Accepted Manuscript

Variable Refrigerant Flow Cooling Assessment in Humid Environment Using Different Refrigerants

Roba Saab, Hilal Al Quabeh, Mohamed I. Hassan Ali

PII:	S0301-4797(18)30783-7
DOI:	10.1016/j.jenvman.2018.07.031
Reference:	YJEMA 7752
To appear in:	*Journal of Environmental Management*
Received Date:	28 December 2017
Accepted Date:	10 July 2018

Please cite this article as: Roba Saab, Hilal Al Quabeh, Mohamed I. Hassan Ali, Variable Refrigerant Flow Cooling Assessment in Humid Environment Using Different Refrigerants, *Journal of Environmental Management* (2018), doi: 10.1016/j.jenvman.2018.07.031

Variable Refrigerant Flow Cooling Assessment in Humid Environment Using Different Refrigerants

Roba Saab, Hilal Al Quabeh, Mohamed I. Hassan Ali*
Department of Mechanical Engineering
Khalifa University of Science and Technology, Masdar City Campus, Abu Dhabi, United Arab Emirates

ABSTRACT

Variable Refrigerant Flow (VRF) is a cooling system developed to anticipate and minimize operating and maintenance costs. VRF allows personalized control and maximizes flexibility to accommodate changing tenants in high rise and compound buildings in hot and humid environments. Although many studies have previously modeled VRF systems from an energy perspective, minor attempts have been made to analyze the exergy performance of this technology. The aim of this paper is to present an exergy/energy analysis of VRF technology to address the effect of refrigerant flow as well as the cooling-air flow rates on the electric energy saving in the hot and humid zones. This analysis will be then used to investigate its performance in humid areas, particularly the Gulf region. VRF is an advanced air conditioning system that is developed to manage load variability by controlling the compressor speed and the expansion valve opening. It is proposed that the system be implemented at Masdar City buildings, located in Abu Dhabi.

In this study, VRF units from different manufacturers were modeled and compared using engineering equation solver (EES) and *IPSEpro* software. The models, which were mainly developed on EES were repeated for validation on similar models that have been developed using the *IPSEpro* software, and the results were in agreement within 6% uncertainty. Parametric studies were done after modeling the system on EES, where both the high and low pressures in the cycle were varied to obtain the corresponding COP and second law efficiency operating range. It was noticeable that COP and second law efficiency are significantly affected by the evaporator and condenser temperatures and pressures. In addition, as significant concern has been raised due to the impact of refrigerants on global warming, different refrigerants were considered and the results showed that refrigerant R-410a would be the second most efficient refrigerant, after ammonia, for such systems. Finally, an effectiveness NTU evaporator model was implemented to minimize the overall power consumption of the VRF system under various zone loads. It was found that, under a typical set of zone loads, the optimal refrigerant

*corresponding author: miali@masdar.ac.ae