KALASALINGAM
ACADEMY OF RESEARCH AND EDUCATION
(DEEMED TO BE UNIVERSITY)
Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A++" Grade

EXSEL
EXperiential and SErvice Learning

EXSEL – Experiential Core
Design, Build, Operate Project

WATER VERTICAL

Problem Statement:
Smart Water Treatment (Laundry Effluent)

PS No: 10

Team No:06

Room No:11510

Faculty Mentor: Dr Naresh KS / Biotech

2024 - 2025

STUDENT FILE

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PS NO	
TEAM NO	**06**
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SIGNIFICANT CONTRIBUTION IN THE TEAM	**Experiment setup and monitoring**

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1. EXECTIVE SUMMARY

The photocatalyst process using ZnO is inexpensive comparing to all the other process. Here we check the COD, PH, TDS and TURBIDITY for the both treated and untreated water. We add ZnO at the corner of the containers and we give light source to it.

Then we give aeration to the containers and then it removes the dyes, oils, debris and microplastics contain in the water. After it undergoes UV light and treated comes out.

2.BACKGROUND OF PROBLEM STATEMENT

The problem statement defines that in our college all the laundry waste water was 50000 litres per day. And also they wash 3000 kg clothes per day. And they spent 1 ½ lakh rupees per buying water per month. The laundry waste water contains dyes, microplastics, debris, oils, grease, fibres etc present in the water**.**

3.GAPS IN EXISTING SOLUTION:

- Zinc oxide has wide band gap which restricts its absorption to UV light
- It is highly sensitive to pH changes and can dissolve in acidic or basic environments due to its amphoteric nature.
- Large-scale application of ZnO photocatalysis face challenges like material cost, energy efficiency.
- ZnO may not degrade all pollutants effectively

4.TARGET / SITE DESCRIPTION

1.Sewage water treatment plan:

A sewage water treatment plant is designed to treat wastewater from domestic, industrial, and commercial sources before it is released into the environment or reused**.** It contains some stages. They are:

1**.**WATER INLET: all the sewage waste water comes into water inlet

Screening: It removes Large debris, such as plastic, sticks, and rags, through screens.

2.PRIMARY TREATMENT: Here sludges settles down at the bottom of the containers.

3.Then we give aeration to the tanks.

4.After that we perform sand filtration and chlorine treatment.

5. Lastly treated water comes out.

2.Drinking water treatment plan:

- **A**ll the water collected in tank called storage tank.
- We connect the storage tank to feed pump.
- Then we transform those water into multigrade filter, activated carbon filter to filter the water to drink
- Then it undergoes through anti scalant dosing.
- Then the filtered water goes under micro filter.
- After we give high pressure pump to the water.
- After filtering the water we reject the water which is unused and we use those water for gardening purpose.
- Treated water undergoes UV light and goes into permeate storage tank.
- Then we supply the water for drinking purpose.

3.Laundry waste water treatment:

Usage of water:

- Daily they wash 3000 kg clothes.
- And also they use 50000 litres of water per day.
- They will spent 1,50,0000 rupees for buying water per month.

We examined the laundry water for the values COD, PH, TDS and TURBIDITY.

PH:

1. Buffer solution used to measure PH.
2. Firstly we have to clean the rod with normal water.
3. Then we put the rod in the buffer solution to neutralize the PH as 7.13
4. After we put the rod in the laundry water.
5. We got PH value as 7.63.

TDS:

1.It is used for conductivity and salinity.

2. Here we don’t use any solution. We directly measure the value.

3. We got TDS = 0.36 ppt.

TURBIDITY:

1.We use buffer solution in this.

2.To check turbidity we have one beaker. We have to fill the buffer solution in that beaker upto the line present in the beaker.

3.Then we put the beaker in the machine and set the value to 0.00

4. Then we pour laundry water into the beaker and check the value after 5 minutes.

5. We got Turbidity=0.01 NTU.

5.PROPOSED SOLUTION

Collection and Pre-Treatment:

- Collect laundry wastewater in a tank.
- Remove large particles or debris using a simple filtration system.

Photocatalyst Selection:

- Use a photocatalyst such as zinc oxide (ZnO). It's highly effective, inexpensive, and widely used in photocatalytic processes.
- The photocatalyst can be in powder form.

Reaction Setup:

- Add the waste water into first container and check the COD, PH, TURBIDITY and TDS
- After checking the values then the water goes to aeration tanks which are in next container and in this container photocatalyst(ZnO) is present at the corners if the container.
- We have to keep the glass walls for the aeration container because light has to pass for the ZnO.
- Then treated water comes out and the again we test the values of COD, PH, TURBIDITY and TDS.

UV/Visible Light Source:

- After performing all the tests the treated water undergoes UVlight and comesout through the outlet.

6.NEED FOR PROPOSED SOLUTION:

The need for our proposed solution is

- We are using photocatalyst process using ZnO chemical.
- We check the COD, PH, TDS and TURBIDITY values for both treated water and untreated water. It removes the dyes and microplastics from laundry water.
- We attach the glass tubes at the corner of the container to pass the light through the container, because ZnO wants the light source to it..

7.APPROACH AND METHODOLOGY

Problem Identification**:**

- Analyze the characteristics of laundry wastewater, including chemical oxygen demand (COD), pH, dyes, and other contaminants.

Objective:

- Develop an efficient, cost-effective, and environmentally friendly system to treat laundry wastewater using photocatalysis.

Technology Selection:

- Select a suitable photocatalyst (e.g., Zinc oxide, ZnO) based on its proven efficiency, availability, and cost.
- Choose a light source (UV or visible light) compatible with the photocatalyst.

METHODOLOGY :

we implement our product in some steps. They are:

1.WATER INLET: Firstly we collect the all laundry waste water from all the hostels and stores in tank called inlet.

2.After collecting all the water we perform screening, In screening any large granules, debris will be removed and also filters the water.

3.After filtering the untreated water can be poured into large containers, then we perform some operations to know the levels of COD, TURBIDITY, PH, TDS. After finding these levels we come to know how much percentage the dyes can be removed.

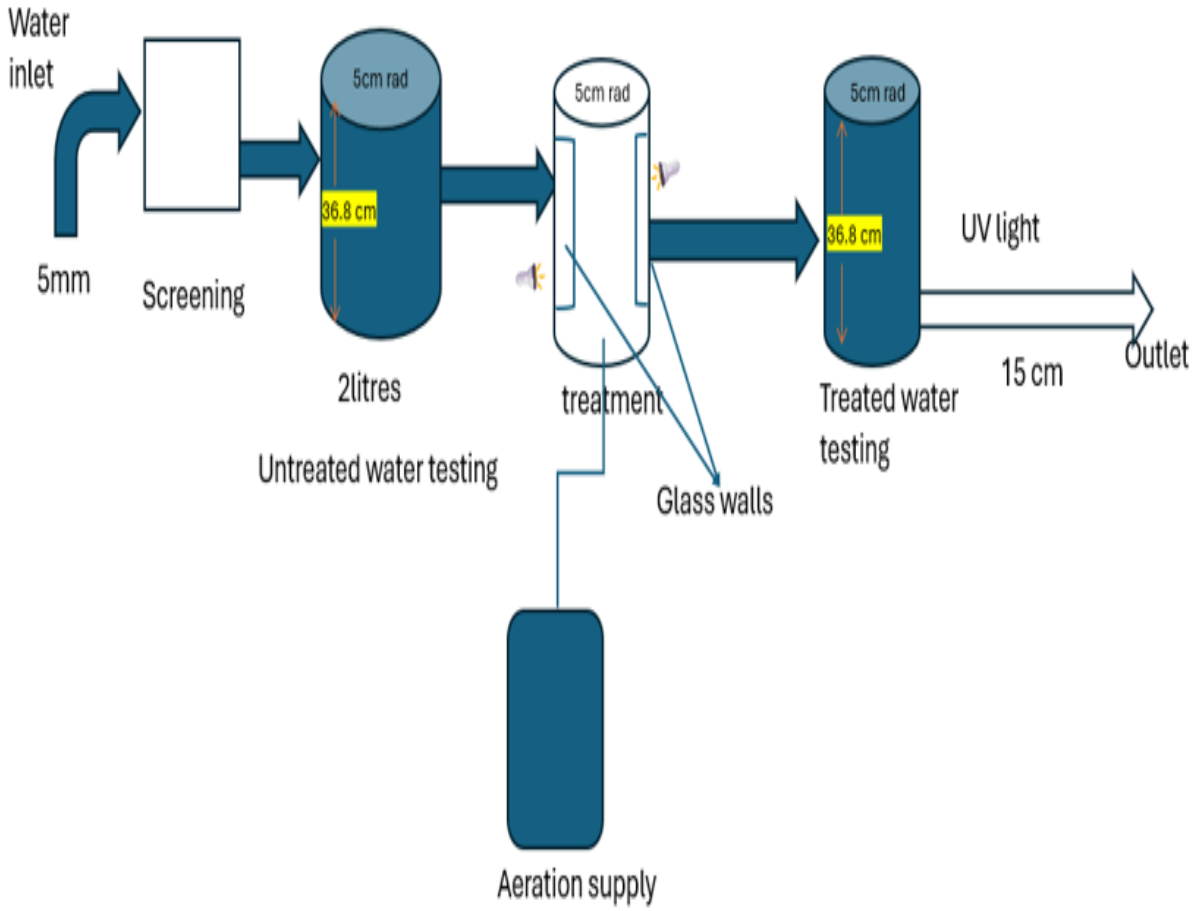
4.Then water goes to next container, there we keep aeration tanks to grow microorganisms and metabolize organic matter.

5.After that we get treated water in another container. Here also we perform the COD, TURBIDITY, PH, TDS again to check the treated water percent.

6. Lastly we check with the UVlight, if any microorganisms are present.

7.The untreated water goes out through outlet.

8.DESIGN DETAILS



9.WORK PLAN

WEEK-1:

We selected the teams according to our idea.

WEEK-2:

I have gone through our problem statement in very detail and also understood it very clearly.

WEEK-3:

In this week I come across the different techniques of solutions for the problem statement and our team discussed and selected one technique.

WEEK-4:

We gone through our technique of solution very clearly. And also we prepares a sample ppt for our solution.

WEEK-5:

We designed the flow diagram for our solution and also I prepared the document of report till we done our research.

WEEK-6:

We will come across more detailed step by step process and design of our solution.

WEEK-7:

We will list out the components and also how much quantity needed for the proposed solution**.**

WEEK-8:

We will prepare the cost analysis for each and every component and total cost for the proposed idea.

10. BENCH MARKS

- It degrades the percentage of pollutants up to 90%.
- ZnO typically ranges in between 0.01−0.1 min−
- Photocatalyst dosage reduces to 0.1–2 g/L.

11.COST AND PAYMENTS

Initial Cost:

Components	Quantity	Cost(in Rs)
ZnO.	1kg	290
Plastic Containers	2	500
Pipe(5mm)	1meter	160
Led lights	2(5w)	130
UVC	1	345
Cloth filter	1(10*10 cm)	150
Glass Container	1	400
ZnO coating glass rod	1	700
pH meter	1	615
Total:		3290

Operation Cost:

Components	Operational Frequency	Cost(in Rs)
Energy Cost	monthly	25
ZnO Powder	One time	100 - 300
Total:		650 approx

Maintenance Cost:

Components	Maintenance Frequency	Cost(in Rs)
Cleaning	**monthly**	**20**
Uv light Replacement	**6 – 12 months**	**500**

12. BENEFITS

Pollutant degradation:

It removes dyes from the clothes.

Cost-Effective and Abundant:

ZnO is inexpensive

Eco-Friendly and Sustainable:

ZnO is reusable and it eliminates the use of Additional chemicals.

13.LEGAL MATTERS

Environmental Regulations:

- Water Pollution Control Laws-U.S. Clean Water Act
- Effluent Discharge Standards-limits on chemical and biological contaminants in treated water.

Occupational Health & Safety Laws:

- Chemical handling and worker protection laws
- Nanoparticle handling guidelines

Waste Management Laws:

- Hazardous and non-hazardous waste management regulation
- Nanomaterial waste handling

Patent and Intellectual Property:

- Protected by existing patents
- Patentable if it's novel, non-obvious, and has industrial applicability.

Product & Process Certification:

- ISO standards
- Local standards for graywater recycling

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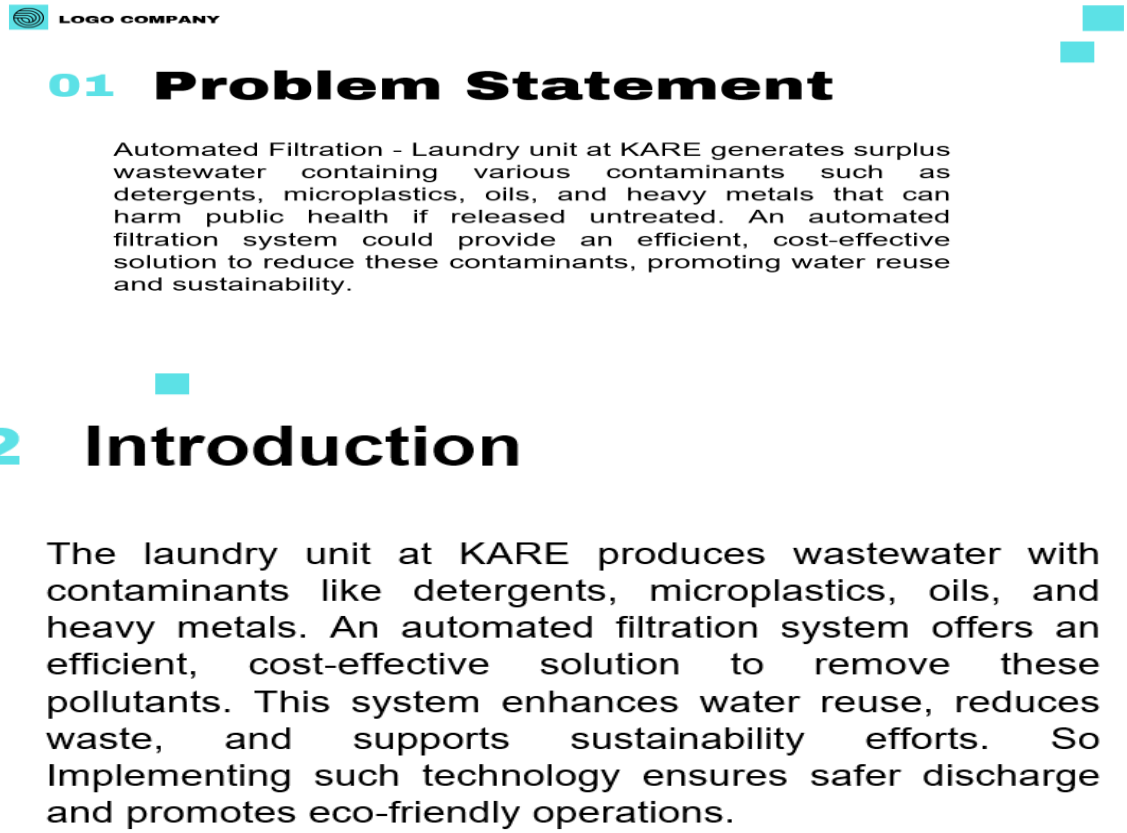
14.ZEROTH REVIEW REPORT

In Zeroth review report we have done the following:

- We have an idea to treart the water by IoT-Enhanced Hybrid Membrane Bioreactor with Advanced Oxidation Process for Sustainable Wastewater Treatment, but by our mentors suggestion we changed our process of filtration.
- Furtherly we selected the photocatalysis process using ZnO.
- Then we studied about the process clearly and moved further.

15.ZEROTH REVIEW SLIDES



03 Abstract

An automated filtration system for the KARE laundry unit can effectively remove contaminants like detergents, microplastics, oils, and heavy metals from wastewater. This system enhances water quality, ensuring environmental safety and reducing public health risks. By enabling water reuse, it promotes sustainability and cost-effectiveness. Implementing such a solution supports eco-friendly practices and resource conservation.

4 Literature survey

S.NO	AUTHOR	TITLE	METHODS
1.	Enviro Chemie Team	Ideal Treatment of Laundry Wastewater with Ultrafiltration Installations	1.Ultrafiltration 2.Pre-treatment 3.Water Reuse
2.	Researchers at MDPI	Advanced Treatment of Laundry Wastewater by Electro-Hybrid Ozonation–Coagulation Process	1.Electro-hybrid Process 2.Advanced Oxidation 3.Microplastic Removal
3.	BOLLFILTER Engineers	Filtration Solutions for Water & Wastewater Treatment Plants	1.Self-Cleaning Filtration 2.Particle Removal 3.Automation
4.	E3S Conferences Team	The Use of Moving Bed Bio-Reactor to Laundry Wastewater Treatment	1.Moving Bed Bio-Reactor 2.Biological Treatment 3.Sludge Reduction
5.	Oxidation Technologies Researchers	Laundry Wastewater Treatment for Its Reuse in Washing Processes	1.Coagulation-Flocculation 2.Filtration 3.Ozonation
6.	S. R. Moharir , P.A. Patni , A.V. Datar [n]	Study of treatment of laundry wastewater treatment	1.Chemical Precipitation 2.Chemical Precipitation+Detox 3.Adsorption,4.Aerobic treatment

06 Existing Methods:

1. Ultrafiltration (UF)
2. Reverse Osmosis (RO)
3. Activated Carbon Filtration
4. Sand and Multimedia Filtration
5. Ozonation
6. Coagulation and Flocculation

07 Proposed solution

- We use photocatalyst process to reuse the laundry water.
- In this photocatalyst process we use ZnO to remove dyes, microplastics, oils etc from laundry waste waster.
- We perform screening to remove large debris from waste water.
- We also check the PH for before and after the process done.

16.FIRST REVIEW REPORT

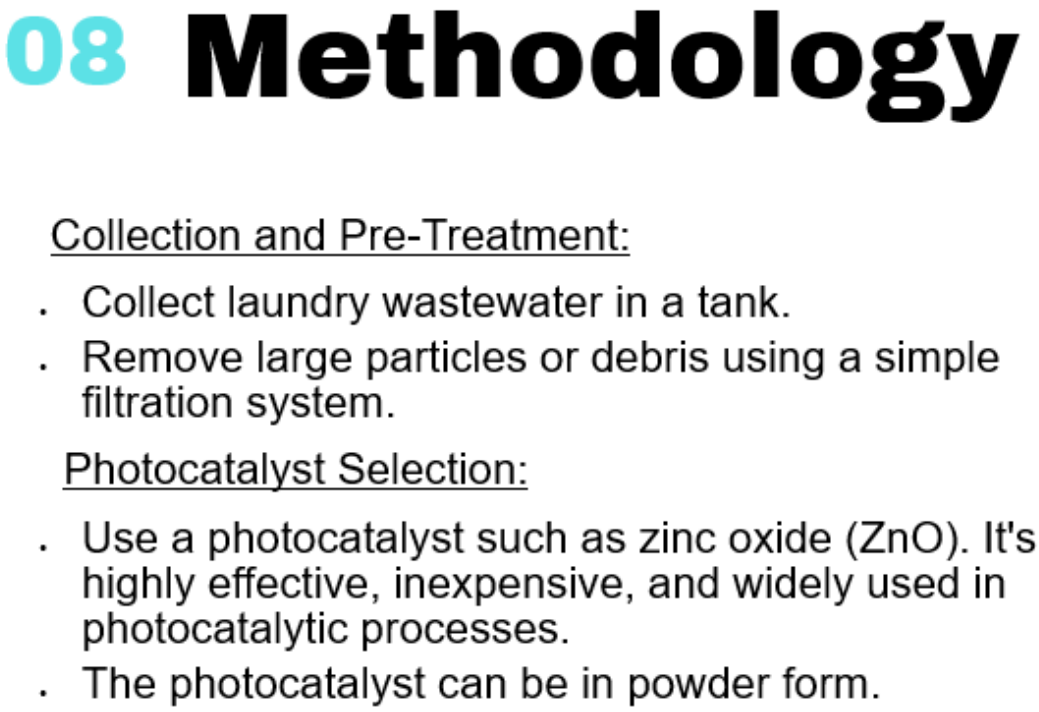
Initially we checked whether our process will work or not.

Initially we setup the process in a beaker with laundry waste water with ZnO coated glass slide.

Then we given aeration to the beaker for mixing with the semiconductor.

And also we give light source to release photons to react with ZnO.

17.FIRST REVIEW SLIDES



Reaction Setup:

Add the waste water into first container and check the TURBIDITY .

After checking the values then the water goes to aeration tanks which are in next container and in this container photocatalyst(ZnO) is present at the corners if the container.

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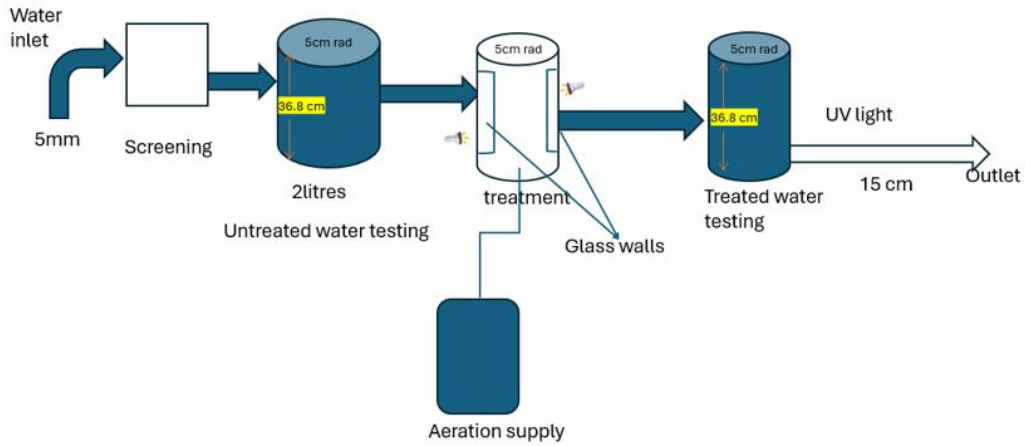
Then treated water comes out and the again we test the values of TURBIDITY

09 Design Details



10 Experiment Setup

12 Initial cost

Components	Quantity	Cost(in Rs)
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13 Operational cost

Components	Operational Frequency	Cost(in Rs)
Energy Cost	monthly	25
ZnO Powder	One time	100 - 300
Total:		650 approx

14 Maintenance cost

Components	Maintenance Frequency	Cost(in Rs)
LED bulb	yearly	20
UV light Replacement	yearly	1000
	Total	1020

19.REFERNCES

- **Kansal, S. K., Singh, M., & Sud, D. (2007)**

  Title: Studies on photodegradation of two commercial dyes in aqueous phase using different photocatalysts.

- **Daneshvar, N., Salari, D., & Khataee, A. R. (2004)**

  Title: Photocatalytic degradation of azo dye acid red 14 in water: Investigation of the effect of operational parameters.

- **Ahmed, S., Rasul, M. G., Martens, W. N., Brown, R., & Hashib, M. A. (2010)**

  Title: Heterogeneous photocatalytic degradation of phenols in wastewater: A review on current status and developments.

- **Akpan, U. G., & Hameed, B. H. (2009)**

  Title: Parameters affecting the photocatalytic degradation of dyes using TiO_2-based photocatalysts: A review.

- **Gupta, S. M., & Tripathi, M. (2011)**

  Title: A review on the synthesis of ZnO nanostructures and their applications.

20.APPENDIX I

Materials:

- ZnO
- Laundry waste water
- Distilled Water

Experimental Setup:

- Glass slide with ZnO coating
- Light to penetrate
- Aerator

Characterization Techniques:

- Turbidity Sensor
- TDS Value
- PH Meter