

Improvement of Energy Efficiency and Cost Management for Household Refrigerators Under Different Climate Classes and Examination of Effect of VIP Ageing and Usage of Electronic Expansion Valve Technology

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Abstract : Energy consumption (EC) and costs due to the usage of refrigerators are increasing continuously. This creates a disadvantage not only on the budget of customers but also to global warming. This study aims to decrease EC and cost due to refrigerator EC all around the world. Research about the effect of climate classes on industrial cabinets, supermarket refrigerators or room air conditioning systems can be found in open literature; however, to the best of authors' knowledge, there is no study that includes the effect of climate classes, vacuum insulation panels (VIP) and polyurethane (PU) aging, and electronic expansion valve (EEV) technology for home refrigerators. For this purpose, 4 configurations are examined for household refrigerators for ST (subtropical) and T (tropical) climates. The aging of VIP and PU and the annual interest rate of electricity cost (%5) are considered to obtain more accurate results in calculations. Heat gain (Q), EC, and CO₂ emission are calculated. Config. 1, 2, 3 and 4 are with NO VIP, FULL VIP, NO VIP+ EEV, and FULL VIP+EEV, respectively. As a result, it is observed that Q for Config. 1 and 2 increase as Temp increases. Moreover, from ST to T climates, for all the configurations, EC increases. Additionally, the payback period (t) is based on reference cabinet Config. 1 is calculated. It is considered that annual electricity cost as constant for every climate. When ts are compared with Config. 1 for both climates, it is seen that the minimum t of 2 years is Config. 3. This study shows not only is EEV a better alternative option than VIPs. Hence, EEVs are way cheaper than VIPs and have shorter t, but it also allows us to compare Ec, Q, CO₂ emissions, and cost.

Keywords : energy, thermodynamics, ageing, VIP, polyurethane, expansion valve, EEV, PU, climate, refrigerating, cooling, efficiency

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