IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 2, July 2023

Performance Evaluation of Heat Pump Systems for Cold Climate Regions

Ireneo C. Plando, Jr.

Faculty, College of Technology,

Surigaodel Norte State University, Surigao City, Philippines

Abstract: *This research presents a comprehensive investigation into the performance of heat pump systems operating in cold climate regions. Through a mixed-methods approach involving quantitative analysis and qualitative user insights, the study aims to elucidate the intricate dynamics influencing system efficiency, user behavior, and environmental impact. Quantitative data analysis reveals a 20% average decline in the Coefficient of Performance (COP) during extreme cold temperatures, underscoring the challenges of maintaining high efficiency under demanding conditions. Load shifting potential is demonstrated by a 15% reduction in energy consumption during off-peak hours, showcasing the systems' contribution to grid stability and energy efficiency objectives. Qualitative interviews with users uncover preferences for defrost strategies and highlight the importance of system responsiveness. The findings collectively emphasize the need for an integrated approach that amalgamates technological advancements, user preferences, and sustainable practices to optimize heat pump system performance in cold climates. This research contributes valuable insights to the advancement of heating solutions tailored for challenging climatic conditions*

Keywords: Heat Pump Systems, Cold Climate Regions, Performance Evaluation

REFERENCES

[1]. Dincer, I., & Rosen, M. A. (1999). Energy, environment and sustainable development. *Applied energy*, *64*(1-4), 427-440.

[2]. Centobelli, P., Cerchione, R., & Esposito, E. (2018). Environmental sustainability and energy-efficient supply chain management: A review of research trends and proposed guidelines. *Energies*, *11*(2), 275.

[3]. Rosen, M. A. (1995, June). The role of energy efficiency in sustainable development. In *Proceedings 1995 Interdisciplinary Conference: Knowledge Tools for a Sustainable Civilization. Fourth Canadian Conference on Foundations and Applications of General Science Theory* (pp. 140-148). IEEE.

[4]. You, T., Li, X., Cao, S., & Yang, H. (2018). Soil thermal imbalance of ground source heat pump systems with spiral-coil energy pile groups under seepage conditions and various influential factors. *Energy Conversion and Management*, *178*, 123-136.

[5]. Wood, C. J., Liu, H., &Riffat, S. B. (2010). An investigation of the heat pump performance and ground temperature of a piled foundation heat exchanger system for a residential building. *Energy*, *35*(12), 4932-4940.

[6]. Michopoulos, A., Voulgari, V., Tsikaloudaki, A., &Zachariadis, T. (2016). Evaluation of ground source heat pump systems for residential buildings in warm Mediterranean regions: the example of Cyprus. *Energy Efficiency*, *9*, 1421-1436.

[7]. Kulkarni, K., Devi, U., Sirighee, A., Hazra, J., & Rao, P. (2018, June). Predictive maintenance for supermarket refrigeration systems using only case temperature data. In *2018 Annual American Control Conference (ACC)* (pp. 4640-4645). IEEE.

[8]. Vering, C., Wüllhorst, F., Mehrfeld, P., & Müller, D. (2021). Towards an integrated design of heat pump systems: Application of process intensification using two-stage optimization. *Energy Conversion and Management*, *250*, 114888.

[9]. Sinclair, B. J., Stinziano, J. R., Williams, C. M., MacMillan, H. A., Marshall, K. E., & Storey, K. B. (2013). Real-time measurement of metabolic rate during freezing and thawing of the wood frog, Rana sylvatica: implications for overwinter energy use. *Journal of Experimental Biology*, *216*(2), 292-302.

[10]. Ayompe, L. M., Duffy, A., McCormack, S. J., & Conlon, M. (2011). Measured performance of a 1.72 kW rooftop grid connected photovoltaic system in Ireland. *Energy conversion and management*, *52*(2), 816-825.

[11]. Thorstensen, B. (2001). A parametric study of fuel cell system efficiency under full and part load operation. *Journal of power sources*, *92*(1-2), 9-16.

[12]. Taggart, J. (2017, June). Ambient temperature impacts on real-world electric vehicle efficiency & range. In *2017 IEEE Transportation Electrification Conference and Expo (ITEC)* (pp. 186-190). IEEE.

[13]. Khalesi, H., Lu, W., Nishinari, K., & Fang, Y. (2020). New insights into food hydrogels with reinforced mechanical properties: A review on innovative strategies. *Advances in Colloid and Interface Science*, *285*, 102278.

[14]. Cai, L., Cao, M., Regenstein, J., & Cao, A. (2019). Recent advances in food thawing technologies. *Comprehensive Reviews in Food Science and Food Safety*, *18*(4), 953-970.

[15]. Barbin, D. F., Sun, D. W., & Su, C. (2013). NIR hyperspectral imaging as non-destructive evaluation tool for the recognition of fresh and frozen–thawed porcine longissimusdorsi muscles. *Innovative Food Science & Emerging Technologies*, *18*, 226-236.

[16]. Amer, M., & Wang, C. C. (2017). Review of defrosting methods. *Renewable and Sustainable Energy Reviews*, *73*, 53-74.

[17]. Chua, K. J., Chou, S. K., & Yang, W. M. (2010). Advances in heat pump systems: A review. *Applied energy*, *87*(12), 3611-3624.

[18]. Omojaro, P., &Breitkopf, C. (2013). Direct expansion solar assisted heat pumps: A review of applications and recent research. *Renewable and Sustainable Energy Reviews*, *22*, 33-45.

[19]. De Gracia, A., &Cabeza, L. F. (2015). Phase change materials and thermal energy storage for buildings. *Energy and Buildings*, *103*, 414-419