Zukunft Bau

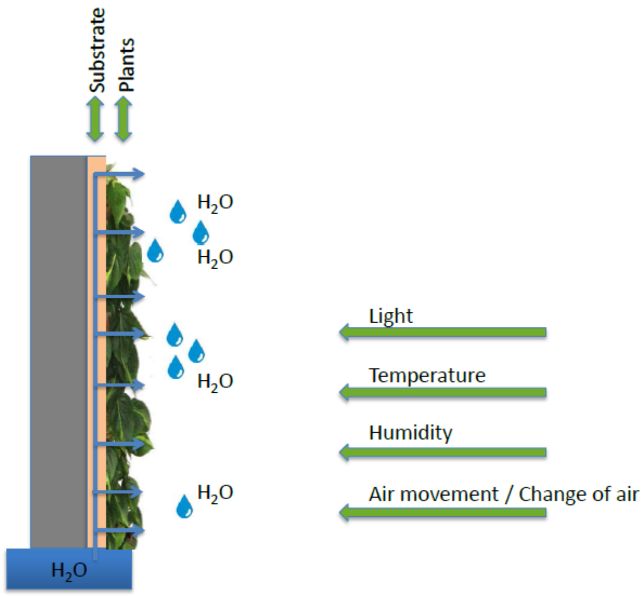
Structure / table of content Short report

Title

Indoor greening as a predictable, decentralized support for climate control in low-energy buildings.

Scientific ratio

Due to the effective insulation and the ventilation with heat recovery the relative humidity in low-energy buildings might be very low. Air humidifier can be used to restore an ambient humidity. However, humidification often results in elevated levels of germs in the air. In this study it was tested whether vertical indoor greening improves the room climate in respect to the humidity.



Pic. 1: Diagram of the mode of action of functional, vertical greenings

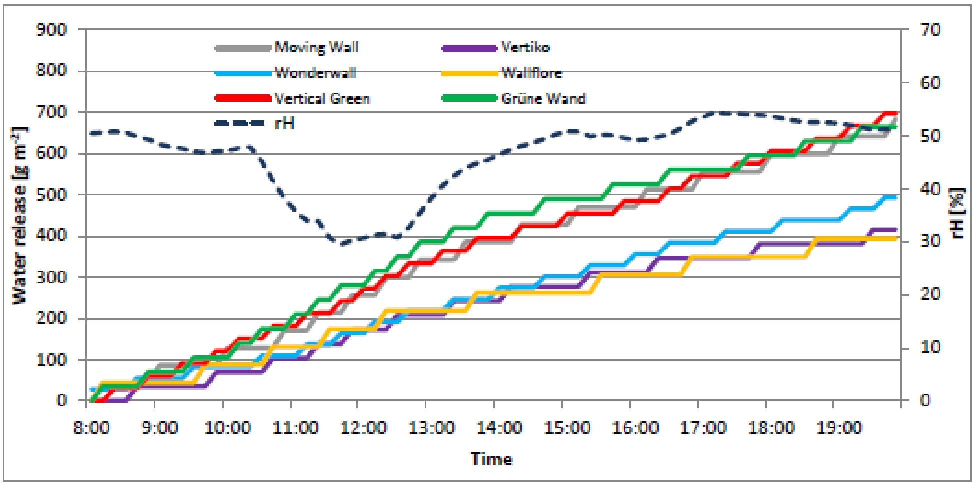
Aim and scope of the project

Six vertical indoor greening systems were selected based on the level of water that they release from the substrate. These are: Moving Wall (Sempergreen Vertical Systems, NL), Vertiko (Vertiko GmbH, D), Wonderwall (Copijn Utrecht, NL), Wallflore Flex (Wallflore Systems, NL), Vertical Green (Ruof Grün Raum Konzepte, D) and Grüne Wand (H&W Bewässerung GmbH, D). The amount of water that was released as vapour by each greening was calculated from the loss of weight. Tests were conducted under controlled conditions in a greenhouse. The room climate was monitored continuously and correlated to the amount of water released by each greening system.
Then, the transpiration response to varying climate conditions was tested. The test was conducted without and with planting (*Philodendron hederaceum*). The frequency

and level of irrigation was adjusted to the needs of the planting. The amount of water release varied between 25 (Wallflore) und 50-56 g m^{-2} h^{-1} (Vertical Green, Grüne Wand, Moving Wall). The systems Grüne Wand und Vertical Green showed a self-regulatory effect related to the air humidity and the best adaptation to changing climate conditions. The main factors influencing evaporation were air velocity and light irradiation. Temperature had a minor effect. The systems Grüne Wand and Vertical Green also provided the best water supply for the planting. As a result, the two systems showed the best plant growth and were superior in their optical appearance.

Pic. 2: Experimental setup in the greenhouse - six different indoor greening systems with planting on scales

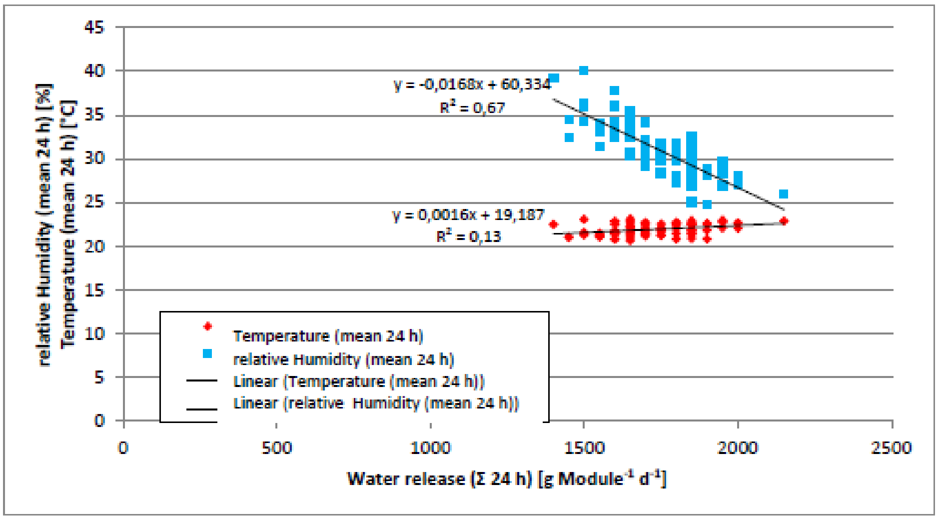
Parallel to the experiments in the greenhouse climate data of two low-energy buildings were collected periodically (ZAE Bayern and Finanzamt Freising). The building ZAE Bayern was chosen for further experiments since it showed a less favourable room climate. In the last part of the project the indoor greening system Grüne Wand was implemented into three offices. The system was chosen because it showed the best performance in the previous tests. Two office rooms were used as control.



Pic. 3: Water release of systems with planting at optimized irrigation (summarized values from 13.2.14 8:00 to 19:50) in relation to relative humidity in the greenhouse

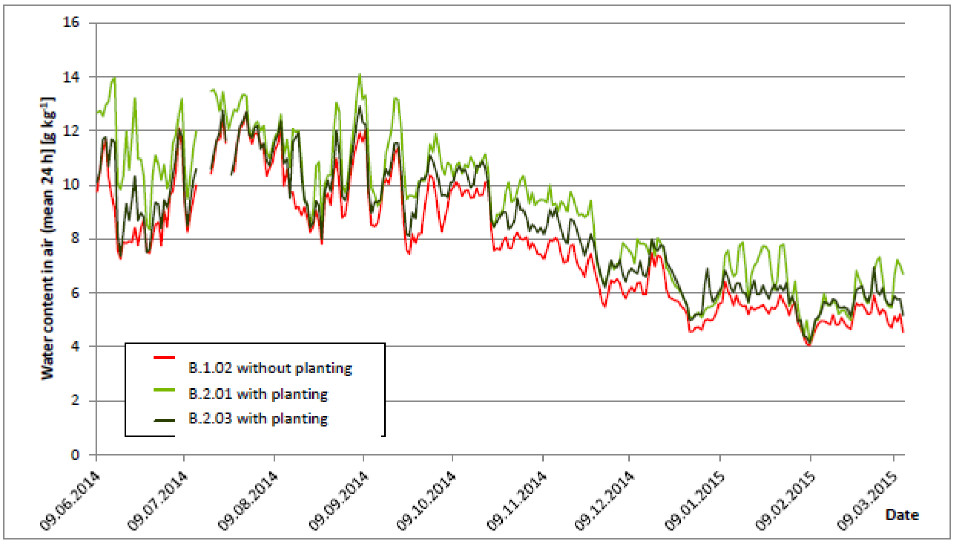
Pic. 4: Experimental setup in room A.1.02 with Grüne Wand on scales

The data showed that the level of evaporation strongly correlated with the humidity of the room. Thus, evaporation was high at low humidity and vice versa. In the smaller offices with an indoor greening of 0.72 m² evaporation was 35 g m^{-2} h^{-1} at high humidity and 76 g m^{-2} h^{-1} at low humidity. In the larger office equipped with 1.44 m² of planted area evaporation was 41 g m^{-2} h^{-1} at high and 53 g m^{2} h^{-1} at low humidity. On average evaporation per m^2 of planted area was 50 g m^{-2} h^{-1} in offices and greenhouses. In smaller offices, in which door and windows were closed most of the time, relative humidity increase by 20 percentage points compared to the control room. When doors and windows were left open humidity was 14 percentage points higher in small offices and 8 percentage points higher in the large office.



Pic. 5: Correlation of water release (Σ 24 h) [g $Module^{-1}$ d^{-1}] and relative humidity (mean 24 h) [%] and temperature (MW 24 h) [°C], respectively in room A.1.02

Compared to the control room comfort on the comfort scale was higher in rooms with indoor greening due to the higher humidity in winter. However, during summer indoor greening can increase the risk of water precipitation. Based on the identified parameters a suitable indoor greening area per room size was calculated and its energy consumption was estimated.



Pic. 6: Comparison of water content in air (mean 24 h) in small offices with greening (B.2.01 with closed door and B.2.03 with open door) and without greening (B.1.02 with open door) in the period of 09.06.2014 to 12.03.2015

Summary

Aim of this study was to establish the effect of indoor greening on the room climate in low-energy buildings. The study shows that vertical greening can increase the relative humidity. Therefore, decentralised vertical greening systems can be employed to regulate the room climate. It was stated that calculation of the necessary indoor greening area is possible. Moreover, information on maintenance is provided. In the future the data of this project will be helpful for architects and users of indoor greening.

Benchmark data

Title: Indoor greening as a predictable, decentralized support for climate control in low-energy buildings

Scientist / project management: Hochschule Weihenstephan-Triesdorf, Dr. Annette Bucher

Budget: 267.925,69 €

Amount of grant by Zukunft Bau: 187.546,79 €

Current time of project: 01.04.2013 to 01.06.2016 (self-financing prolongation until 27.07.2015)