Investigating and designing an atmospheric water harvesting system based on active cooling of panels

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EINDHOVEN UNIVERSITY OF TECHNOLOGY

Bachelor End Project - public summary

Department of Mechanical Engineering,
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Public Summary

This project was assigned by Studio Sway, a design studio managed by Shaakira Jassat [1]. The crippling drought in Cape Town inspired Studio Sway to work on atmospheric water harvesting (AWH) systems. Hence, the aim of this paper was to investigate and design an atmospheric water harvesting system based on the active cooling of panels. Specifically, the objective of the report was to propose a pilot system for Eindhoven. Further, the goal included determining the proposed system's levelized cost of water. In addition, the goal included basing system design decisions on essential criteria such as efficiency, sustainability, scalability, and aesthetic appeal.

The research was initiated by conducting a literature review of the AWH systems. Through the review, certain system specifications were set. Further, the components involved in the system were determined. Specifically, the components consisted of solar panels, inverter, heat pump, heat sink, electrical energy buffers, thermal energy buffers, fan and water condensation panels. Later, different options for each component were evaluated. Further, technical and economic specifications of each component were provided. In addition, commercially available products were selected for solar panels, inverter, heat pump, electrical energy buffer and thermal energy buffer. Moreover, while defining the water condensation panels, the research ventured into different material choices for the condensation surface of the panel. Eventually, the use of recycled HPDE sheets was advised due to their low cost, weight and fabrication capabilities.

A numerical model created by Rick de Lange was utilised to compute the total heat flux per square metre of the panel (W/m^2), water production per square metre of the panel (L/m^2h) and the water production per heat extraction (L/kWh). The model was used for panel sizing, facade sizing, and calculating the water production for different systems.

Later several design strategies with different combinations of components were investigated. Through the evaluation of design strategies, an initial system was proposed. Then, other systems were proposed to optimise the yearly water production and reduce the initial system's total capital expenditure. Moreover, the yearly water production and the total capital expenditure of all systems were evaluated before proposing two different pilot systems. Further, the yearly water production and the levelized cost of water for these systems were determined.

References

[1] About - Studio Sway. https://studio-sway.com/about/, 2018.