

Experimental Investigation of Energy Consumption of A Commercial Walk-in Freezer

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Abstract-Refrigerators and coolers are an essential part of the food industry. They are working based on the vapor compression cycle which requires energy input to absorb heat from the cold space and reject it to the ambient. Alongside this energy, there is energy drainage source coming from the need to melt a frost layer that is accumulated on the cooling coil surface due to its low temperature which is below the freezing point. The energy used in defrosting evaporator coils is a wasted energy that costs a lot especially when it is used in a large-scale units like food storage warehouses. The present paper is exploring and examining the energy required to operate a commercial walk-in freezer. The freezer was tested using two different defrost process controls. The energy consumption data were recorded and analyzed to evaluate the defrost refrigeration ratio (DRR) and perform a cost analysis of one year of operation. The tested unit was operated in two modes, the first is fixed time scheduled defrost and the second is on-demand defrost (adaptive strategy) for comparison. The results show that the defrost-to-refrigeration energy consumption ratio is 2% and the annual cost of operation is \$438 when the freezer is operating under on-demand mode. In addition to that, the defrost ratio in scheduled defrost is 29% and 19% for defrost initiation every four and six hours, respectively. Moreover, their annual operating cost is \$528 and \$511, respectively. Based on that, the reduction in operating costs due to the use of on-demand mode is 21% and 17% compared to scheduled defrost every four and six hours.

Keywords: Refrigeration, Walk-in Freezer, Defrost Energy, Energy Consumption.