

Analysis of Coefficient of Performance (COP) of a compression refrigeration system using Response Surface Methodology.

Augusto Y. Takinami (IC)

Abstract

The proposal of these work consists in an analysis of performance coefficient (COP) of a compression refrigeration system, with simultaneous perturbations, using response surface methodology. Industrial, commercial, and residential refrigeration systems are responsible of a significantly part of energy consumption in Brazil, and the behavior of these systems are responsibility of undesirable energy costs, because of variables subject interdependence to various fluctuations that modify the operation conditions. It's expected with this work to develop an easy implementation methodology of a refrigeration system, allowing constructing a database of a statement comportment, which permits an easy heuristic models implementation.

Key words: Refrigeration, Instrumentation, PLC

Introduction

The refrigeration systems are great energy consumers. Therefore, the industry is looking to improve energy efficiency in refrigeration applications. An efficient system reaches the thermal performance used in a process with a lower consumption of electric energy.¹

The objectives of this project are two: configuration of a supervision system to monitor in real time important variables of the refrigeration process, and the implementation of a surface response to obtain the refrigeration system variables comportment and construct a knowledge base to use in heuristic models.

Results and Discussion

It was set a supervision system to acquisitions of data of PLC using OPC, to monitor and manipulate three variables of the refrigeration system: rotation frequency of the condenser water pump, rotation frequency of the evaporator pump and rotation frequency of the condenser. Therefore, through an application of an experimental plan methodology, it was possible to create an experiment matrix necessary to quantify each variables of the process effects with the effects of energy consumption and COP.

Lastly, the experiments of the matrix were executed and, with the results, it was possible to use the surface response methodology to identify the best condition of the refrigeration system.

Image 1 and 2. Surface response about energy consumption relative to frequency of rotation of the condenser water pump, the rotation frequency of the evaporator pump and the rotation frequency of the condenser.

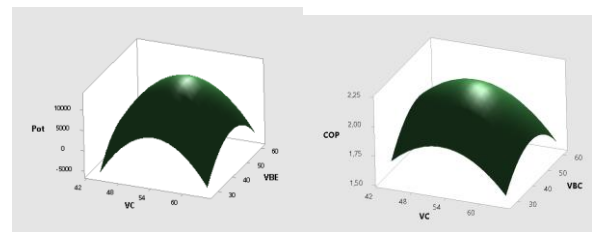


Chart 1. Best condition to optimization of a refrigeration process with compression.

VC	VBC	VBE	COP	POT
48,4 Hz	47,0 Hz	68,8 Hz	2,1	3110 W

Conclusions

With the proposed methodology, it was possible to identify the most relevant variables to each response. It was also possible to identify the best condition of the refrigeration system. It's visible the compressor relevance in energy consumption and the others variables of the process influences.

Acknowledgement

Thanks to Professor Flávio Vasconcelos and Tarcisio S. Dantas to knowledge transference during de Project.

¹SILVA, F. V. "Comparação do desempenho de um sistema de refrigeração para resfriamento de líquido, controlado a diferentes modos de controle." PhD Dissertation, Faculty of Food Engineering, Unicamp, Campinas, p. 1-3, 117 – 119, 2003.