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USE OF FRESNEL LENSES IN SEWAGE TREATMENT PLANT FOR ANALYSIS OF FECAL & COLIFORM BACTERIA

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Abstract: Solar disinfection using Fresnel lenses is an innovative method for treating wastewater effluent from sewage treatment plants (STPs). This study focuses on site selection criteria, sample collection techniques, Fresnel lens selection considerations, and wastewater testing protocols. The project aims to harness natural UV radiation from sunlight to disinfect wastewater effectively. Key findings include the importance of maximizing solar irradiation, avoiding shadows, proximity to the source, considering flow rate, land availability, grid connection, compliance with environmental regulations, and community acceptance. Sample collection methods ensure the integrity of water samples for accurate analysis. Fresnel lens selection involves defining project requirements, considering focal length, effective aperture size, material, optical efficiency, mounting, tracking, cost, and supplier support. Wastewater testing evaluates parameters such as temperature variation, microbial content, dissolved oxygen, BOD, COD, pH, MLSS, turbidity, and color. The project cost includes materials and testing expenses. Solar disinfection effectively reduces bacterial contamination, making it a preferred method for wastewater treatment.

Key Points - Solar Disinfection, Fresnel Lens. Methodology, Site, Selection, Sample Collection, Cost of Project, Test to Be Conducted

I. INTRODUCTION

Solar disinfection with fresnel lenses is an innovative approach for treating wastewater effluent from sewage treatment plants (stp) the study focuses on site selection, sample collection, fresnel lens selection, and wastewater testing protocols. The objective is to utilize natural uv radiation from sunlight to effectively disinfect, we are focusing on evaluating the efficacy of fresnel lenses in killing Fecal & Coliform Bacteria, document all experimental procedures, data, obtaining result and preparing comprehensive report summarizing the findings of the efficacy study, including statistical analyes and graphical representation discussing the implications of the results and potential applications of solar disinfection using fresnel lenses in wastewater treatment.

II. METHODOLOGY:

Site Selection:

We have selected the site based on criteria such as solar irradiation in Pune, Maharashtra, India, on average receives solar radiation of 3.5-6.5 kWh/m2/day, with around 12 h, Shadows, proximity to the STP discharge point, flow rate, land availability, and compliance with environmental regulations.

Sample Collection:

Water samples are collected from the STP tank using clean, sterilized containers. Sampling equipment and procedures ensure the integrity of the samples for accurate analysis.

Fresnel Lens Selection:

The effective aperture size of the Fresnel lens determines the amount of sunlight it can capture and concentrate. We have Selected 150 mm x 150 mm an aperture size suitable for our intended application and target area. Larger aperture sizes capture more sunlight and provide higher intensity, while smaller apertures are more compact and may be suitable for smaller-scale applications. Factors such as focal length, effective aperture size, material, optical efficiency, mounting, tracking, cost, and supplier support are considered for selecting the appropriate Fresnel lens.

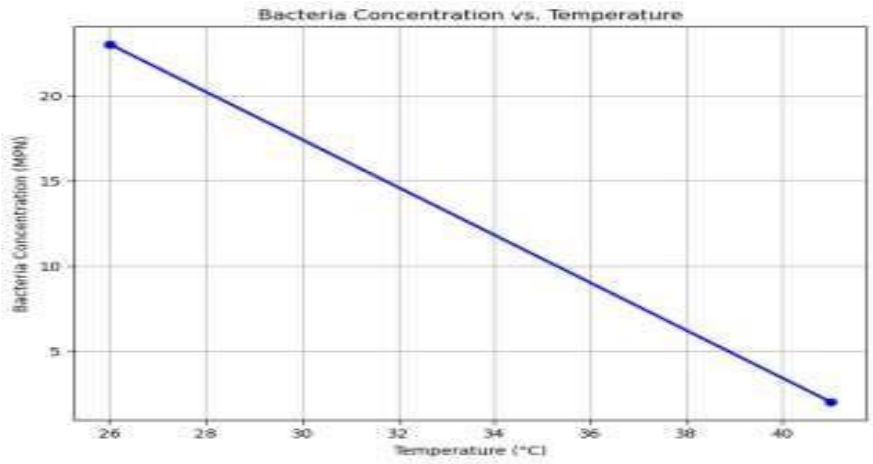
Wastewater Testing: The wastewater was exposed to the Fresnel lens for a duration of 42 minutes, resulting in a temperature increase of 15°C. The sunlight was concentrated over a 20 mm surface area of the waste water. Also various tests are conducted to evaluate parameters such as temperature variation, microbial content (including fecal and coliform bacteria), dissolved oxygen, BOD, COD, pH, MLSS, turbidity, and color.

Results:

TESTE	SAMPLE	Test Result
DO	2 mg/L	NO CHANGE
BOD	70-75 mg/L	NO CHANGE
COD	200 mg/L	NO CHANGE
PH	6.7	NO CHANGE
MLSS	70 mg/L	NO CHANGE
Fecal & coliform	26 mpn/100 ml	>2mpn/100 ml

III. ANALYTICAL APPROACH

The research findings indicate that the Fresnel lens treatment did not significantly alter the characteristics of the wastewater, including dissolved oxygen, BOD, COD, pH, and MLSS but Fecal & Coliform has reduced from 26 mpn/100 ml to > 2mpn/100ml,



OBSERVATION:

Here, Total solar energy consumed to reduce bacteria from 26 mpn to > 2 mpn are calculated from following process

Fresnel lens Focal length	150 mm
Concentrated Sunlight Diameter over waste water	20 mm
Initial Temperature Of Water (T1)	25° c
Final Temperature Water (T2)	41° c
Temperature Difference In Water (T2 – T1)	15° c
Waste Water Sample Taken	100 ml

Calculation

Total energy conservation
= m x c x ΔT
= 100 ml x 4.186 joule/gram $_{o}$C x 15° c
= 6279 J

Total 6668 J solar Energy consumed for effective disinfection from 23 MPN/ 100 ml to >2 MPN/ 100 ml of Fecal & Coliform Bacteria.

IV. COMPLIANCE ASSESSMENT

The results are compared against relevant standards and regulations set by organizations such as the Bureau of Indian Standards (BIS) and the Maharashtra Pollution Control Board (MPCB) to evaluate compliance with wastewater quality guidelines.

Total and Fecal Coliforms:

Fecal coliform found in sample: 23 mpn/100 ml
Permissible limit as per IS 1622, 1982: >2 mpn/100 ml
Test result: >2 mpn/100 ml

V. CONCLUSION:

The research findings indicate that raising the temperature of the wastewater from 26 degrees Celsius to 41 degrees Celsius using a Fresnel lens is a form of solar disinfection, and it appears to have been quite effective in reducing the fecal coliform count from 23 MPN to less than 2 MPN per 100 millilitres,

i. Total 6668 J solar Energy conserved for effective disinfection of 23 MPN/ 100 ml of Fecal & Coliform Bacteria.
ii. >2 MPN/100ml, bacteria are remained in waste water after 41 minutes of solar exposure under Fresnel lens. which is confirming the requirement of IS 1622 (1981)

Also, the research findings indicate that the Fresnel lens treatment did not significantly alter the characteristics of the wastewater, including dissolved oxygen, BOD, COD, pH, and MLSS.

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