WINDROW COMPOSTING – AN AEROBIC BIO-CONVERSION AND STABILIZATION OF MUNICIPAL SOLID WASTE IN CHANDIGARH

NAAC ACCREDITED
GRADE 'A' CGPA3.52

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1. **Rapid increase in the population density** and urbanization resulted in exponentially increased food and fruit demand and dramatic increase in green waste,which resulted in their bulk generation which put significant pressure on society and environment economy.
2. **In the present era, the accumulation of solid waste is the main global environmental challenge**.The low stigma to food waste conversely results in India discarding 68.8 million tonnes in landfills and comes **third after China and USA in total green house gases (GHGs) emission.**
3. **To highlight best organic waste management strategy to achieve carbon foot print benefits**,present study is conducted on food,fruit and green waste co-composting using windrow composting,an eco-friendly.biological aerobic integrated waste management to produce safe, stabilized and nutrient enriched soil amendment,
4. **It is a dual nature phenomenon**,which creates income generating opportunity in beginning by covering disposal cost and bio-stable compost at end.The project was commenced in March 2019 and is in operational level.

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Challenges faced during the Composting process

1.Solid waste auditing:The first and foremost if the solid waste auditing, which plays an important role in devising the composting strategy i.e Layout designing,sizing and capacity.

2.Segregation:The segregation at source present major challenge,as composite culture is dumped in landfills which results in green house gases(GHGs) emission.It also hampers the composting process.

3.House hold composting:The major obstacle stands in way of household composting is the misconception that the composting is smelly and attract flies and maggots,the problem which is solved in present study,as compost generating process is organoleptic.

4.The fourth challenge is Budgetary constraint.The budget limitations concerning community composting can be addressed by starting low cost windrow composting.But due to financial constrait we have to do manual turning on every 6th and 11th day to maintain physico-chemical parameters.

5.The next challenge is the designing of the windrow plant keeping in minds its economial aspect and land saving.

7.The last challenge we faced is the standardising the compost monitoring the **physico-chemical parameters** (Temperature, pH, Moisture content,Electrical conductivity and C/N ratio) to make compost feasibity to floriculture and landscaping operations.

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Procedure

1. The composting process started with collection of solid waste from the food preparation sources(canteen,mess and juice corner) on daily basis,its segregation and subsequent transport to windrows.
2. Initially,a static triangle windrow piles(3x4m) consisting equal proportion(1;1) of wet and dry waste ,were made and stored for month in piles,which were added to the charging windrow covered with wire guage cover membrane..
3. The bulking agent(grass clippings) was added as basal layer on brick lined charging unit,which was sequentially alternate with food, fruit and vegetable waste(30cm each) and farmyard manure as source of phosphorus.The repitation of the layers were done till the commulative pile reached 1.5m high.
4. The micro-positive pressure generated in windrow micro-climate attributed to joint effects of the forced bottom up ventilation and cover membrane,is conductive in maintaining micro-positive pressure in windrows and making piles aerobic, and odourless (organoleptic).
5. Micro-positive pressure hastens decomposition due to prolonged thermophilic temperature and **reduces GHGs emission by 40%**.

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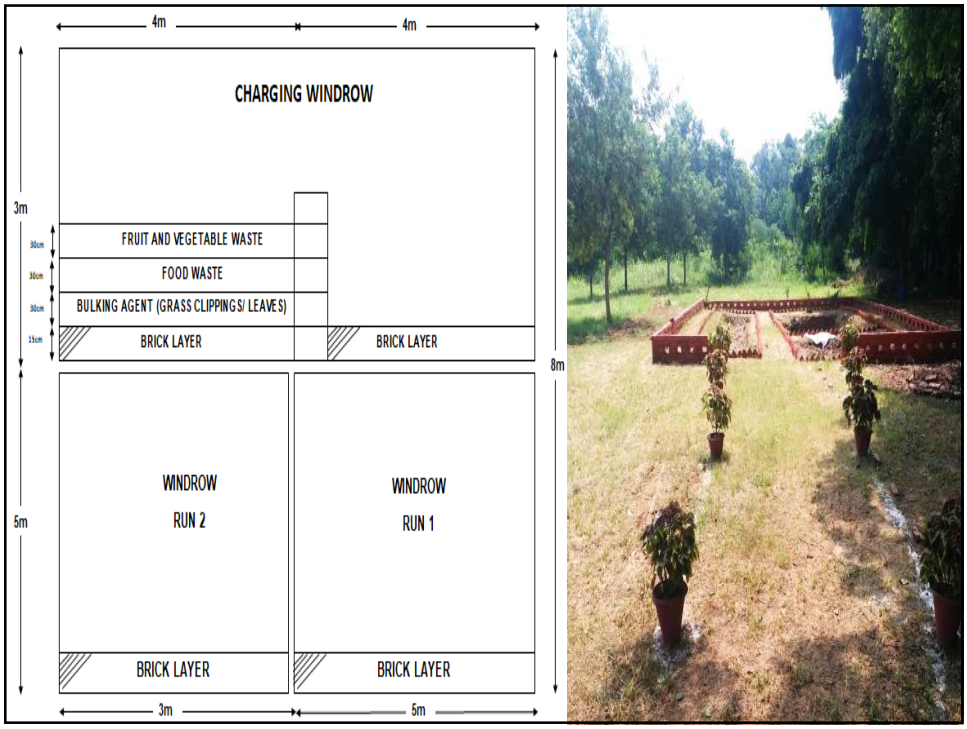
4m
4m
CHARGING WINDROW
3m
FRUIT AND VEGETABLE WASTE
FOOD WASTE
BULKING AGENT (GRASS CLIPPINGS/ LEAVES)
BRICK LAYER
BRICK LAYER
8m
WINDROW
RUN 2
WINDROW
RUN 1
5m
BRICK LAYER
BRICK LAYER
3m
5m

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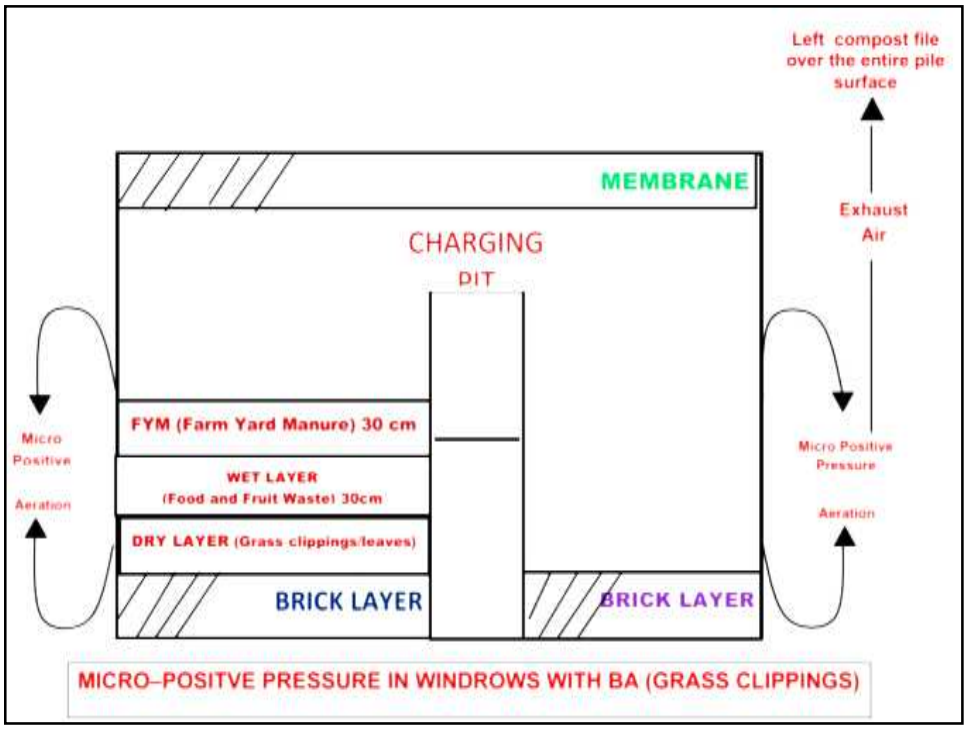
Left compost file over the entire pile surface
MEMBRANE
Exhaust Air
CHARGING PIT
Micro Positive Aeration
FYM (Farm Yard Manure) 30 cm
WET LAYER (Food and Fruit Waste) 30cm
DRY LAYER (Grass clippings/leaves)
Micro Positive Pressure
Aeration
BRICK LAYER
BRICK LAYER
MICRO–POSITVE PRESSURE IN WINDROWS WITH BA (GRASS CLIPPINGS)

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Tangible Benefits

1.Saving and Benefits:The organic compost generated from municipal solid waste with standardised parameters has increased bloom number(2,5 times),diameter and shelf life than control.Till now 29250 cubic feet organic compost is prepared in windrow plant since inception saving money worth one lakh four thousand(Rs1,04000/-) and the farm yard manure (FYM) saved is used in fields and Biogas plants.

2.Carbon foot prints:Waste to energy system plays an important role in diverting organic waste from landfills.Landfilling is the most GHGs intensive option emitting nearly 400 kg CO2 per 100kg of organic waste(Nordah *et al*.,2020)

- 100 kg Organic waste-400 kg CO2 per day;hence in Landfills in **1year (400X365 is equal to 1,46,000 kg CO2 per year**

•In **Single stage windrow composting** in which the standardised compost prepared in **240days** ,the carbon footprint is **160x240=38400kg** CO2 per year,as discussed earlier the windrow composting releases 40%less GHGs emission.The inference from this study is that in single stage windrow composting **74% less CO2 emission in comparison to landfill.**

•In **Two-stage composting** i.e mechanical and manual integration,the mature organic compost formation process completed in **110 days(160x110 days=17600kg CO2 per year**),the CO2 emission is **88%** less in comparison to landfill.

•The organic compost generated has direct influence on water conservation as the frequency of watering in pots and seed beds reduced to half due to porous nature and high humus content of organic compost.

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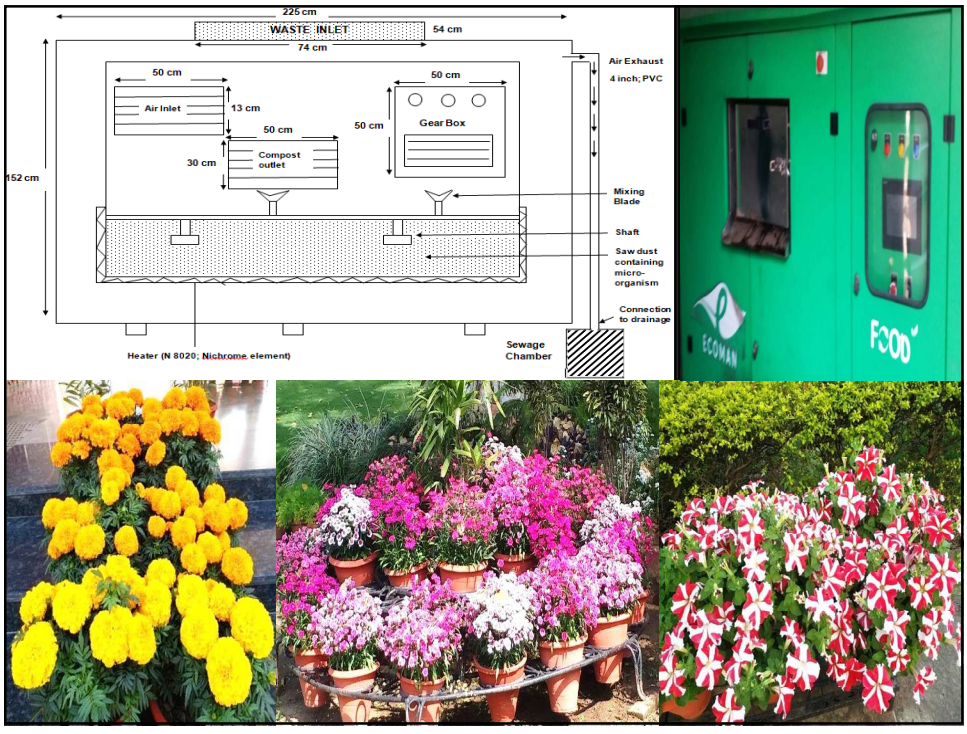

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Intangible benefits

(i)Strategic Planning and Increased organization transparency and responsibility: In order to achieve the "Zero waste institute" the institute categorised the solid waste management in two phases.In first phase,after solid waste auditing,the wet waste is composited and the organic compost used in floriculture and landscaping operations and the institute becomes organic and also successful in achieving the carbon footprint benefits.In the second phase, the institution has adopted the three R's-reduce,reuse and recycle to cut down the 17.6% plastic generated to protect our environment and to a become **"zero-waste institute"**.

(ii)People/Society benefits: In order to create mass awareness about the negative effects of single use plastic and plastic items,the 'No Plastic Day' is celebrated on every Saturday in all education institutes of Chandigarh,in which fifty thousand stakeholders from all streams(students, faculty,gardeners,workers) participated and are administered oath on July 3,2021.Various competitions(Poster making.slogan and essay writing) were organised to achieve cpmmunity outreach.

(iii)Skill Upgradation: In order to create mass awareness,the girl students are trained in the solid waste magnagement(SWM) field,For this the institute is running UGC sponsored certificate course on floriculture and landscaping to inculcate the field knowledge of the topic,Solid Waste Managemetn(SWM).

(iv)Attitude Shift: The city beautiful is observing attitude shift towards solid waste management in society ,as the at source segregation started at household level in Chandigarh which prevents composite culture in landfills and composting plant.

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Replication Potential of Project

(i) Scalability: The major success of any projects fall in its reproducibility and scalability;the present project helped institute and Principal Investigator,Dr Vishal Sharma,in bagging Regional,National and International awards with special appreciation from United Nation through its UNSDG Action Award-2020.The project scalability is replicated and assessed at different sites and area :

(a)Judicial Academy,Sector-43 ,Chandigarh

The Judicial Academy,which harbours,judges doing pre-entry training.generate 30kg Solid waste per day.The windrow plant of 0.2 TPD(Tonnes per Day) is installed and the plant completes one year and in mid of second year and compost generated is used in the floriclture operations.

(b)Post Graduate Government College,Sector-1,Panchkula

The plant of 0.4 TPD is installed at college campus and the solid waste generated is converted in compost and used in seed beds and pots in raising flowers.

(ii)Achievement sharing mode: The achievements are shared with community through media reports,research papers,workshops and extension lectures i.e UN Award,Skoch Award,IFHE,Italy Award, MGNCRE Green Champion Award and Rose Festival "Best Maintained Campus Award".

(iii)Competitor: As it is new field,Indore is above competitor and Bangalore is below, the present study is the modified Indore type

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Evidence and Third Party Confirmation

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मिसाल | बॉटनी विभाग के एचओडी डा. विशाल को यूनाइटेड नेशन ने किया सम्मानित

कूड़े से 110 दिन में तैयार हो रही खाद

सुनेश ठाकुर ●चंडीगढ़

घर के कूड़े को डंपिंग ग्राउंड में फेंकने से कहीं ज्यादा बेहतर है कि उसे रियूज करें। यही कर दिखाया पोस्ट ग्रेजुएट गवर्नमेंट कालेज फार गर्ल्स सेक्टर-11 में बाटनी विभाग के एचओडी डा. विशाल शर्मा ने। उन्होंने कालेज कैंपस में इकोमैन कंपोस्टर की मशीन फूडी को स्थापित कराया है। इससे वह कालेज में जमा होने वाले कूड़े को खाद के रूप में तब्दील कर रहे हैं। इसके लिए डा. विशाल को यूनाइटेड नेशंस ने सस्टेनेबल डेवलपमेंट गोल के तहत अवार्ड भी प्रदान किया गया। यह अवार्ड पाने वाले डा. विशाल देशभर से अकेले व्यक्ति हैं। अवार्ड को पाने के लिए देशभर से 114 एंट्री गई थी, जिसमें डा. विशाल का चयन हुआ।

20 फीसद गैस पैदा करता है ग्रीन हाउस : डा. विशाल ने बताया कि यदि हम कूड़े को खुले में फेंक देते हैं तो वह मीथेन और कार्बनडाईआक्साइड को पैदा करता है, जो कि में सांस और पानी के जरिए चर्म रोग को न्योता देता है। यदि हम

कंपोस्टर के साथ बॉटनी विभाग के एचओडी डा. विशाल शर्मा ●जागरण

कूड़े को खुले गड्ढे में कंपोस्ट करने का प्रयास करते हैं तो वह खुले से 60 फीसद तक विषैली हवा को जन्म देता है जो कि पर्यावरण के लिए बेहद हानिकारक है। इकोमैन कंपोस्टर मशीन सात दिन तक प्रति दिन आठ घंटे के लिए बिजली की खपत करती है जिसका खर्च एक हजार रुपये के करीब आता है, लेकिन ग्रीन हाउस गैस की उत्पादन क्षमता मात्र 20 फीसद तक रह जाती है और यह 110 दिन में पौधे के लिए काम करने को तैयार हो जाती है।

दो वर्ष में 2250 टन पैदा कर चुके हैं खाद : डा. विशाल ने बताया कि कंपोस्टर को दिसंबर 2019 में कालेज में स्थापित किया गया था। मार्च 2020 से कालेज बंद है। इसके बावजूद जो भी पेड़ों के पत्ते या फिर कालेज कैंपस में पैदा होने वाला कूड़ा इसमें डाला जा रहा है, उससे 18 महीनों में 2250 टन खाद तैयार की जा चुकी है। डा. विशाल ने बताया कि इस खाद का इस्तेमाल करने के बाद फरवरी 2020 और 2021 में नगर निगम की तरफ से आयोजित होने वाले रोज फेस्टिवल में कालेज के फूलों को अवार्ड मिल चुका है।

Research Papers:Vishal Sharma.2021.Analytical Approach to optimizing the design of windrow composting plant.Pollution Research,40(3):359-364.ScopusJournal;H-index 23.
Vishal Sharma.2021.Windrow Composting as Municipal Solid Waste Stabilization_A case study in Chandigarh.Pollution.ScopusJournal(Accepted;In press).

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Major learnings from the project implementation- Benefits

(i)The problem solved due to the bioconversion of solid waste are its management are:

- **Unscientific land filling**
- **GHGs Emission**
- **Maintaining soil fertility**
- **Avoiding the breeding grounds for mosquitoes,casual organism of many diseases and saved precious farm yard Manure(FYM),which are used in agriculture fields and in Biogas plants for sustainable development.**
- **The need of market is the organic compost,to have more yield and protect human race from bio-magnification of pesticides and weedicides.The institute becomes fully organic due to use of college waste generated organic compost.**
- **The micro-climate of campus,got moderate,as due to reduction in the emission of green house gases,hence affecting the overall Environment index due to Environmental performed evaluation.**
- **Operational performance:The two stage composting,a new technique developed,save 88% carbon dioxide emission in comparison to landfills.**

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ENVIRONMENTAL PERFORMANCE EVALUATION(EPE) & ENVIRONMENTAL CONDITION INDICATOR(ECI)

- **Microclimate**:The optimisation of the institute climate in comparison to city due to reduction in green house gases.This microclimate is beneficial for innmates of the institute and makes their stay pleasant and comfortable.
- **Solid Waste Management**:The waste generated compost through windrow composting makes institute fully organic and helped the institute to bag "Best Maintained Campus"at Regional,National and International level,these third parties confirmation is the management performance indicator.
- **Low GHGs Emission**:The single and two-stage windrow composting reduces carbon dioxide emission by74% and 88% respectively and contribute in prevention of environmental global problems like global warming,Ozone depletion,if studies replicated at National level.
- **Scalabilty**:The case study is already replicated in two places in tricity and the reproducibility of results confirms the study adaptability.
- **Reduce dumping sites and landfills**:The segregation at source and windrow composting reduces dumping sites and landfills in campus.This results in GHGs reduction and provide clean and pleasant sight to Human eye.

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