IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

WASTEWATER TREATMENT USING SMS (SPENT MUSHROOM SUBSTRATE)

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ABSTRACT

Spent mushroom substrate (SMS) technology for wastewater treatment is an innovative approach that utilizes the by-products generated from mushroom cultivation to treat wastewater. Spent mushroom substrate refers to the leftover material from mushroom cultivation after the mushrooms have been harvested. This material is rich in organic matter and contains various nutrients, making it suitable for use in wastewater treatment processes. The SMS technology typically involves using the spent mushroom substrate as a substrate or filter medium in constructed wetlands or bio filtration systems. In these systems, the SMS acts as a bio filter, providing a surface for microbial growth and creating an environment where microorganisms can degrade organic pollutants and remove nutrients from wastewater. The effectiveness of SMS technology for wastewater treatment depends on factors such as the type of wastewater being treated, the characteristics of the spent mushroom substrate, and the design of the treatment system. Research has shown that SMS technology can be effective in removing pollutants such as organic matter, nitrogen, and phosphorus from wastewater, while also reducing odors and improving water quality. One of the key advantages of SMS technology is its cost-effectiveness and sustainability. Since spent mushroom substrate is a by-product of mushroom cultivation, it can often be obtained at low cost or even for free, reducing the overall cost of wastewater treatment. Additionally, using SMS for wastewater treatment helps to recycle organic waste and reduce the environmental impact of mushroom cultivation. Overall, spent mushroom substrate technology offers a promising approach to wastewater treatment that combines environmental sustainability with effective pollution control. Ongoing research and development in this field continue to refine and optimize the use of SMS for wastewater treatment applications.

Keywords: Biofiltration, Spent mushroom substrate (SMS), microbial growth, wastewater treatment

1. INTRODUCTION

Slow sand filtration indeed presents a promising solution for water filtration, especially in rural areas where resources and skilled operators may be limited. Its reliance on biological processes for particle removal makes it a sustainable and environmentally friendly option for addressing water contamination issues. Slow sand filtration operates on the principle of allowing water to percolate slowly through a bed of sand, during which biological organisms present in the sand layer actively degrade and remove contaminants. This process can effectively remove a wide range of pollutants, including organic compounds, pesticides, and heavy metals, without the need for additional chemical treatments.

One of the key advantages of slow sand filtration is its simplicity and low maintenance requirements, making it particularly suitable for small communities or remote areas where access to sophisticated filtration systems may be limited. Moreover, the absence of chemical additives reduces the environmental impact associated with conventional water treatment methods. However, it's important to note that slow sand filtration may not be suitable for all water sources or contamination scenarios. Factors such as the composition and concentration of pollutants, as well as the availability of land for filtration basins, need to be carefully considered when implementing this technology. In addition to slow sand filtration, there are other emerging technologies and strategies for addressing environmental contamination, including advanced oxidation processes, phytoremediation, and bio augmentation. Combining different approaches and tailoring solutions to specific environmental contexts can help maximize the effectiveness of pollution remediation efforts.

2. REVIEW OF LITERATURE

Research papers published recently in various international and national journals have been reviewed. Only those papers published in squint reviewed journals have been considered in this literature review. Focus is on cultivation of mushroom and its growth, production, waste generation and treatment, which includes (a) cultivation of mushroom (b) yield performance of mushroom (c) Various effects on environment (d) EIA consideration (e) Industrial waste management. So some are the literatures have taken with considering above core points are as under:

Chu-Wen Yang In this study, SMCs, waste products of mushroom cultivation, were used as a low cost material for the removal of emerging pollutants. This design not only employs the concept of my core mediation but also turns SMCs into a useful resource

Márton Czikkely A special mushroom compost was used as an adsorbent, and they found the heavy metal adsorption properties of this special compost. Heavy metal solutions were used to determine the adsorption processes. The heavy metal solutions were prepared from Cu, Cd and Mn in single, double and triple combinations and in several concentrations.

Alka Singh et al. (2018) focuses on the efficiency of different substrates in Oyster mushroom cultivation. The study found that wheat straw performed the best among various substrates tested, including beans, moonbeams, soybeans, maize stalk, and tree parts residue. The authors highlight the importance of substrate selection for maximizing production efficiency.

Tanmay Kotasthane (2021) investigates the morphology and yield performance of various edible mushrooms, including Pleurotus sajor-caju, P. ostreatus, C. indica, and V. volvacea. The study utilized a substrate mixture consisting of sugarcane bagasse, coconut coir, sorghum, maize stalk, and dust. Pleurotus sajor-caju showed the highest yield on a mixture of jowar and maize stalk, followed by P. ostreatus, while C. indica exhibited good yield on straw. V. volvacea also showed promising yield results. The paper suggests further exploration of these mushrooms for their medicinal properties.

These studies contribute to the understanding of substrate efficiency and yield performance in mushroom cultivation, which is valuable for optimizing production processes and exploring potential medicinal properties of edible mushrooms.

Wastewater treatment involves a variety of methods to remove contaminants and pollutants from water before it is released back into the environment or reused. Here are some common methods of wastewater treatment:

3 METHODOLOGY

1. **Preliminary Treatment**: This involves the physical removal of large objects, such as sticks, leaves, and debris, as well as grit and sand. Screening and grit chambers are often used in this stage.

2**. Primary Treatment**: In this stage, wastewater flows into large tanks where solids settle to the bottom as sludge, and oils and greases rise to the surface as scum. The clarified water in between is then passed on for further treatment.

3. **Secondary Treatment**: This stage removes dissolved and suspended biological matter. It typically involves biological processes where microorganisms consume organic pollutants. Common methods include activated sludge process, trickling filters, and rotating biological contactors.

4. **Tertiary Treatment**: Also known as advanced treatment, this stage further refines the water to remove nutrients, pathogens, and other contaminants. Processes such as filtration, disinfection (e.g., chlorination, UV radiation), and chemical treatment (e.g., flocculation, ozonation) are used.

5. **Advanced Treatment**: Some wastewater treatment plants employ additional advanced treatment processes for specific contaminants or to meet stringent discharge standards. Examples include membrane filtration (e.g., reverse osmosis), ion exchange, and advanced oxidation processes.

6. **Disinfection**: Before discharge or reuse, wastewater undergoes disinfection to kill remaining pathogens. Common disinfection methods include chlorination, ultraviolet (UV) irradiation, and ozonation.

7. **Sludge Treatment and Disposal**: The solid residue, or sludge, generated during the treatment process, undergoes further treatment, such as digestion (anaerobic or aerobic), dewatering, and drying. The treated sludge can be disposed of in landfills, incinerated, or used for agricultural purposes as bio solids.

8. **Resource Recovery**: Some wastewater treatment plants incorporate resource recovery processes to extract valuable resources from wastewater, such as energy (through anaerobic digestion), nutrients (e.g., phosphorus, nitrogen), and water for reuse (water recycling or reclaimed water).

These methods can be applied individually or in combination depending on the specific characteristics of the wastewater and the desired quality of the treated water. Additionally, the choice of treatment methods may vary based on factors such as regulatory requirements, available infrastructure, and financial considerations.

3.1 MATERIALS

- Soil(different types of soil)
- Culture
- Potato - dextrose Agar medium (PDA)
- Potato -dextrose Yeast Agar Medium (PDYA)
- Malt Extract Agar medium (MEA)
- Compost Extract Agar medium (CEA)
- Malt Peptone Grain Agar Medium (MPGA)
- Water (treated , untreated)
- Microbes
- Spawns
- Straw (different crops)
- Substrates

List of chemicals for the production and testing purposes are to be required as under:

- Formaldehyde
- Gypsum
- Urea
- DAP or SSP
- MOP
- Substrate/organic matter
- Disinfectant

3.2 COLLECTION OF DATA

As discussed in the objectives will collect the data from the mushrooms production house, such as type of soil used in the culture, media, type of mushrooms production, quantity and quality of mushrooms, mushroom samples from various industries. Also to make comparisons of many parameters with the different production industries places at various locations.

3.3 FIELD EVALUATIONS

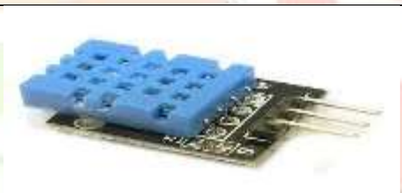
On the field will observe the each and every process of mushrooms in its production. For this need to visit two or many locations of mushrooms for the comparative study, and can analyse the different factors with the findings of negative & positive impacts of mushrooms production on the surrounding environment. The reuse or recycling of waste is done on site or not if so then what are the further effects that will look after.

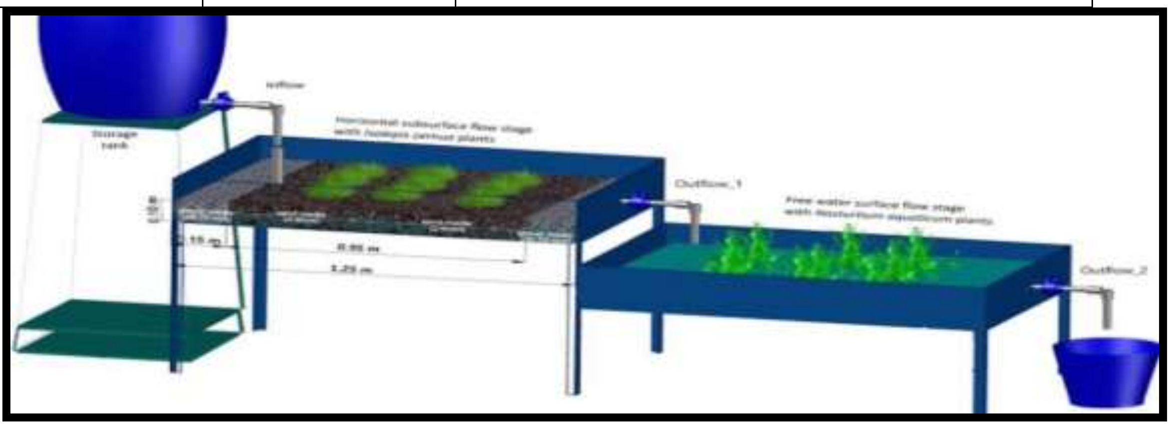
3.4 EXPERIMENTAL SETUP

For the method of composting and casting we require some apparatus for testing variant parameters. In this mushrooms production the mainly we will test the soil, culture, temperature, humidity, moisture, biological, chemical etc parameters for further study and comparisons so we need some set up for doing this test as under:

3.5 STUDY AREA

The sewage treatment plant (STP) of Ujjain, Madhya Pradesh discharged its water after the chlorination process in the fields for irrigation purposes. But, this water is notas much suitable for irrigation because foams are occur in the water due to presence of biodegradable surfactants (e.g. household detergents) from industrial and municipal waste water, excess production of extracellular polymeric substances (EPS) by activated sludge under nutrient condition. So, our aim of study is to check the physico-chemical parameters of the STP water and then remediate it bymycoremediation to make the water suitable for agricultural purposes. In our present study, we remediate the waste water of STP by two methods: Firstly, by Mushroom Extract (M.E.) Secondly, by Microfiltration.

SR NO	NAME OF EQUIPMENT	MEASURING PARAMETERS	INSTRUMENTS
1	Soil testing Machine	Moisture Content	
2	Soil testing kit	Type of soil	
3	Water testing kit	Water parameter as PH, Temp, turbidity etc	
4	Humidity-Temp tester	Counts humidity and temperature both	
5	Microbial counter	Counts microbes, bacterial colony etc	



SET-UP FOR FILTERATION OF WASTEWATER BY USING MUSHROOM

3.6 COLLECTION OF WASTEWATER SAMPLE

The waste water samples were collectedfrom the mounds of the fields in which STP water get discharged for irrigation purposes which are located at Gau Ghat, Hari Phatak , Ujjain , Madhya Pradesh These samples were used for testing the physico-chemical parameters and for the remediation of wastewater by mushroom extract and by mycofiltration in suitable conditions. The testing of samples was carried out at Environmental Engineering Lab, MIT, Ujjain.

3.7 WORK IN PROGRESS

1. Sampling Plan:
   Collect water samples from the some source (STP, Ujjain) for untreated water and treated water at regular intervals and its ensure that samples are collected at the same time and under similar environmental conditions to minimize variability.
2. Experimental Procedure:
   Treat water samples with mushroom extract and conduct mycofiltration according to the experimental protocol. Monitor the treatment process and record any observations or deviations from the protocol. Conduct duplicate or triplicate experiments to ensure reliability and reproducibility of results.
3. Data Analysis:

Compare the physico-chemical parameters of untreated water with water treated by mushroom extract and mycofiltration. Calculate percentage reductions or improvements in each parameter to quantify the effectiveness of the treatment methods. Use statistical analysis (e.g., t-tests, ANOVA) to determine if the differences between treated and untreated water samples are statistically significant.

4. Interpretation of Results:

Interpret the data in terms of the impact on water quality and suitability for various purposes (e.g., drinking, irrigation, industrial use). Discuss any limitations or constraints of the experimental setup and potential areas for future research or improvement. Consider the broader implications of the findings for water treatment and environmental management.

PLEUROTUS OSTREATUS AND BUTTON MUSHROOM PRODUCTION

4 CONCLUSION

1. Baseline Research and Observation:

Conduct extensive literature review on mushroom cultivation techniques, including different species, substrates, and environmental conditions. Observe and document mushroom growth under various circumstances and conditions to identify factors affecting yield.

2. Experimental Design:

Design controlled experiments to systematically test the effects of different variables such as substrate composition, temperature, humidity, light exposure, etc., on mushroom growth. Use statistical analysis to analyse the data and identify optimal conditions for maximum yield

3. Impact Assessment:

Evaluate the economic, environmental, and social impacts of mushroom cultivation activities. Analyse the costs and benefits of mushroom cultivation, including revenue generation, job creation, and market opportunities.

4. Environmental impact assessment: Assess the resource use (e.g., water, energy), greenhouse gas emissions, and waste generation associated with mushroom cultivation. Social impact assessment: Consider the social benefits and challenges of mushroom cultivation, such as employment opportunities, community well-being, and cultural implications.

5. Sustainable Development Strategies:

Identify environmentally sound and sustainable practices for mushroom cultivation, considering the findings from impact assessment and experimental research. Develop strategies to minimize resource use, waste generation, and environmental pollution. Promote the adoption of sustainable practices among mushroom growers through education, training, and policy support.

6. Wastewater Treatment Module:

Develop an eco-friendly wastewater treatment module using spent mushroom substrate (SMS) as a bio filter or adsorbent. Conduct lab-scale experiments to optimize the treatment process and evaluate its effectiveness in removing pollutants from wastewater. Scale up the treatment module for application in mushroom cultivation facilities or other wastewater treatment systems.

7. EIA Module Development:

Design an Environmental Impact Assessment (EIA) module specifically tailored to evaluate the environmental impacts of mushroom cultivation activities. Incorporate indicators for assessing air quality, water quality, soil health, biodiversity, and ecosystem services. Provide guidelines and tools for conducting EIAs and monitoring environmental performance throughout the mushroom cultivation lifecycle.

8. Promotion and Implementation:

Develop outreach and communication strategies to disseminate research findings and promote sustainable mushroom cultivation practices. Collaborate with industry stakeholders, government agencies, NGOs, and academic institutions to implement recommended strategies and policies. Monitor and evaluate the adoption of sustainable practices and the effectiveness of wastewater treatment modules over time

By following this structured approach, we can contribute to the promotion of environmentally sound and sustainable development in the mushroom cultivation sector while addressing economic and social concerns.

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