AQUA TERRA

Environmental & Sustainable Hotel Using Greywater and HVAC System

Civil & Environmental Engineering & Architectural Engineering Depts

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Background

– Problem Statement

Hotels in Saudi Arabia need greywater recycling and energy-efficient HVAC systems due to limited water and high energy consumption. The country's arid climate requires HVAC for guest comfort, but this contributes to high energy use and carbon emissions. Sustainable water management policies like Saudi Vision 2030 aim to reduce consumption in the hospitality industry. Implementing eco-friendly practices can attract environmentally conscious guests and align with policies.

– Constraints

1- Water Quality: Unpredictable quantity and quality and space availability

2- Energy Efficiency: To maintain visitor's comfort

3- Compliance with safety structural rules: Complying with Saudi Building Code (SBC).

- Target Specifications

• **Targeted specification for Greywater:**

Parameter	Unit	Recommended Water Quality Standards
Turbidity	NTU	<= 5
PH		6 - 8.4
Total suspended solids (TSS)	mg/L	<=10
Chemical oxygen Demand (COD)	mg/L	<=50

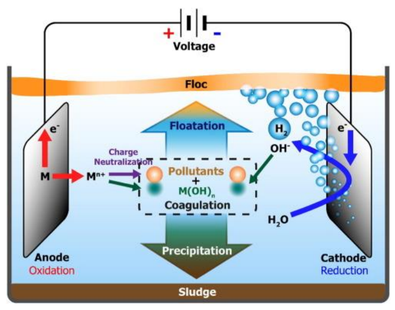
• **Targeted specification for HVAC:**

Envelope	walls	U-Value	0.454	R-Value	2.06
	Roof	U-Value	0.272	R-Value	3.54
	Fenestrations	U-Value	2.83	SHGC	0.25

Prototype Design

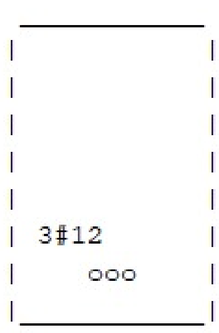
Water Treatment Design: Electrocoagulation process will be used in this project. This process needs to have 3 tanks and depends on the following parameters to design a proper system:

- Flow(Q)= 52 m^3/day
- Volume(V)= 0.72 m^3
- Number of electrodes sheets = 6
- A/V =(150 - 450) m^2/m^3
- Total surface area= 14.4 m^2



Structural design: this part was performed using STAAD PRO software, to design and analyze the building structurally. Some criteria were used using SBC as shown in the cross-section of a beam, such as:

- Minimum cover to be =25 mm
- space between bars = 56.8 mm



HVAC Design

Testing

Proof that specifications were met

A- Water Treatment: Two samples were taken, one before conducting treatment, and one after doing the treatment:

- **Turbidity:** it was measured by Turbidimeter which is the key indicator to our experiments. A 97% efficiency was achieved in this test and the most important is that is within our specifications. (154 - 4.7)/154 *100 = 97%
- **Total suspended solids (TSS):** it was measured by gravimetric analysis of water, using 50 mL sample and 0.45-micrometer paper filter and left for 1 hour in the oven of 104 C, using the following formula to calculate TSS:

Weight before	weight after
1.8419 g	1.8423 g

$$\frac{Weight_{final}(g) - Weight_{initial}(g) \times 1{,}000{,}000}{Sample\ Volume\ (mL)} = mgTSS/L$$

TSS = 8 mg/L

- **pH:** pH meter was used to determine PH before treatment 8, and 6.47
- **Chemical Oxygen Demand (COD):** it was measured by a COD analyzer, and reading before treatment was 86 mg/L, and after treatment was 44 mg/L

Conclusions