared to conventional papers.
- is recyclable
- is available at an affordable cost

Uses of Hand Made Paper:

The handmade papers are used for office stationery, writing pads, conference folders, computer printouts, drawing and documentation sheets, certificate and degree awards, for making fancy products and diaries, for making photo frames, paper bag and variety of other decorative and show case products.

Raw Materials Used for Hand Made Paper:

A wide range of raw materials such as paddy and wheat straw, jute, rags, cotton rags, hosiery cuttings cotton linter, tailor cuttings, fibers (Jute /hump), bagasse, cotton stalks, grasses, waste paper etc., are used in making handmade paper. They are available abundantly and regularlyfrom different sources. The proposed unit makes permanent arrangement for procuring raw materials in bulk from various suppliers.

Service Requirements and its availability for proposed manufacturing unit:

- Water
- Power
- Building shed
- Drying shed
- Labour /work force
- Chemicals

The most common equipment / machines used for handmade paper making:

- Rag Chopper

- Beaters
- Pulp Tanks
- Calendar machine
- Agitator
- Hydraulic press
- Cylinder mould
- Vat power drives machine
- Iron box, etc. are major tools and equipment used.

Technology and manufacturing process:

The standard equipment are available for handmade paper production. The important among them are:

(a) Rag chopper- It is used for cutting the rag into fine pieces suitable for beating in beater machine. Beater Machine-The pulp from the pulper machine sent to beater machine for the formation of fine pulp which plays an important role for formation of board of good quality. Auto Vat - used for the forming of paper sheets in the traditional Indian manner. A measured quantity of diluted pulp is spread evenly on to a wire mould, which is clamped in between two wooden deckles in a water tub. The excess water in the pulp is drained mechanically by manual operation.

(b) Hydraulic press -- presses the post of newly formed sheets to remove excess water

(c) Calendaring machine-- It's a series of hard pressure rollers used to form or smoothen a sheet

(d) Cutting machine-- Is used for waste cutting

(e) Weighing balance-- For weighing or measuring weight of raw materials as well as other required items.

1. Manufacturing Process - The process of making handmade paper involves a series of steps that are briefly discussed below. Sorting and dusting: the raw material that is to be used is manually sorted and foreign material like buttons; plastic, synthetic fibers etc. are removed. To remove dust and dirt the material is shaken vigorously.

2. Rag Chopping: The sorted and dusted material is chopped into pieces of equal size.

3. Beating: The raw material is mixed with water and harmless chemicals and beaten in a Hollander beater. This consists of a U-shaped trough, with a drum; on the outer side of this drum are iron blades that cut the raw material to make a pulp out of it. There is a washing drum as well that cleans the pulp and drains the dirty water. The quality of the paper to be made determines the consistency of the pulp. Sheets of handmade paper can be made in two ways.

4.Dipping Method: This method is normally used for fine or thin paper. The pulp is diluted with water and put into a masonry trough or vat. The lifting mould (a mesh on a wooden frame) is dipped into the trough, shaken evenly and lifted out with the pulp on it. The consistency of the pulp in the tank should be kept constant all the time.

5. Lifting Method: This method is used for all paper and especially for card paper. A fixed quantity of pulp is poured evenly onto a mould, which is then clamped between two wooden deckles (frames) and then dipped into a water tank. The mould in then lifted using a lever mechanism that allows the excess water to drain away.

6. Couching: Once the sheet is formed, the wet paper is transferred onto a cloth like muslin or felt sheet and a stack of interleaved sheets in made.

7. Pressing: A hydraulic press is used to remove the excess water from the sheets. Pressing reduces the thickness of the paper and the sheets become more compact. This process improves the physical properties of the paper and helps drying.

8. Drying: Even after the sheets have been pressed, they still contain about 50% to 65% of the moisture. The sheets are hung in the sunlight to dry. Solar dries can speed up the process and the space required for drying. Coloured papers are dried in the shade to prevent the sun from bleaching the color.

9. Cleaning and Sizing: Small particles of dirt and other foreign matter are removed manually with a sharp instrument. The cleaned sheets are coated with a layer of starch to improve the

quality of the paper and prevent feathering. This process is called sizing. This can be done manually using a brush or by dipping the sheet into a vat containing sizing chemicals.

10. Calendaring: The sheets are then placed between metallic plates and passed through spring-loaded rollers in a calendaring machine. This makes the paper smooth and increases the gloss of the paper.

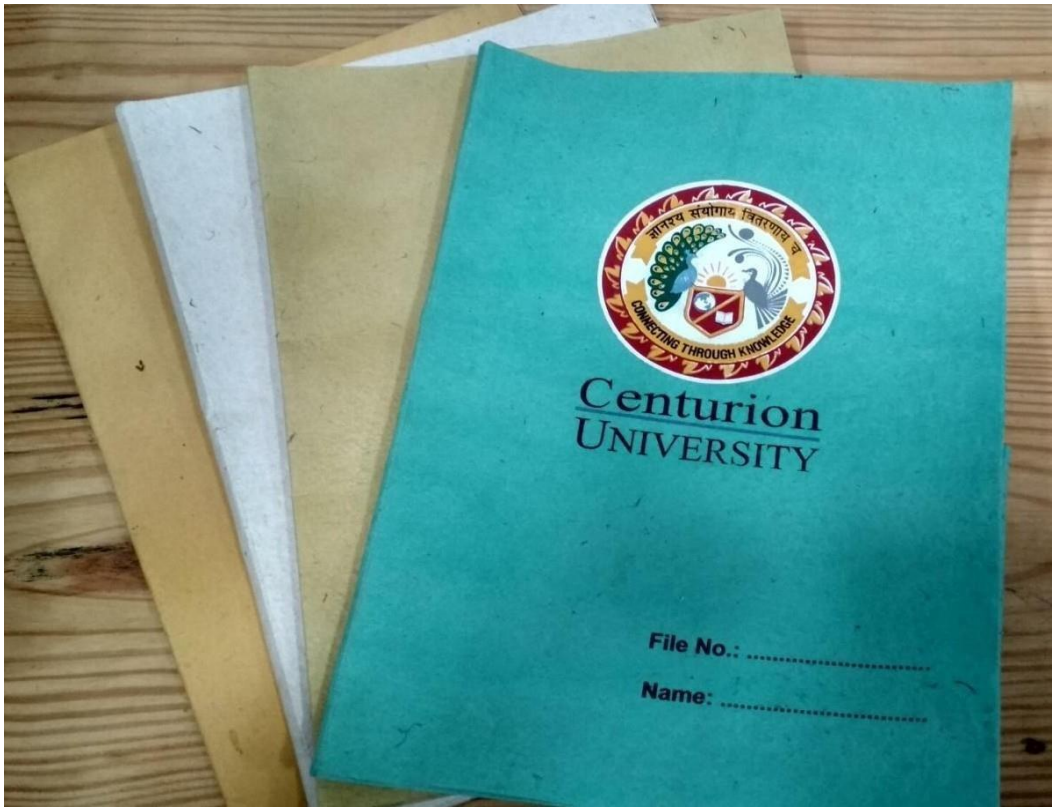
11. Cutting: The sheets are cut neatly according the required size using a cutting machine.

Unit Details are as Follows:

Sl.No	**Existing Facility (Space)**	**Existing Production Units**	**Quantity of Production (Per Month)**	**Selling in INR**	**Customers**	**Target Market/Prospects**
1	25*25 sq.ft	Handmade paper bag	Bag-600, Diary- 150, File-500	Rs 100000 (Per Month)	Sabat Expert, Utkal Amrita Group, Odisha Govt. Drinking Water Group	Govt. & Private Handlooms

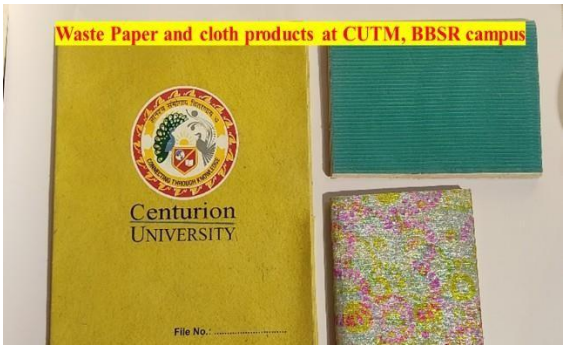
Pictures of Some of Our Products:


CHARLES
DARWIN
UNIVERSITY



In this unit different products like paper, covers and pens called Likhan are made out of waste paper at Bhubaneswar campus.

Items	Quantity (per month)
Pen	3000
Higher thickness Sheet paper	2500
Lower thickness Sheet paper	1000
Diary	150
Bags	300
files	500



6. Paper Pen Production Unit:

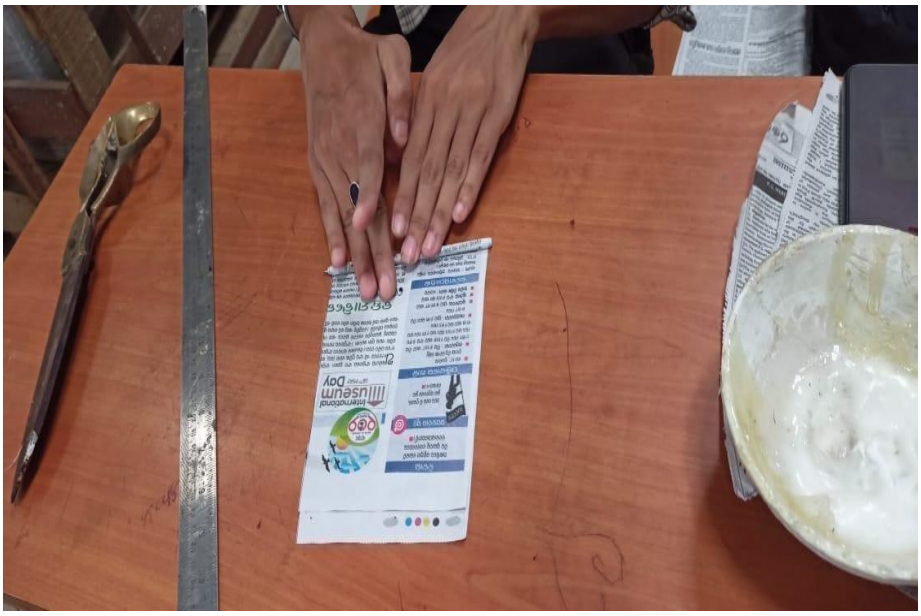
CUTM, Bhubaneswar campus has a paper pen manufacturing unit where ecofriendly and crafted pens are made from waste paper. The pen thus produced is available in the brand name as "LIKHAN".

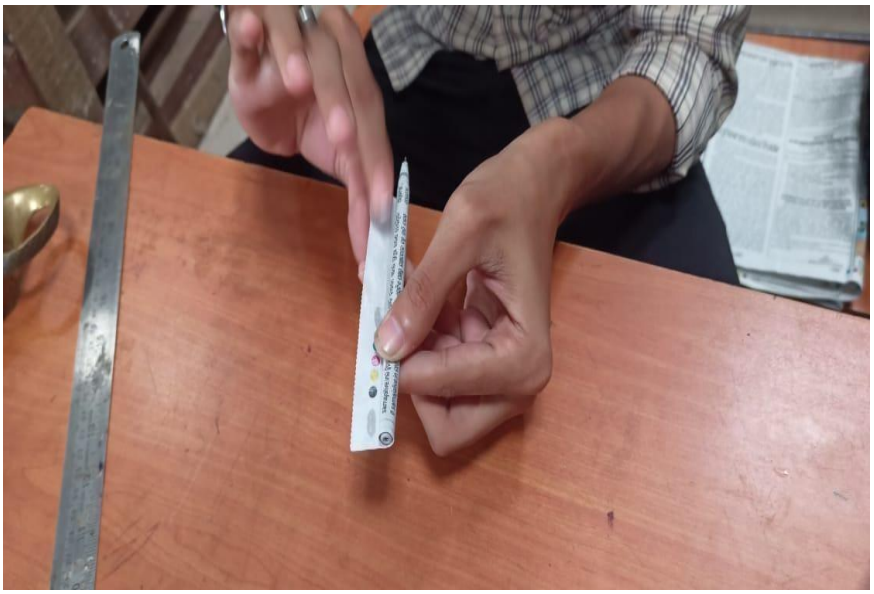
Materials for making paper pen:

- Refill
- Waste newspapers / papers
- Glue
- Punching machine
- Eyelet

Procedure of the Paper pen making:

- Collecting some wastes newspaper or normal papers and new refills
- After that take a piece of newspaper or any paper of 54.5cm*13.8cm dimension for 14.4 cm refill.
- Fold the paper in to half and put the refill in that fold with adding some glue and leave it for 1 – 2 min.
- Now role the paper along with refill with adding some glue on its inner surface and after that pen is ready.
- For better look we add some fabric colour on its back side.
- Now make the pen cap of size 7.5 cm by same paper rolling process.
- Close the one end of that role with some glue. And ribbit an eyelet at that end for good looks.
- Now the pens ready to use.






likhan

7. Paving Block Using Plastic Waste:

CUTM, Bhubaneswar campus is manufacturing the paving blocks using cement, aggregates, sands and waste plastics. Cement bags are collected from local suppliers. Aggregates supplied bylocal crusher (figure 1) and sand are obtained from local river bed (figure 2). The waste plastics (HDPE) are collected from campus food stalls as well as from nearby village. After collection, plastics are dried under sun for few days then shredded as shown in figure 3 below.

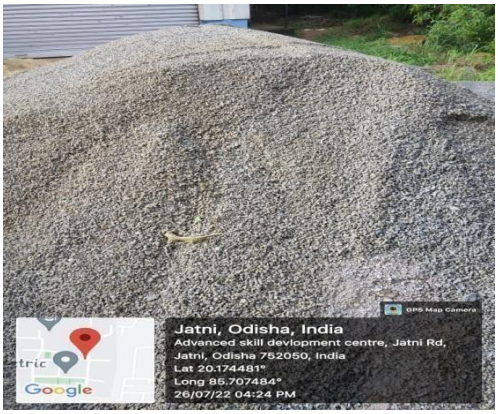


Figure 1Aggregate used for manufacturing of paving block

Figure 2Sand from local river bed

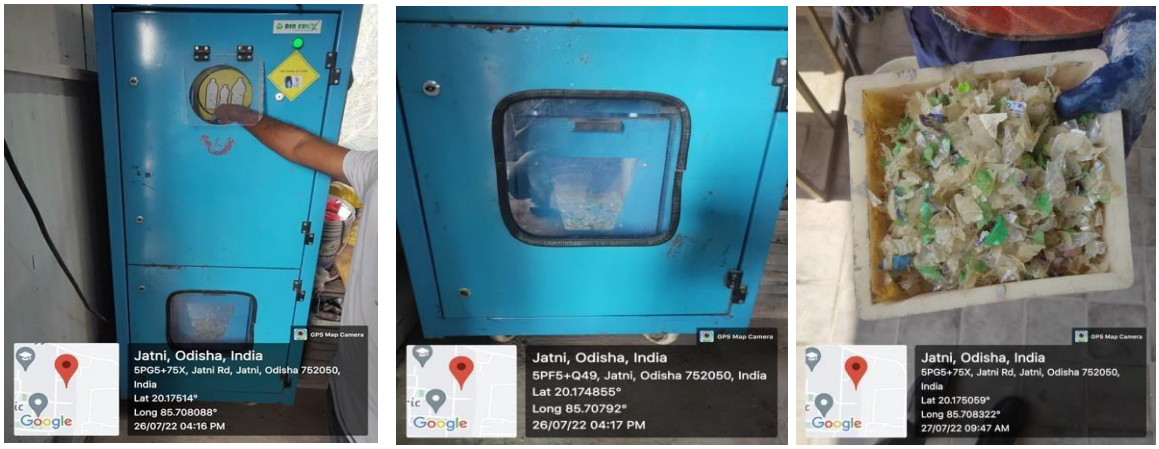


Figure 3 Process of waste HDPE plastic

Manufacturing Process of Paving Blocks:

The paving blocks are prepared at the CUTM campus in various shapes such as dumbbell, square, zigzag, hexagonal and kerb stone whereas the dumbbell and square shape blocks are having thickness of 60mm and zigzag & hexagonal having 80mm. For this M30 grade of concrete is used with cement 15%, coarse aggregate 55%, fine aggregate (sand) 29% andshredded waste plastic 1%. For manufacturing this block, first all the ingredients are feed to the concrete mixture in dry condition mixed it properly as shown in figure 4. After that, required amount of water is added to the dry mix in concrete mixture and run the mixture for few minutes to confirm the homogeneous mix of the entire fraction materials later remove from it (figure 5).

Figure 4 Mixing of all the ingredients in dry state

Figure 5 Removing of wet mix for pouring to block mould

Before pouring wet mix into the paving block mould, the mould should be oiled and colour then pouring the concrete mix as shown in figure 6 to 7. After pouring mix into the mould, it kept over a vibrating table for few minutes for removing the voids presented in figure 8. After vibration the prepared moulds are kept under shade for 24 hours and then remove from it shown in figure 9. Further the freshly prepared blocks (figure 10) are water cured for seven days. Production of paving block in this unit is 500 per days.

Figure 6 Application of oil and colour inside the mould

Figure 7 Pouring of wet concrete mix into mould

Figure 8 Application of vibration to mould

Figure 9 Paving blocks after 24 hours

Figure 10 Paving block after removing from mould

Testing of Paving Block

After seven days of curing, a sample of each batch is bringing to laboratory to check its strength performance. For this Universal Testing Machine (UTM) is used available at CUTM Advanced Testing and Calibration Laboratory, Bhubaneswar. This testing result is presented in figure 11. Tentative weight of a block is varying from 4 to 5 KG.

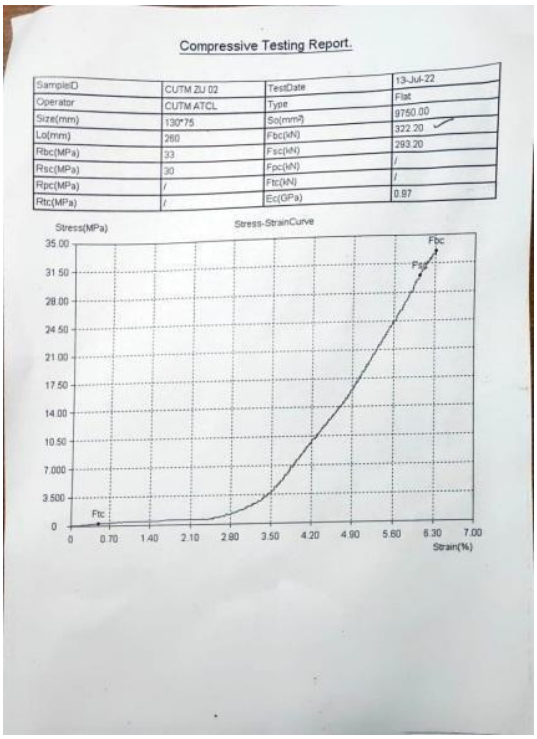


Figure 11 Compressive strength of paving block

Buyers

These manufactured paving blocks containing waste plastic are used inside the campus as well as supplied to the outside of the campus (figure 12). One of the buyers of this product is KT Global School, Khurda, Odisha. The cost of one block is coming without plastic is nearly 18.5 rupees for 80mm whereas with plastic it cost reduces to nearly 16 rupees. In the similar way for 60mm paving block without plastic 14.5 rupees and with plastic nearly 13 rupees.

Figure 12 One of the final products of paving block

Daily 500 concrete paver blocks are manufactured from waste plastics, cement and sand at CUTM, BBSR campus.

Shape	Thickness (mm)	Concrete Grade	Composition
Dumbbell	60 mm	M-30	cement (15%), coarse aggregate (55%), fine aggregate (sand) (29%) and shredded waste plastic (1%).
Square	60 mm	M-30	
Zigzag	80 mm	M-30	
Hexagonal	80 mm	M-30	

Apart from the above initiatives, the University also striving to strengthen the waste management facilities by signing MoUs with relevant organizations and employing cutting edge technologies.

Anita Patra

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