

Evaluating vertical greenery system:

Impacts on indoor air quality, water management and energy performance in a controlled chamber

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OBJECTIVES

To study the impact of a vertical greenery system (VGS) in an office space on:

- ✓ indoor air quality,
- ✓ energy consumption,
- ✓ graywater reuse.

Methodology - Scenarios

2 VGS¹ of 1.4m x 2.10m each
Total area: 5.88m²



Length: 3.7m
Height: 2.6m
Width: 4.9m
Vol.: 47m³

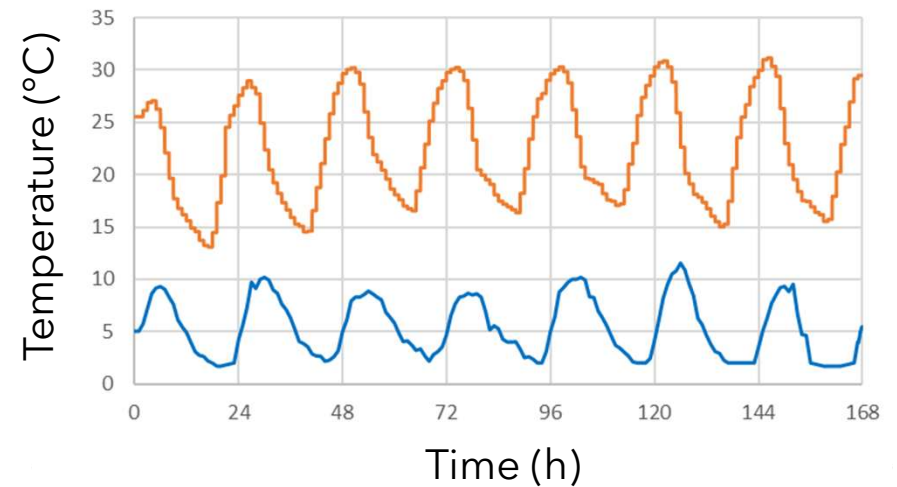
¹Aglaonema, Epipremnum aureum, Nephrolepis exaltata, Dracaena fragrans, Chamaedorea elegans, Spathiphyllum wallisii, Chlorophytum, Hedera helix, Begonia rex, and Tradescantia zebrina.

Winter mode: 1 week in February 2015²

1. Heating provided by an electric heater set to 21°C

Summer mode: 1 week in Augustus 2022²

2. Cooling with chilled ceiling set to 24°C
3. Floating temperature - No system



²Measurement taken at the Arlon Campus weather station

Methodology – By field

ENERGY - Impact of VGS

Energy consumption - Measurement of heating/cooling power and energy by scenario

Thermal conditions - Measurement of indoor temperatures and relative humidity

AIR QUALITY - Monitoring

Spore release - VOC concentrations - Formaldehyde concentrations -

Dry deposition potential¹ (PM_{2.5})

Sampling for each scenario - Days 1, 4 and 7

- ✓ [Empty chamber]
- ✓ [Chamber with source²]
- ✓ [Chamber with source² and GW system]

GREYWATER MANAGEMENT - Analyses in and out

Suspended solids, carbonaceous substances, forms of nitrogen and phosphorus, major elements (Ca, Mg, Na, K)

2 identical VGS

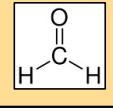
- ✓ wall 1: irrigated with tap water;
- ✓ wall 2: with greywater.



¹ <https://doi.org/10.3390/Plants13121633> - « Advancing Methodologies for Investigating PM_{2.5} Removal Using Green Wall System », C. Falzone et al., 2024

² freshly painted gypsum board

Results – Impacts of VGS

 ≈29 L/wall f: 15 days								
 Winter	Set to 21°C	↗	↗		x1	x10 ↘	↘	Profil modification 
 Summer « Floating »		↘	↗↗	Not measured	x2 ↗	x2 ↘	↘	Profil modification 
 Summer « Cooling »	Set to 24°C	↗↗	↘		x2 ↗	x2 ↘	↘	Profil modification 

⚠ During periods of prolonged absence, if there is no active ventilation or heating/cooling system
 ➔ Significant risk of damp in the premises (RH >97%)



Irrigation optimization

Ideal 100L/wall, frequency 1 per 15 days (more than seller's indication : 30L/week)

Graywater reuse

- Diminution of carbonaceous substances ≈ 80% and other >90%.
 - No impact on the plants.
- Best solution

Conclusions

Experiment

Energy

Cooling effect of the walls: **winter** – slight increase in energy consumption; **summer** – reduced energy consumption.

Impact on relative humidity: positive effect in winter; very negative effect in summer.

Water reuse

Water demand: more than seller's prediction.

Graywater reuse: water savings, no visible effect on plants, significantly less polluted graywater.

Air Quality

Concentrations of formaldehyde and VOCs decrease in the presence of VGS. However, poor ventilation and uncontrolled watering lead to mold growth.

Constraints

Individual experimental requirements of teams

Walls were covered with aluminum to limit exchange between materials and air during air quality experiments, which could affect radiant temperature measurements used for thermal comfort calculations.

Coordination of research teams

Tests are subjected to availability and scheduling constraints.

Physical presence is required in the test area during air sampling → impact on internal airflow within the chamber

Other

Problems in the climate-controlled chamber can affect several experiments (e.g. power cuts, irrigation issues, etc.)

Thank you

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