

Feasibility and Energy Efficiency Analysis of Chilled Water Radiant Cooling System of Office Apartment in Nigeria's Tropical Climate City

Authors : Rasaan Adekunle Olabomi

Abstract : More than 30% of the global building energy consumption is attributed to heating, ventilation and air-conditioning (HVAC) due to increasing urbanization and the need for more personal comfort. While heating is predominant in the temperate regions (especially during winter), comfort cooling is constantly needed in tropical regions such as Nigeria. This makes cooling a major contributor to the peak electrical load in the tropics. Meanwhile, the high solar energy availability in the tropical climate region presents a higher application potentials for solar thermal cooling systems; more so, the need for cooling mostly coincides with the solar energy availability. In addition to huge energy consumption, conventional (compressor type) air-conditioning systems mostly use refrigerants that are regarded as environmental unfriendly because of their ozone depletion potentials; this has made the alternative cooling systems to become popular in the present time. The better thermal capacity and less pumping power requirement of chilled water than chilled air has also made chilled water a preferred option over the chilled air cooling system. Radiant floor chilled water cooling is particularly is also considered suitable for spaces such as meeting room, seminar hall, auditorium, airport arrival and departure halls among others. This study did the analysis of the feasibility and energy efficiency of solar thermal chilled water for radiant floor cooling of an office apartment in a tropical climate city in Nigeria with a view to recommend its up-scaling. The analysis considered the weather parameters including available solar irradiance (kWh/m²-day) as well as the technical details of the solar thermal cooling systems to determine the feasibility. Project cost, its energy savings, emission reduction potentials and cost-to-benefits ration are used to analyze its energy efficiency as well as the viability of the cooling system. The techno-economic analysis of the proposed system, carried out using RETScreen software shows that its viability in but SWOT analysis of policy and institutional framework to promote solar energy utilization for the cooling systems shows weakness such as poor infrastructure and inadequate local capacity for technological development as major challenges.

Keywords : cooling load, absorption cooling system, coefficient of performance, radiant floor, cost saving, emission reduction

Conference Title : ICSHC 2024 : International Conference on Solar Heating and Cooling

Conference Location : Cairo, Egypt

Conference Dates : December 16-17, 2024